Learning about the conditions for improvement and excellent care from high performing clinical networks

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Learning about the conditions for improvement and excellent care from high performing clinical networks

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Ring the bells that still can ring. Forget about your perfect offering.

There is a crack in everything. That's where the light gets in.

Leonard Cohen
Acknowledgements

After 15 very interesting years as a nurse anesthetist, I started my quality improvement journey in 1990. The journey began with some surprising outcomes of a survey I conducted out of curiosity. It was a qualitative study of the experiences of acute surgery patients. Together with Lill de Grève, an experienced researcher and psychologist I conducted several focus group meetings with former patients, applying the critical incident technique. A powerful research method I have continued to use ever since.

The patients reported that their journey through healthcare was fragmented and unpredictable. Most of the information they needed to understand about their own situation, was absent or conflicting. They often felt helpless because important questions and messages seemed to be ignored, or did not arrive to the right persons in time. In addition, the patients were poorly prepared to understand how to manage their health situation and needs after discharge. Knowing this, I had to do something to solve the problem. Funded by the Norwegian Ministry of Health and Care services, and supervised by Professor Dr. of Medicine Petter Andreas Steen, I was leading my first quality improvement project in collaboration with Lill de Grève and Sissel Køhn (RN). I thank them all for their great cooperation. I learned that being a pioneer working to solve problems nobody had heard about, with methods nobody had heard about was challenging. However, the project contributed to an inevitable culture change.

Since 1998, I have been involved in the improvement advisor team of the learning collaboratives of the Norwegian Medical Association (NMA). It has been a rewarding effort. The director for professional competence, Hans Asbjørn Holm, initiated and managed the collaboratives. As an experienced physician, he fully understood the importance of involving the clinicians in a knowledge based “bottom up” approach to quality improvement, grounded on multiprofessional collaboration, measurement and knowledge-based improvement guidance.

I started my research journey in 2005 with support from Hans Asbjørn, the Quality improvement fund of the NMA, and from my leaders Katja Uwritz and Unn Teslo at Ringerike hospital. The journey included a study of the intellectual underpinnings of quality improvement at Dartmouth in 2007 and 2008, at the foot of the quality improvement giants Paul Batalden and Eugene Nelson, and under the wings of Marjorie Godfrey. I am forever grateful to my leaders for supporting my studies.

I have made my PhD-study under the brave and supportive leadership of Hilde Skredtveit Moen, and the director for professional competence in Vestre Viken Halfdan Aass. Endorsing my study, they
allowed me to join a PhD program at the Faculty of medicine UiO, for three years and nine months in 80 percent of my position as a senior advisor at the quality department of Vestre Viken Hospital Trust.

Working for something greater than me, I have had the pleasure to involve the most excellent representatives of the next generation of healthcare professionals in the process. It is impressive to witness their excellent efforts in the development of successful educational programs about the continual improvement method and skills to an increasing number of leaders, advisors and improvement teams at Vestre Viken and other hospitals in our health region, and to several Norwegian universities and college graduates.

I thank Rune Tuft, Berit Marie Flørnes, Hanne Juritzen, Else Breines, Astrid Lundesgaard, Tone Thoresen, Margareta Jacobsen, Aud Ellen Haugen, Bente Monsen, Mette Walberg, Wender Figved, Christine Marie Rygg, Merete Finjsrøn, Maria Bergli, Elisabeth Kaasa, Vigdis Bache Semb, and Per-Erik Holo, the members of SPC forum, and all my other colleagues for your cooperation and knowledge sharing.

In addition, I have hundreds of professionals to thank for what I have learned from their change efforts. I have been working and learning together with them since I left my position as nurse anesthetist in 1992, and I have said it directly to them many times and now I am writing it down; I could never have made this journey of learning without you. You belong to the bravest clinicians, leaders, teachers, mentors, colleagues and students at Akershus, Ullevål, Ringerike and Bærum hospitals, Gjøvik University College, the University of Bergen, the University of Oslo, The Dartmouth Institute, The learning collaborative boards of The Norwegian Medical Association and their quality advisor team, Forum for Statistical Process Control, and the Quality department of Vestre Viken.

My brother Olav was my first advisor, helping me feel skillful despite my absolute novice position as a researcher. My son Haakon has helped me understand highly difficult things, making me feel it was easy to grasp. My son Kristian and my personal advisor Leila Reinola have provided me with process guidance, promoting my ability to handle certain social processes with patience and wisdom.

My first supervisor Per Hjortdahl has designed and guided my educational journey with creativity and wisdom. My supervisor Eugene Nelson took good care of me at Dartmouth, and has guided me well since then. I thank my former leader Ole Tjomsland for pushing me over the edge of the PhD-program, and my supervisor Leiv Sandvik for providing statistical help and useful knowledge. I thank my first quality improvement teacher John Øvretveit from my study at the University of Bergen, and for inviting me to his great international Quality Improvement Research Network meetings.
I will be forever grateful to my main supervisor Michael Bretthauer, who has been a wall of knowledge to lean on, and a loyal and conscientious gardener to my growth.

In this thesis, “we” means healthcare professionals and quality improvement experts involved in the many expert panels of the dissertation study, and I thank you all for your wise participation.

I am endlessly grateful for more than ten years of important knowledge sharing, instrument development, data collection, analysis and reflection on the results together with the psychologist Lill de Grève, the physicians Bjørnar Nyen, Tordis Sørensen Høifødt and Lars Strauman, the nurses Gro Sævil Haldorsen and Ellen Andersen and the bioengineer and department leader Ada Schreiner.

I am grateful to the physicians Guttorm Brattebø, Trond Bjørge, Thorbjørn Sund and Karin Møller and the department leaders May Janne Botha Pedersen and Kent Håpnes, for providing the 22 July-study with valuable and broad experience from crisis management, psychosocial support and trauma care within surgery, anesthesiology, internal medicine, psychiatry, and family medicine.

It is important for me to commemorate doctor John Colin Poole for his role in the Sustainability study of the successful local medical response after the Utøya terror attack. First, Colin was a valuable source of information by his position as a dual commander that days, and then he was a member of the research team until he suddenly died in February 2014, in the Mountains of Chamonix.

22. July 2011, Colin was the Chief Medical Officer of the surgical department of Ringerike and Bærum hospital. As a certified Advanced Trauma Life Support (ATLS) instructor, he was a driving force in the development of the local emergency medical service. In the late afternoon of 22 July, he volunteered from vacation, saving lives and participating in the tactical leadership team with his highly appreciated competence.

I want to thank the (few) friends and family members who have been paying my studies interest, and all the others for helping me escape from this ongoing, intensive venture by supporting my role as a friend, sister, aunt, cousin, mother, mother in law, and an extremely happy grandmother to ten of the most wonderful adolescents and children.

Finally, I thank my husband and best friend Trygve. Thank you for always being there for me. Thank you for participating with patience in my reflections over the kitchen table day out and day in all these years, providing me with guidance, wisdom and knowledge based on your own academic journey, and on your many years as senior manager in a large organizations where constant change is the normal.
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1.2. Summary

This PhD-project analyses the conditions for improvement and excellent care among high performing clinical teams and networks. The study aim is to contribute to the knowledge about why things go right in healthcare.

We are learning from high performing teams about why things go right in the intervention stages of a continual improvement process. In a survey among the 189 projects of eight learning collaborative of The Norwegian Medical Association (NMA), the response rate was 70 percent. 54 of the 132 projects were sampled to be successful by a validated instrument (Paper 1) and compared to the less successful projects in a multivariate regression analysis (Paper 2). Two domains associated with success were found, (included in condition 1, 5 and 6 below).

We are learning about why things go right from a trauma care network responding successfully to a terrorist attack at Utøya youth camp in Norway in 2011. The network was staffed by 260 professionals covering 35 different roles, from the scene at Utøya to discharge from the local hospital. Five focus groups covering 30 of the 31 most important roles told their stories (Paper 3). A combination of four determinants for success were found (included in condition 1-6 below).

In the multi-method part of the PhD project, additional information about the historical and theoretical underpinnings of the high performing teams and networks has been collected. The trauma system was found to be in the sustainability stages of a continual improvement process, partly rooted in the continual improvement thinking provided by the Learning collaboratives of NMA.

Through an interpretive synthesis of the results of the primary and additional studies, This PhD project found six conditions for improvement and excellent care by:

1) **Invisible web of interaction.** Professionals with defined roles & tasks are working and learning together in multiprofessional teams, continually improving the care in an environment of mutual empowerment and a common desire to make a positive difference together with the patient.

2) **Management by trust, knowledge and data collection.** Leading and continually improving the system, developing common, easy available plans with clearly defined roles & responsibilities.

3) **Fostering creative ability.** No plan can cover everything that may happen. In unpredictable situations the system can be insufficient or failing. With a good structure, knowledge and trust, improvisations can be made, maintaining communication, collaboration and interaction among professionals, patient and family, creating good solutions, rescue patients from the adverse consequences of an event, and allowing the team to be able to do what the situations demands.

4) **Minimizing the number of handoffs** in the care process prevents adverse events.

5) **Monitoring current practice and change.** Identifying key process and outcome variables, reflecting together on the variation, using control charts where time is a variable, and/or video-recording where the data appear simultaneous (e.g. training sessions). Make decisions based on the findings.

6) **Professional and improvement knowledge guidance.** Continual information about best practice, with easily available coaching when needed, integrated into daily work like yeast in a bread.

These results may be of help to leaders and stakeholders in making complex healthcare systems healthy enough to be able to produce health in collaboration with the patients in predictable and unpredictable situations where sustainability and resilience is paradoxically working together.
1.3. Thesis structure

PART I. STRUCTURE
The first part is presenting Table of content, Summary, Lists of tables and figures, Glossary and abbreviations, and an Index of the six conditions for improvement and excellent care (the thesis statement) with references to where each of the six conditions is commented this thesis.

PART II. INTRODUCTION
The second part is a broad presentation of the existing knowledge about managerial and improvement theories and approaches in healthcare. Based on the differences in their epistemological, ontological and methodological assumptions I have categorized them into two different philosophical domains, as discussed in the Discussion section.

PART III. METHODS
The third part presents the mixed methods approach of this thesis, and the four primary studies. This thesis includes a broader presentation of the design, progress, data collection and analysis methods, including limitations and issues not dealt with in the different parts of this PhD project.

PART IV. RESULTS
The results part is a selection of outcomes from the four primary studies underpinning my thesis statements, and the outcomes of the multi-method (fifth) part of the dissertation study.

PART V. DISCUSSION
The discussion section reflects the complexity of the thesis. Because the research questions of this thesis to a large degree are global, I tried to limit the scope of the many aspects by footnotes, referring to the parts that contain a more detailed presentation of each subject.

PART VI. REFERENCES
This thesis includes 328 literature references and more than 270 footnotes. For pragmatic reasons, the list is a combination of the Harvard and the BMJ reference styles. The in-text citations are made in Harvard style (before punctuation), but without commas between the authors name and year of publication (e.g. Batalden 2018). In the Reference list, the citations are listed in alphabetical order by the author’s surname (Harvard style) but texted according to the BMJ reference style. In addition, I use Footnotes when possible, to make the text easier to read, and to reduce the number of brackets in the text, as with the Harvard citation style.

PART VII. APPENDICES
The first appendix is a summary of the qualitative part of the Project study. This is my master’s degree study published in 2011, and followed up as one of four primary studies in my PhD-project. Second, some details from the quantitative part of the Project study about response rates and success levels are displayed. Third, the literature reference frame of Table 6 is presented in details. Appendix four is displaying an example of leadership driven follow up measurements after one of the learning collaboratives in our material where the leader was part of the improvement team. The control chart indicates how variation may first be influenced by the leader’s engagement, and later by the unstable situation of a predicted leaders change when you do not know if a new leader will pick up the improvement project and continue to advance it or not.
1.4. Original papers

The original papers are referred to in this thesis by their paper numbering (1-3).

**Project study (quantitative part): Learning from high performing improvement teams about the conditions for success at the intervention stages of continual improvement processes**

*Paper 1. The sampling instrument:*


*Paper 2. The conditions for success at the intervention stages of continual improvement processes:*


**Sustainability study: Learning from a high performing emergency care network about the conditions for success at the sustainability stages of a continual improvement process**

*Paper 3. The conditions for success at the sustainability stages of a continual improvement process:*

1.5. Tables, Figures and Boxes

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1.6. Glossary & abbreviations

**Best Practice:** Technique or methodology that, through experience and research, has proven reliability to lead to desired result. A commitment to using the best practices in any field is a commitment to using all the knowledge and technology at one’s disposal to ensure success (Godfrey 2013).

**Climate:** Employees’ perception of an organisational or workplace culture. Climate and culture are terms often used interchangeably in the literature, without clear-cut boundaries. (Braithwaite et al. 2017).

**Clinical Microsystem:** Small group of people including patients and families who work together on a regular basis to provide care to discrete populations of patients. It has clinical and budget aims, linked processes, and shared information environment; and it produces performance outcomes. Microsystems evolve over time and are often embedded in larger organizations. They are complex, adaptive systems, and as such they must do the primary work associated with core aims, meet the needs of their members, and maintain themselves over time as clinical units (Nelson et al. 2011, Godfrey 2013). The patient is part of the microsystem where the quality experienced by the patient is made or lost (Berwick 2002).

**Coaching:** A collaborative relationship formed between a coach and coachee for the purpose of attaining professional or personal development outcomes which is valued by the coachee (Godfrey et al. 2013).^1^

**Concept:** A concept is in this thesis defined as a system, made of the composition of different approaches, which are used to help people know, understand or simulate a subject the model represent.

**Context:** Context can be defined as all factors that are not part of a quality improvement intervention itself, and is generally understood as the conditions or surroundings in which something exists or occurs, typically referring to an analytical unit that is higher than the phenomena directly under investigation. (Nilsen 2015 page 7).

**Continuous improvement versus continual improvement:**

**Empirically:** In this thesis, the term *continuous* improvement is referring to programs of regularly training and evaluation (without interruption). *Continuous* improvement systems may be embedded in a hospital-wide *Continual* improvement system that is dynamic and open to other improvement opportunities that should be found in addition to regularly training and evaluation.

**Theoretically:** In this thesis *Continual improvement* is first of all referring to the theory of Batalden & Stolz in 1993, which partly is a translation from industry to healthcare from Deming’s *System of

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^2^ See also Chapter 3.2.5.3. *Improvement process guidance (coaching)*
Profound Knowledge. It is a holistic theory of what knowledge domains should be combined in the process of improving healthcare. A process that is forming a never-ending Plan-Do-Study-Act cycle.

Grammatically: The adjectives continual and continuous are like twins: they both come from continue, are similar in many ways, but still different when it comes to practice. Continuous can be used to refer to space as well as time. Continual typically means ‘happening frequently, with some intervals between. Overall, continuous occurs much more frequently than continual. ³

Nationally: The Norwegian language does not differ between continual and continuous. Most healthcare leaders and professionals use the term ”Kontinuerlig forbedring” in the meaning “always look for opportunities for improvement, making desired changes happen when necessary”.

Historically, and in most quality improvement literature, (inclusive of the papers of the PhD-project), both terms are used, rooted in the continuous improvement theory of Joseph Juran (1951) and the continual improvement theory of W. Edwards Deming (1986). The IHI Learning collaborative model (Breakthrough Series⁴) is developed in a cooperation between Donald Berwick and Paul Batalden (assessing the theories of Deming and Juran to be of equal and complementary value⁵). Paul Batalden (influenced by Deming) use the term continual improvement (Batalden & Stolz 1993), and Donald Berwick (Influenced by Juran), uses the term continuous improvement (Berwick 1989) for approximately the same thinking. Both Juran and Deming started their careers at Western Electric’s Hawthorne plant in Chicago, where they were influenced by each other and by the work of Walter Shewhart in the early 1920-ies⁶. Shewhart was the inventor of the Plan-Do-Study-Act cycle, and the statistical process control method, both included in the systematic approach to improvement in the IHI learning collaborative model.

Control chart: (See also Run-charts) Control charts support statistically informed decision making by including reference lines that highlight the role of chance. Control charts typically include a centre line indicating the central tendency of data and at least two control lines signifying chance variation (Shewhart 1931, Wheeler 2000, Schmidke 2017) See example of a control chart in Appendix 4.⁷

CPO-scale: We validated and published the Change, Process and Outcome scale as an (self-) evaluation instrument for planning, managing and assessing the systematic approach to improvement (Paper 1). The CPO-scale (instrument 1) is based on the Model for improvement⁸, with focus on linked aims, changes, measurements and results. The result of the CPO-assessments used for validation, were also used in the quantitative Project study for sampling successful projects, to make a logistic regression analysis of the responses from improvement projects to a questionnaire (instrument 2) with success as the dependent variable (Paper 2).

Determinant: Something that controls or affects what happens in a particular situation (Cambridge dictionary, January 2019).

³ Oxford English Corpus, Accessed February 2018
⁴ See Chapter 3.2.2. The IHI learning collaborative concept
⁵ Personal conversation with Batalden in 2008
⁶ See Chapter 3.1.3. Shewhart, Deming, Juran & Ishikawa
⁷ See also Chapter 4.1.1.4. Statistical Process control
**Discipline vs. profession:** Mahler et al. (2014) refer to the sociology lexicon⁹, describing disciplines as “individual sciences that study different subjects independently of each other. The individual sciences pursue the goal of developing theories as a means of scientifically understanding the world. Accordingly, interdisciplinary collaboration means that researchers from different scientific disciplines work together”. Mahler et al. (2014) argue that “a profession is based on applying the scientific knowledge of a particular discipline¹⁰ and thus mediates between theory and practice¹¹. The sociology lexicon (...) defines profession as a service occupation relevant to society, such as that of physician or lawyer, which is associated with a high level of prestige and income and involves applying, in a relatively autonomous and collectively oriented manner, highly specialized knowledge that has been acquired over a long period of study. The term profession is thus used for practically applied disciplines: medicine is a discipline; a physician represents a profession”.

**In this thesis,** all healthcare professionals (e.g. physicians, nurses, psychologists, ambulance professionals, etc.) and police officers are referred to as professionals.

**EMS:** Emergency Medical Service

**Emergency preparedness:** Emergency preparedness refers to actions performed before an emergency. This includes holding planning and coordination meetings, writing procedures, training staff and volunteers, scheduling emergency drills and exercises, and ensuring that emergency equipment is available, in good repair, and ready to use. Emergency preparedness can help ensure a good outcome.

**Emergency response:** Emergency response refers to actions taken in response to an unexpected and potentially dangerous event. Emergency response can help to minimize negative effects of emergencies and disasters.

**Handoff:** An exchange of responsibility (and awareness) made by handing care of a patient to a teammate, another team, department or care level.

**Leader:** Leader is a word that we use to label a person who is leading or guiding (Nelson et al. 2007).

**Leading:** Leading describes the active process of leading (Nelson et al. 2007).

**Leadership versus management:** Leadership is a word that we use to describe the phenomenon of leading (Nelson et al. 2007). In accordance with Kotter’s theory, leadership and management is not the same. The development of an emergency preparedness and response plan is a matter of leadership, while coordinating the complex response situation is a matter of management (Kotter 2013).

**Infrastructure:** (In this thesis), an Infrastructure is the basic, underlying framework or features of a system or organization. Otherwise, the term is referring to the fundamental facilities and systems

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serving a country, city, or area, as transportation and communication systems, power plants, and schools. (www.Dictionary.com).

**Innovation:** Innovation is crucial to the continuing success of any organization, and its relation to many different environments and approaches has led to a pluralism in definitions. (See Chapter 3.2.6. *Innovation theories*).

**New Public Management:** New Public Management (NPM) is containing different approaches to running public service organizations used in government and public service institutions and agencies, at both sub-national and national levels (see Chapter 3.3.2.).

**NMA:** Norwegian Medical Association

**Management:** In accordance with Kotter’s theory, the development of an emergency preparedness and response plan is a matter of leadership, while coordinating the complex response situation is a matter of management (Kotter 2013).

**Methodology:** In this thesis, *Methodology* is defined as the rationale for using a particular method. A *method* is a defined approach, tools or techniques used in a particular area of study or improvement activity to gain knowledge, achieve a goal, or make a change happen.12

**Multiprofessional versus Interprofessional:** The terms have been defined by Mahler et al. (2014): “Multiprofessional collaboration describes the work of the professions alongside each other and for the most part independently of each other. In the case of interprofessional collaboration, the skills of the different professions overlap. Analogous to this, interdisciplinary collaboration denotes the overlapping of the scientific fields. With transprofessional collaboration, the distinctions between the separate professions disappear and the skills can be mutually interchangeable”.13

Interprofessional cooperation or collaboration in the context of the health professions has been described as follows by Kälble in 2004:14 “interprofessional cooperation means that members of different professional groups with different specialties, a different sense of self-perception and ways of being perceived by others, different areas of expertise and work, and a different level of status all work directly together to provide high-quality, patient-oriented care, so that the patient benefits from the specific skills of each individual profession”.

In this thesis (because diversity is an important value in a system where the whole is more than the sum of its parts) the term interprofessional has only been used on trauma teams of professionals with clearly defined roles, and tasks that have been trained regularly to communicate and interact in mutual respect and empowerment. Because they have been working together, learning together and improving the system and their performance together, they are (to a certain degree) able to overlap

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each other’s roles and skills, if necessary, to do what the situation demands for the benefit of the patient and the patient’s family.

**Ontology:** The nature of reality

**Paradigm:** A world view underlying the theories and methodology of a particular scientific subject (Oxford Dictionary). In science and philosophy, a paradigm is a distinct set of concepts or thought patterns, including theories, research methods, postulates, and standards for what constitutes legitimate contributions to a field (Wikipedia, accessed January 2018).

**Resilience:** “Resilience is the capacity to experience massive change and yet still maintain the integrity of the original. Resilience is not about balancing change and stability. It is not about reaching and equilibrium state. Rather, it is about how massive change and stability paradoxically work together” (Westley, Zimmerman and Patton 2007). See other definitions in Chapter 3.3.6. *Resilience concept and High Reliability Organizations.*

**Run chart:** A run chart is a graphical display of data plotted in some type of order. The horizontal axis is a time scale (e.g., days, weeks, months, quarters) or sequential patients, visits or procedures in a chronologic order. The vertical axis represents the value (the quality indicator being studied, e.g., infection rate, number of patient falls, readmission rate). Usually, the median is calculated and used as the chart’s centerline. The median is required when using the probability-based rules to interpret a run chart (Perla et al. 2010).

**Subsidiarity:** Subsidiarity is the idea that no decision should be made and no function performed at a higher or more central level than can be accomplished at a more local level (Gauss & Cook 2017).

**Sustainability:** Sustainability has been defined as the ability to continue over a period of time, or the ability to corroborate or substantiate a statement, or the ability to maintain or support an activity or process over the long term.  

Sustainability has been defined as a socio-ecological process characterized by the pursuit of a common ideal. An ideal is by definition unattainable in a given time and space. However, by persistently and dynamically approaching it, the process results in a sustainable system.

In economics, sustainability has been defined as continued development or growth, without significant deterioration of the environment and depletion of natural resources on which human well-being depends. This definition measures income as flow of goods and services that an economy can generate indefinitely without reducing its natural productive capacity.

When healthcare professionals agree on a common practice, it is mostly leading to a reduction in the common cause variations of the target process, displayed on a control chart, as a signal of a possible sustainability.

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15 Cambridge Dictionary, accessed January 2018
16 Wikipedia, accessed January 2018
18 See example in Appendix 4
1.7. Index of the six conditions for making things go right

This list is made for the readers of this thesis who would like to dive into the six conditions for making things go right (the thesis statement) without reading the entire thesis. The conditions are here sorted by their headline numbering, which is not meant to be a hierarchy. The six conditions are interrelated and can be selected or combined in different ways in different situations.

1) Invisible web of interaction

Chapter 4 Rationale
4.1.3.3. The adaptive cycle

Chapter 6 Selected outcomes
6.4.3.2. What characterizes the many improvisations?

Chapter 7 What does this all mean?
7.2.3. When sustainability and resilience work together
7.2.5. Theoretical underpinnings with implications
7.2.4.1. Discussing intervention & sustainability stage conditions
   Findings regarding: Spread (Item 20-21)\(^{19}\)

Chapter 9 Conclusion
9.2. Further research

2) Management by trust, knowledge and data collection

Chapter 1 Summaries, lists, and definitions
1.6. Glossary & Abbreviation (Leadership versus management)

Chapter 3 State of knowledge
3.2.1. Total quality management
3.1.5. Quality improvement history, Ringerike hospital
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Chapter 4 Rationale
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Chapter 6 Selected outcomes
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Chapter 7 What does this all mean?
7.2.4. Comparing intervention and sustainability stages
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Chapter 9 Conclusion
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\(^{19}\) At Ringerike hospital, patient participation in the design/redesign of clinical processes has been is part of the routine since before the millennium shift.
3) **Fostering creative ability**

*Chapter 4 Rationale*
4.1.3.1. Systems theory  
4.1.3.2. Complex adaptive systems  
4.1.3.3. Resilience theory  
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*Chapter 6 Selected outcomes*
6.4.3.2. What characterizes the many improvisations?

*Chapter 7 What does this all mean?*
7.2.1. The link between the EMS and the collaboratives  
7.2.2. Creativity and the Swiss cheese metaphor  
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7.2.3. When sustainability and resilience work together  
7.2.4. Comparing intervention and sustainability stages  
7.2.4.1.6. The challenge of spread  
7.3.1.2. The Learning, interaction & empowerment paradigm  
7.3.1.4. The complexity of a successful healthcare service  
7.3.6. Creativity as a resource

*Chapter 9 Conclusion*
9.2. Further research

4) **Minimizing the number of handoffs**

*Chapter 3 State of knowledge*
3.2.2.2. Mesosystem

*Chapter 5 Research methods*
5.3.1.1. Inductive analysis

*Chapter 7 What does this all mean?*
7.2.4.1.2. The handoff challenge  
7.2.4. Comparing intervention and sustainability stages  
7.3.5. Sustainability and spread is no quick fix

5) **Monitoring current practice and change**

*Chapter 3 State of knowledge*
3.1.3. Shewhart, Deming, Juran & Ishikawa  
3.2.1. Total quality management  
3.2.5.6. Normalization Process Theory (NPT)

*Chapter 4 Rationale*
4.1.1.3. Knowledge about variation

*Chapter 7 What does this all mean?*
7.2.3. When sustainability and resilience work together  
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- Findings regarding Measurements, Item 9-11 % 14-1  
- Findings of others regarding Measurements, Item 9-11 & 14-15  
- Findings regarding the managers’ follow up/ sustainability, Item 17 & 19
Findings of others regarding the managers’ follow up/sustainability, Item 17 & 19

7.2.5. Theoretical underpinnings with implications

Chapter 9 Conclusion
9.2. Further research

6) Professional and improvement knowledge guidance

Professional knowledge guidance

4.3.1. Delineation of the Thesis
   Paragraph 4b

Chapter 3 State of knowledge
3.1.5. The quality improvement history of Ringerike hospital
3.2.2. The Clinical Microsystem concept (Education and training)
3.2.5. Organizational learning and mastery climate

Chapter 4 Rationale
4.1.1.7.2. Asking what and how, not so much why
4.2.2. The Norwegian team-training concept (BEST)

Chapter 7 What does this all mean?
7.2.4.1. Discussing intervention & sustainability stage conditions
   Findings related to patient aims (Item 4)
7.3.1.4. The complexity of a successful healthcare service

Improvement knowledge guidance (coaching):

Chapter 3 State of knowledge
3.2.2. The Clinical Microsystem concept (Education and training)

Chapter 4 Rationale
4.1.4. Improvement process guidance
4.2.1. The IHI learning collaborative concept
4.2.2. The Norwegian team-training concept (BEST)
4.3.1.4. Improvement guidance(coaching) research

Chapter 7 What does this all mean?
7.2.4.1. Discussing intervention & sustainability stage conditions
   o Findings related to Improvement knowledge guidance (Item 1, 12 & 13)
   o Findings of others: Improvement knowledge guidance (Item 1, 12 & 13)
   o Findings regarding Measurements (Item 5, 9-11, 14-1)
   o Findings regarding the manager’s follow up/sustainability Item 17 & 19

7.2.5. Theoretical underpinnings with implications
7.3.4. The combination of measurement and guidance

Chapter 9 Conclusion
9.2. Further research
PART II. INTRODUCTION

Chapter 2. Problem description

2.1. Why did we do this?

2.1.1. Trying harder will not work

There are many quality and safety problems in healthcare. For example, Kapur et al. (2015) found that the number of preventable medical deaths every year in USA alone equals that of almost three fatal airline crashes per day, concluding that if this were the case in aviation, no one would be allowed to fly until the problem is solved.

This thesis is an attempt to figure out how we can make care safer and better. An increasing number of researchers are not convinced that a relentlessly focus on what goes wrong is the best way to develop better and safer care of patients (Jeffcott et al. 2009, Lawton et al. 2014, Baxter et al. 2016, Braithwaite et al. 2015, Holling et al 2015). There is no evidence that criminalization of professional mistakes promotes organizational learning, even though this is an increasingly prevalent phenomenon at the intersection of safety work, sociology, criminology, and legal as well as social justice (Dekker 2011, Gordon S et al. 2014).

Something has to be done. With seven years of case management and statistical experience on the quality board of a large university hospital, I have witnessed how healthcare professionals often take the blame for adverse events, even when (as is usually the case) the events were caused by a poor system. The distress of healthcare professionals involved in adverse events “the second victims” has been shown to be similar to that of the patient “the first victim”. In addition, insufficient organizational support and lack of feedback make it more difficult for professionals to emotionally process the adverse event and reach closure (Ullström et al. 2013).

In a longitudinal study over a 2-year period in a large facility, Dekker found that penalties did not deter undesirable behavior. Rather, penalties drove the development of a noncompliance underground, encouraging people to conceal errors, perversely reducing accountability and learning. Peer intervention was found to be more effective in generating accountability and desired change than punitive administrative action; less blame led to more accountability (Dekker & Laursen 2007).
2.1.2. The voice of the healthcare professional

New Public Management (NPM) and Corporate Governance have been the dominant intellectual forces in healthcare since the 1980s (Nølte 2009). The overall aim is to ensure the public that all medical treatment is equal to the public (Malmose 2013). NPM has allowed managers to expand their domain into areas previously regarded as the responsibility of clinicians (Radcliffe and Dent 2005). NPM principle number seven\(^\text{20}\) is *Cost reduction*, a focus on keeping cost low and efficiency high. But the challenge of *doing more with less*, falls on the healthcare professionals, who face an extremely complex working environment in clinics, wards, operating theatres and family practices.

Knowledge of the needed conditions to do a good job in healthcare is highest at the place where patients and professionals meet. The voice of the patient has fortunately been more and more included as a part of the NPM strategy (PasOpp).

The perspectives of the healthcare professionals, however, seem to be of little interest in the NPM system (Rozenblum et al. 2013). Consequently, politicians, regulators, policy makers, software designers, equipment providers, managers and researchers, who are all remote from the clinical environment, base their efforts on what they *imagine* everyday clinical work to be. But this “work-as-imagined” is based on second- or third- hand accounts of how practice is actually done, and relies on aggregated data that often arrive with substantial delay (Braithwaite et al. 2015), and which are (in my experience from several improvement projects), seldom reliable. The clinicians are mostly aware of this, but their input has not been sought by the policy makers.

The patient is the only one who experiences the journey through healthcare as a whole, including the quality and safety of the interactions and communication between the different healthcare levels, sites and healthcare personnel on this journey.

Communication failures are likely to occur in healthcare for a variety of reasons, including the wide range of staff and distractions/interruptions that are prevalent in the many clinical interactions (Kapur et al. 2015). In some situations, communication failures can be life-threatening (Gruen et al. 2006, Joint Commission 2007, Stahl et al. 2009, Zarkison et al. 2017).

\(^{20}\) See chapter 3.3.2. *New Public Management and Corporate governance*
2.1.3. High performing healthcare services

Over 20 years coaching quality improvement efforts, I have seen how multiprofessional quality improvement teams with great enthusiasm and endurance have made changes happen, closing the gap between what the professionals know and what they do, to the benefit of the patients. Still, empirically driven research on how to get a good start to an improvement process is limited (Davidoff et al. 2009).

Healthcare is first intended to “treat diseases”, but is seldom designed to facilitate improvement efforts, or to ensure sustainability and needed adaptation of improvements. But high performing healthcare services exist. During my 15 years as nurse anesthetist, I have witnessed how my multiprofessional colleagues have contributed to medical and psychosocial “miracles” for the benefit of the patient. Healthcare is full of such undocumented “miracles”.

We need to understand what conditions surround and are created by high performing clinical teams and networks. The time is come to study successful improvement efforts and excellent healthcare services to build knowledge of how and why work goes well (Lindberg et al. 2013, Lawton et al. 2014, Hollnagel et al 2015, Baxter et al. 2016, Ghaferi et al. 2016).

2.1.4. Individual quality versus system quality

At the heart of a scientifically grounded theory for improving health care is the premise that quality is a system property. Therefore, the level of performance is primarily determined by the design of a healthcare system, not simply the will, native skill, or attitude of the people who work in that system. This is a relatively rare insight in a world strongly biased toward individual accountability and, when things go wrong, blame (Berwick 2003).

Consistent with earlier studies (Batalden & S 1993, Institute of Medicine 2001, Berwick 2003), we found in 2011 that the improvement of knowledge and skills of individuals are important elements of a culture of continual improvement, but is not enough to achieve sustainable changes. As much as 90 percent of the focus group statements we studied highlighted the need for a system of continual quality improvement to be able to solve the problems that organizations experience in trying to make lasting improvements (Brandrud et al. 2011). How do we change a system? Donald Berwick wrote:
“Three preconditions seem helpful: to face reality, to seek new designs, and to involve everyone. Facing reality means identifying the gap between current performance and the performance we desire. Without recognition of a gap, change cannot occur” (Berwick 2003).

A system must facilitate training to achieve quality improvement. One example is the effect of quality control and quality improvement within colorectal cancer screening, where poor performance may be corrected by establishing a system of continuous\textsuperscript{21} evaluation and internal dissemination of results (Bretthauer 2003, Bretthauer 2004, Bretthauer & Brandrud 2014).

**Involving everyone:** Involving the professional environment in developing an internal system of continuous evaluation and internal dissemination of results. A system that promotes common reflection by professionals on the variations in their own performance, for the sake of learning and improvement.

**Seeking new designs:** Sticking to the endoscopy example, some countries have made great efforts to formalize and structure endoscopist training, often within the framework of continual quality improvement initiatives. This has led to impressive and sustained improvement in the quality of endoscopy services, as recently shown for colonoscopies in the United Kingdom (Gavin et al. 2013).

**Facing reality:** A crucial issue is the establishment of reliable thresholds for good quality. These thresholds are required to define competency, e.g. for certification as accredited endoscopists in cancer screening programs. The methods applied by Ward and co-workers to define competency are well-known in quality improvement (Ward et al. 2014).

As expected, depending on the method applied for thresholds and error margins, one gets slightly different results, but all seem valid. The method chosen should be transparent, easy-to-understand and simple to implement locally. Getting rid of counting proxies such as numbers of procedures and instead directly measuring more important quality indicators such as cecum intubation rate, adenoma detection rate and ultimately individual outcome indicators as the ones mentioned above is the obvious next step (Bretthauer & Brandrud 2014).

If the crucial technical skills still are insufficient, supervised training and re-certification of the employees involved would be obvious next steps to go. Finally, it is a leader’s responsibility to identify employees still not fulfilling defined quality criteria, and offering this person alternative tasks in a respectful way (Bretthauer 2003, Bretthauer 2004).

\textsuperscript{21} In this thesis, the term *continuous* improvement is referring to regularly activities without interruption, e.g. monthly training. *Continuous* improvement systems are embedded in a larger, hospital-wide *Continual* improvement system that is more dynamic and open to any improvement opportunity that should be found, and in a combination of professional and improvement knowledge, tailored to the particular task or item.
2.1.5. Making sense of theory and its use in improvement

One of the targets of this thesis is to contribute to demystifying theory and its use in improvement by identifying what formal and informal theories have contributed to success in the intervention stages and in the sustainability stages of a continual improvement process.\footnote{See Chapter 4.1. \textit{Theoretical underpinnings} and Chapter 7.2.5. \textit{Theoretical underpinnings with implications}}

Many of the difficulties of securing improvement lie in the enormous complexity of healthcare delivery systems, including their challenging technical, social, institutional and political contexts (Glouberman & Zimmerman 2002).

Nevertheless, we can attribute some challenges to the persistent failure to take full advantage of informal and formal theory in planning and executing improvement efforts (Davies et al. 2010).

It is of course possible to achieve high levels of quality and safety based on intuition derived from experience alone, with little evident help from formal theory. However, the few successful examples do not help to build a science. In this thesis, I am joining Frank Davidoff (2015) and Per Nilsen (2015) in arguing that the explicit application of theory could shorten the time needed to conduct improvement interventions.

One example is the diffusion of innovation theory, helping us to understand the difference between the early and the late majority. We have to win the hearts and minds of the early majority first, instead of wasting time and loosing courage on those who are not willing to change (yet). When the late majority at last has been convinced by a satisfied early majority, e.g. because of good test results provided by Plan-Do-Study-Act cycles, the late majority will join in and make the new system sustainable.

Theory could, preferably by the help of wise guidance, optimize the design of the intervention, identifying \textit{what conditions are necessary for achieving good and sustainable outcomes}, and enhance learning from those efforts (Foy et al. 2015, Grol & Wensing 2013, Marshall et al. 2013, Davidoff et al. 2015).
2.2. The research questions of the thesis

The present thesis is aimed to develop thesis statements from a synthesis of the data and findings in the four primary studies, and from additional key informant interviews & document studies as part of the Multi method part of the thesis. Here are the research questions tailored to the Multi method part of the PhD-project:

**Global research question**

*What are the determinants for an organization to provide excellent and sustainable health care services where sustainability and resilience is paradoxically working together?*

**Specific research questions**

1) **Learning from high performing clinical teams and networks:** What are the conditions for successful improvements and excellent care in the intervention stages vs the sustainability stages of a continual improvement process?

2) **What are the theoretical and historical underpinnings of the high performing clinical teams and networks?**

**Sub-questions**

1. **Is there a link between the theoretical underpinnings of the high performing clinical teams and networks?**

2. **What characterized the improvisations that were made as part of the local medical and psychosocial response to the Utøya terror attack?**

3. **Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?**

4. **To what degree was the response to the Utøya terror attack based on continual improvement theory, culture and practice?**

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23 See Chapter 5.2.4. *Data collection Multi method study*
2.3. Delineation of the thesis

There are eight issues not dealt with in this PhD project.

1. This PhD-project is neither an experiment, nor a study of the experiments of others, aiming to bring evidence to the success of the services and projects in our material. The PhD project has been developed with the prerequisite of the known outcome; the success of the projects was documented by their own measurements, and the successful handling of the victims of the terror attack at Utøya in 2011, was established by several independent reports (Gjørv et al. 2012, Lereim et al. 2012, KAMEO 2012).

2. This is not a study of terrorist events. The particular healthcare service of the local EMS in action 22 -24 July 2011 has been sampled for research because it is provided with a comprehensive and positive evaluation, and because the high quality and safety level of the service seemed to be a sustainable outcome of many years of continual improvement efforts.24

3. The issue of this PhD-project is not to provide evidence of the success of the learning collaboratives of The Norwegian Medical Association (NMA). Several international studies of the impact of quality improvement collaboratives have already been made, calling for further research on success factors (Schouten et al. 2008). The first part of the quantitative Project study (Paper 1) had a sampling purpose. Our multidisciplinary research team of improvement experts developed, validated and used the CPO-scale (Instrument 1) to identify successful projects among the collaboratives, based on their own measurements.

4. The PhD project is providing no information about the improvement project after the end of the collaborative. We have only random information about a few projects after the end of the collaborative. That means regardless of what happened afterwards, the success of the 54 projects identified by the CPO-scale assessments (Instrument 1), has not been questioned in as long as the final project reports document success before the end of the collaborative, by recognized measure methods, together with a clear linkage between vision, aims, change efforts and measurements. The outcomes of the successful projects are presented in Supplement 3 to the quantitative part of the Project study (Paper 2).

5. The CPO-scale (instrument 1) was published because it may be reliable to improvement workers. The scale was based on a recognized model (IHI Model for improvement), was tested for generalizability, and may be guiding the process of improvement planning, testing and execution of desired changes. In addition, the scale is underpinning a structured and theory-based evaluation of the systematic change processed and the outcomes. The evaluation can be made by teams,

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24 See Chapter 3.1.5. Quality improvement history, Ringerike hospital
leaders or coaches engaged in improvement efforts. The thesis is not comparing and discussing
the CPO-scale in relation to outer process and outcome scales that have been developed. This does
not mean the item is out of interest, but because my global PhD project is large enough already,
by focusing only on what we have learned from the high performers about the conditions for
improvement and excellent care, and in the theoretical and historical underpinnings of their
success. It is for example interesting that the only helpful tools mentioned by our informants were
the locally developed Trauma manual (see Appendix to paper 2, page 4) and the “Action cards”
(see thesis Figure 10: Simple, complicated and Complex pars of the successful EMS).

6. **We have learned much more in the sampling process than presented in this thesis.** We have learned
about the interdependency of aims, change efforts and proper measurements, and that successful
projects mostly have well written reports, indicating that the ability to communicate (relationship)
is part of the success. What I have learned together with my research team from this part of the
PhD project, has underpinned our ability to develop a questionnaire (instrument 2) about the
conditions for improvement, and our ability to analyse the responses from the improvement teams.

7. **The two instruments of the Project study are illuminating different parts of an improvement
process, but the thesis is limited to the questionnaire outcomes only (instrument 2).** The
generalizable, theory-based scale (instrument 1) focus on the stepwise improvement intervention
itself (Paper 1), while the questionnaire (instrument 2) is empirically, focusing on the conditions
for change in their (local) workplace with or without the support from a (national) learning
collaborative.

8. **It has not been an issue of this thesis to comment on the differences in the success rate of the eight
learning collaboratives, but three things are still worth considering (see Appendix 2).** The purpose
of presenting the CPO-evaluation result per collaborative in Appendix 2, was to illustrate the
balanced representativeness of the projects at the three success levels that have responded to our
questionnaire (instrument 2).

See Appendix 5 for other delineations, related to the primary studies of this thesis.
Chapter 3. State of knowledge

3.1. Quality managerial and improvement history

History identifies many managerial and improvement pioneers. This dissertation is limited to include pioneers that belong to the reference frame of this thesis because they belong to the theories and approaches increasingly confirmed by research, and thus may contribute to explain my findings. I am also presenting the roots and followers of a rather opposite philosophy (Taylorism) that is appealing with its clear and simple messages to politicians and healthcare leaders, but has limited research support.

3.1.1. Florence Nightingale

The nurse Florence Nightingale was a pioneer of modern quality improvement in healthcare. She entered the scene in the mid-1800s, seven decades before other quality improvement pioneers. In a book from 1901, a French doctor credits Nightingale with a mortality reduction from 60 percent to 2.2 percent because of her ability to transform the hospitals from top to bottom. McDonald (2009), however, found she has been credited with sanitary reforms and record keepings she could never have undertaken:

“She recorded the outcomes of care. The death rate among the patients was worst in February 1855 at 42.7% of all soldiers admitted. After her sanitary reforms, which started on 17 March 1855, the death rate fell to 2.2% by June 1855. She showed a causal link between the sanitary reforms and this dramatic fall in mortality” (Neuhauser 2003).

McDonald found the drop in mortality to be accurate, but it was not Nightingale but the Sanitary Commission that started the work in March 1855. Nightingale arrived in November and had done what she could, short of the rebuilding of infrastructure that only engineers with a sizable work force could have been able to provide. Nevertheless, showing the link between sanitary reform and the fall in mortality was her work—done in the two years following the war (McDonald 2016).

McDonald’s findings are especially interesting in light of complexity theory and the ongoing resilience “revolution” related to adverse event investigations. People seldom are alone in their achievements and history is far more complex than first realized.

25 McDonald 2009
27 See Chapter 3.3.6. Resilience concept and High Reliability Organizations
“Statistics can save lives, but only if the lessons are correctly learned and adequate changes made, which must then be monitored. Nightingale was a firm believer in the possibility of unintended consequences, a lesson she learned from Quetelet28. Her research methods still make good sense for the social and health sciences, especially for those who seek to apply research results to make changes in the real world” (McDonald 2016).

3.1.2. Frederik Winslow Taylor

Frederick W Taylor (born in 1856) became a self-taught industrial engineer at the time American industrial production was new, and immigrants were accepting all kinds of work to survive in their new homeland. Taylor developed a Scientific Management Theory promoting the idea that there is “one right way” to do something. His management strategy was a static optimization of work imposed by “those who know” on “those who do”. Taylor’s idea was that the work could be subdivided into highly specialized tasks as it was planned, allowing less skilled people to staff the production line. By measuring the time employees took to perform their tasks, he learned how to arrange the sequence of work to maximize the output of each person and of the factory as a whole.

Assuring quality of the manufactured products was primarily the responsibility of inspectors. In 1925 a quarter of the employees at Western Electric Hawthorne Plant (which made telephone equipment) were inspectors. The inspection system worked well enough; quality was fairly good, but the rate of improvement depended on a limited system, not on the workforce (Berwick 2003).

The improvement approach was extreme standardization, controlling the compliance of employees to ensure they met the standard. The consequence is that the workforce now focuses on self-defense, since it is assumed that any quality problems results from the workers’ lack of compliance. Once this lack of compliance is pointed out, the “guilty ones” are expected to change their behavior as there may be negative consequences if they do not. (Grol & Wensing 2013).

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28 “Adolphe Quetelet was one of the most prominent figures of the second half of the nineteenth century, yet in present-day histories of several social sciences the impact of his ideas is widely ignored. The first Chapter consists of a sketch of his life and work. Astronomer and statistician, he sought to apply the mathematical tools of astronomy to create was has been called a ‘mathematics of society’” (Jahoda 2015).
3.1.3. Shewhart, Deming, Juran & Ishikawa

The American engineers Walter A Shewhart, W. Edwards Deming and Joseph Juran are often considered the three key founders of the quality improvement movement. Two of Shewhart’s contributions were presented to the world by Deming, and continue to influence the daily work of quality, namely, control charts (SPC) and the Plan-Do-Study-Act cycle (Best & Neuhauser 2006A).

In 1925, Western Electric Research Laboratories and part of the engineering department of the American Telephone & Telegraph Company (AT&T) were consolidated to form Bell Telephone Laboratories, Inc., as a separate entity. Western Electric Hawthorne Plant in Cicero (a suburb of Chicago) produced hardware for the Bell Telephone Company. The Western Electric Company grew rapidly with the need for telephones, and by 1930 there were 43,000 employees.

Dr. Walter A. Shewhart worked at Hawthorne until 1925, when he moved to Bell Telephone Research Laboratories where he remained until his retirement in 1956. While at Hawthorne, Shewhart became Deming’s mentor and taught him how to apply statistics to measure and control process variation. The understanding of variation became one of the key elements of the Deming philosophy. Dr. Deming’s holistic approach to leadership and management ties together seminal theories in four interrelated key elements as a “System of profound knowledge”29:

- Appreciation of a system
- Understanding variation
- Theory of knowledge
- Understanding psychology and human behavior.

(Best & Neuhauser 2005)

Dr. Joseph Juran, who worked at Hawthorne from 1924 to 1941 was also influenced by Shewhart. He contributed greatly to the human dimension of management. Other contributions include the Pareto chart and the Juran trilogy. Dr. Juran was worried about the cost of poor quality, illustrated by this approach to cross-functional management, which is composed of three managerial processes: quality planning, quality control, and quality improvement. Without change, there will be a constant waste;

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29 Demings system of profound knowledge has been translated to healthcare by Batalden & Stolz (1993) and is included in their “Continual improvement” model as “Improvement knowledge”. See Chapter 4.1.1. Continual improvement, Figure 1 The continual improvement definition. See also Paper 3, box 3.
during change, there will be increased costs, but after the improvement, margins will be higher and the increased costs are recouped (Best & Neuhauser 2006B).

The experts at Hawthorne, whose task was to standardize and control the workforce, were witnessing the working conditions that evolved under the influence of Taylor’s management philosophy. The quality improvement philosophy of Shewhart, Deming and Juran was to promote self-reflection among healthcare leaders and workers, seeking smarter (knowledge-based) and less wasteful solutions together (Wig 1995, Berwick 2003).

In this paradigm, the teams of workers are seen as the ultimate source of knowledge on how to make the necessary improvements happen. Because a good result is the product of a well-functioning process, the employees are monitoring and studying the variation of their own practice, with a focus on learning. Their findings are informing the improvement process by continual Plan-Do-Study-Act (PDSA) cycles.  

Shewhart created the PDSA cycle, applying a systematic approach to improving work processes. When the PDSA cycle is applied consistently, it can result in a sustainable continual improvement process.

As a reaction to the single focus on production and result, Shewhart developed a system, known as statistical process control (SPC). His idea was that the workers could learn to study the variation of the production processes, to detect and prevent sources of failures before they occur. Drawing on Shewhart’s work, both Deming and Juran recognized that system problems should be addressed and that satisfying the customer’s needs was important (Wig 1995, Bauer 2006).

Hawthorne evolved to be a “multidisciplinary research lab”, for the creation of sociology, social psychology and anthropology of the work place (Best & Neuhauser 2006A). As social sciences are concerned with society and the relationships among individuals within a society, this may explain how engineers as Shewhart, Deming and Juran were including so much knowledge about learning and social interaction from other academic disciplines in their managerial thinking.

The same year (1924) as Shewhart described his first control chart (SPC), there began a series of research projects, which came to be known as the Hawthorne studies. Elton Mayo found that a social placebo effect happened (Hawthorne effect) because productivity increased when attention was paid to the workers. Studies of the relationship between better lighting and increased productivity concluded surprisingly that productivity increased as the lights in the factory were dimmed (Best &

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30 See Chapter 4.1.1.7. Model for improvement
31 See Chapter 4.1. Theoretical underpinnings
32 See Chapter 4.1.1.4. Statistical Process Control (SPC)
Neuhauser 2006A). After the Second World War, Dr. Deming, Dr. Juran and Dr. Armand Feigenbaum, were sent to Japan to help rebuilding the industry.

In Japan, Deming, Juran and Feigenbaum met the organizational theorist, Dr. Kaoru Ishikawa, who translated the early lessons of Deming and Juran into a Japanese concept of quality circles.

After becoming a full professor in the Faculty of Engineering at The University of Tokyo (1960), Ishikawa introduced the concept of quality circles (1962) in conjunction with JUSE33. This concept began as an experiment to see what effect the "leading hand" (Gemba-cho) could have on quality. It was a natural extension of these forms of training to all levels of an organization (the top and middle managers having already been trained). Quality circles would soon become very popular and form an important link in a company's Total Quality Management system.34 His “Ishikawa diagram” is also known as “cause and effect diagram” or “fishbone diagram” often used in the analysis of industrial processes (Wig 1995). Ishikawa expanded Deming's four Plan-Do-Study-Act steps into the following six:

1. Determine goals and targets.
2. Determine methods of reaching goals.
3. Engage in education and training.
4. Implement work.
5. Check the effects of implementation.
6. Take appropriate action35.

Ishikawa believed in leadership based on trust, that quality cannot exist without trust, and that the employee’s ability and willingness to do the right things right, and to develop is a fundamental prerequisite for quality (Wig 199536).

3.1.4. Codman and Donabedian

3.1.4.1. Ernest Amory Codman

Ernest Amory Codman, M.D., (December 30, 1869 – November 23, 1940) was a pioneering Boston surgeon making contributions to the study of medical outcomes. Codman was born in Boston

33 JUSE: Japanese Union of Scientists and Engineers
34 See Chapter 3.2.4. Lean methodology
35 http://www.skymark.com/resources/leaders/ishikawa.asp (Downloaded August 2018)
Massachusetts, graduated from Harvard Medical School in 1895 and interned at Massachusetts General Hospital.

He was an advocate of hospital reform and is the acknowledged founder of what today is known as outcomes management in patient care. Codman was the first American doctor to follow the progress of patients through their recoveries in a systematic manner. He kept track of his patients via "End Result Cards" which contained basic demographic data on every patient treated, along with the diagnosis, the treatment he rendered, and the outcome of each case. Each patient was followed up on for at least one year to observe long-term outcomes.

He also made significant contributions in the fields of radiology, anesthesiology, shoulder physiology and surgery, duodenal ulcer surgery, and the study of bone sarcoma. While in his last year of medical school, Codman interned at Massachusetts General Hospital (MGH). At the time, medical students at MGH gave anesthesia during surgery. Codman bet his classmate and best friend, Harvey Williams Cushing, who later became a renowned neurosurgeon, to see whose patients would have better outcomes under their care. The result was the first use of anesthesia charts—graphing such data as the medicine administered to the patient and the patients’ pulse and respiration rate—a significant advance in anesthesiology.  

With an interest in health care quality, he established the first bone tumor registry in the United States. Codman was also a public health pioneer, studying hospital outcomes to determine how they could be improved. He wrote

"Every hospital should follow every patient it treats long enough to determine whether the treatment has been successful, and then to inquire ‘if not, why not’ with a view to preventing similar failures in the future" (Codman 1914).

Codman’s work in quality assessment eventually led to the founding of what is now the Joint Commission (JCAHO).  

37 https://www.britannica.com/biography/Ernest-Amory-Codman (Duncan Neuhauser, downloaded February 2019)

38 http://www.whonedit.com/doctor.cfm/2558.html, and https://en.wikipedia.org/wiki/Ernest_Amory_Codman (Downloaded August 2018). See also Chapter 3.3.3. Accreditation and Certification.
3.1.4.2. Avedis Donabedian

Avedis Donabedian (7 January 1919 – 9 November 2000) was an Armenian physician serving as a medical officer at American University of Beirut. He was the founder of the study of quality in health care and medical outcomes research.

Donabedian understood health care as a system. He stated people have a big problem understanding the relationship between quality and systems, because system management doesn’t get taught in medical school or nursing school. Systems awareness and systems design are important for health professionals, but are not enough. His famous triad was published in in 1966\(^{39}\), dividing quality of health care measures into structure, process and outcome.

**Structure** denotes the attributes of the settings in which care occurs. This includes the attributes of material resources (such as facilities, equipment, and money), human resources (such as the number and qualifications of personnel), and of organizational structure (such as medical staff organization, methods of peer review, and methods of reimbursement).

**Process** denotes what is actually done in giving and receiving care. It includes the patient’s activities in seeking care and carrying it out as well as the practitioner’s activities in making a diagnosis and recommending or implementing treatment.

**Outcome** denotes the effects of care on the health status of patients and populations. Improvements in the patient’s knowledge and salutary changes in the patient’s behavior are included under a broad definition of health status, and so is the degree of the patient’s satisfaction with care.

“This three-part approach to quality assessment is possible only because good structure increases the likelihood of good process, and good process increases the likelihood of a good outcome. It is necessary, therefore, to have established such a relationship before any particular component of structure, process, or outcome can be used to assess quality” (Donabedian 1988).

Donabedian wrote 11 books and over 100 articles, arguing that:

> “The secret of quality is love, to your patient, your profession and your God. If you have love, you can then work backward to monitor and improve the system” (Donabedian, here by Best & Neuhauser 2004).

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3.1.5. Quality improvement history, Ringerike hospital

On January 1st, 1995 the new CEO initiated the quality improvement journey of Ringerike hospital. This was a leader with a deep understanding of the complexity of healthcare, and the challenging journey of the patient through the healthcare system (patient process).

A multidisciplinary team of the hospital’s professional and administrative leadership went to Leicester Royal Infirmary (LRI) to study their patient process redesign approach, an approach that was aimed to conduct a planned redesign of the generic ‘core’ patient processes of the care.

At Kingston General Hospital (London), they studied multitasking and patient centered care. Kingston followed a principle of designing the daily needed services as close to the ward as possible. They located small functional service units at every ward, so the patients avoided stressful and time-consuming transport. At Poole Hospital they studied the Planetree model.

“Planetree, Inc. is a mission based not-for-profit organization that partners with healthcare organizations around the world and across the care continuum to transform how care is delivered. Powered by over 50,000 focus groups with patients, families, and staff, and over 35 years of experience working with healthcare organizations, Planetree is uniquely positioned to represent the patient voice and advance how professional caregivers engage with patients and families. (…) Our philosophical conviction that patient centered care is the “right thing to do” is supported by a structured process that enables sustainable changes."

The hospital was guided by The Health Quality Service book of John Øvretveit (1992). This book was written because the author was concerned about the danger that as the new systems for standard setting and inspection were adopted, the necessary attitudes, skills and working relationships would be largely ignored and undeveloped. Øvretveit was in accordance with Berwick and Batalden in his translation of the managerial and improvement theories of Shewhart, Deming and Juran from an industrial context to the context of healthcare.

In addition, Peter Senge’s five disciplines of a learning organization were deeply influential at Ringerike hospital. The hospital leadership was convinced that if you want to change something, it is not a matter of capacity, but a matter of attitudes towards what you want to make together. Practicing “management by walking around”, they enacted their ambition of including everybody in a

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41 See Chapter 4.1. Theoretical underpinnings
42 The five disciplines are described in Chapter 3.2.5.1. The learning organization
transformation of the hospital. First, they invited every leader to learn patient process redesign, and then they asked everyone to observe and report every possible opportunity for improvement, to be followed up by the leadership by planned, systematic improvement cycles, in a comprehensive reflection and learning process, similar to the double loop learning theory of Argyris (1997).

Their improvement teams were always multidisciplinary, engaging everybody in mapping and redesigning their own service to the actual patient population. The patients were included in the improvement teams, assuring that a planned change should benefit the patient. They were focusing on the system, and a culture of empowerment, trust, pride, belonging and ownership to the changes was growing among the employees in the wake of their participation in the improvement efforts.

The process improvements contributed to a substantial reduction of the costs, and the hospital made annual conferences and courses for other hospitals to spread their improvement knowledge and experience. The improvement efforts automatically involved the outpatient care in 13 municipalities. Through regular meetings, visits and common projects, the hospital and the municipalities worked together to make the patients journey “from home to home” as safe and seamless as possible. Because of these efforts, the hospital received collaboration awards in 2006 and 2007.

An electronic monitoring system (“MAP”) on existing data from the recording system was developed to bring continual information based on real-time data to the professionals and their leaders at the micro- meso- and macro level. In the beginning of 2009, the hospital was selected to represent one of five “National Pilot hospitals” by the Norwegian Ministry of Health and Care from 2009 to 2010 (Thoresen 2011).

All this, in combination with evidence-based professional knowledge guidance, and regular team-training, a continual improvement culture and mindset was developed that enabled the employees to make the impossible possible on 22 July 2011. The continual improvement process at Vestre Viken, Ringerike hospital is still going strong and the improvements made after 2011 are described in the Discussion section of this thesis.

43 The hospital was awarded the Norwegian Productivity price in 2000 by The Polytechnic Association, and CEO Bjarne Riis Strøm received a management price in 2002 by the Society for Human Resource Management.
44 The CEO of Ringerike hospital was the owner of the project. July 2009, just before the prototype was ready for use, the hospital was merged into Vestre Viken Hospital Trust, and the CEO’s of the four hospitals were removed. As supervisor of the “MAP” project, I was assisting the new leadership in saving the project. The digital communication pattern and information structure of the new organization was of cause not clear that early. Consequently, it appeared to be impossible to adjust a prototype tailored to a small part of the new organization into a highly premature organization in the beginning of a long and complex process towards a common structure, culture and context of Vestre Viken.
3.2. Learning, interaction & empowerment approaches

3.2.1. Total quality management

Total quality management (TQM) is in contrast to Taylorism based on trust, according to the philosophy of Shewhart, Deming, Juran and Ishikawa, who are recognized as the founders of the modern quality improvement movement.

Grol and Wensing (2013) are defining the Total quality management this way:

“The approach is less directed to individuals and more to creating the organizational conditions for change; here the assumptions is that poor quality is a system problem. By changing the system, redesigning the care processes, or changing the roles or tasks, improving the internal culture, and continuously monitoring and improving care are increasingly considered as reasonable methods required to optimize patient care.”

(Grol & Wensing 2013)

Several theories and quality and safety improvement approaches are rooted in this thinking, some are presented in this Chapter about Learning, interaction & empowerment approaches. The rest is presented in Chapter 4. Rationale, and in the Discussion chapter 7.3.1. What is the present knowledge?

3.2.2. The Clinical Microsystem concept

3.2.2.1. Clinical microsystem

The smallest replicable units in the health system where patients and healthcare personnel interact to “create health” have been defined as “Clinical Microsystems” by healthcare improvement researchers rooted in the same quality improvement philosophy as the IHI learning collaboratives (Nelson et al. 2002, Nelson et al. 2011).

In a clinical microsystem, the patients, their family and the healthcare personnel are defined to be part of the same system. The term “Microsystems” stems from the research of the economist James Brian Quinn (1992). Quinn studied the most successful service organizations focusing on their smallest replicable units, to identify factors that were important for their success. He found that the management constantly supported and improved the professionals’ ability to meet the customers’ needs. Donaldson and Mohr (2000) and Nelson et al. (2002) studied high performing clinical teams to
identify determinants associated with their success. Their findings were partly overlapping. Nelson et
al. found leadership to be of importance, and summarized their findings to five key domains:

1. Leadership and organizational support
2. Staff focus: education and training, and interdependence of care team
3. Patient focus, community and market focus
4. Performance results and process improvement
5. Information and information technology

According to Nelson, Batalden & Godfrey (2007), the principles associated with success are:

1. Leadership
2. Organizational support
3. Patient focus
4. Staff focus
5. Education and training (coaching)
6. Interdependence of care team
7. Information and information technology
8. Process improvement
9. Performance result

Another way to describe a microsystem is to look at the anatomy of the systems as a set of elements
that work together, here defined as the 5 Ps:

(1) A clear and shared purpose in the microsystem
(2) The patients, the subpopulations that are served by the microsystem
(3) The professionals, the people working together in the microsystem
(4) The processes used by the microsystem to provide care and services
(5) The patterns (e.g. communication and relationship patterns) that characterize the
microsystem’s functioning, culture and outcomes

(Godfrey et al. 2003, Nelson et al. 2007).

A key component of the clinical microsystems approach is the fundamental interest in the patients’

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45 In accordance with Kotter’s theory, the development of an emergency preparedness and response plan is a
matter of leadership, while coordinating the complex response situation is a matter of management.
Here the terms Leadership, Leading and leaders is including both (See “Glossary & abbreviations”).
Taking the patient perspective and personal needs seriously is not only an ethical issue, it is promoting health.

A Norwegian improvement project based on the clinical microsystems approach, resulted in increased satisfaction for patients and staff, reduced waiting time, and reduced variation of waiting time. The outpatients, who were suffering from advanced lung cancer received an updated information leaflet making it easier to understand and predict the care process at the outpatient clinic, helping the patient to achieve cognitive control. The change ideas were based on the patients’ perspectives from direct observation, focus groups and questionnaires on patients’ satisfaction, and by actively reflecting on feedback from patients during the course of the project. The patient quotes and stories were also motivating the healthcare professionals in their improvement efforts (von Plessen & Aslaksen 2008, von Plessen 2008).

An evaluation of the clinical microsystems approach in an English NHS context found that the Microsystem approach is nurturing strengths – of both teams and individuals – by higher staff morale, empowerment, commitment and clarity of purpose (Williams et al. 2009).

3.2.2.2. Mesosystem

Clinical microsystems and other complex adaptive systems, are embedded in other complex adaptive systems. The successful local medical response to the shooting spree at Utøya youth camp 22 July 2011, involved a network of interrelated microsystems from Utøya to discharge from Ringerike hospital and further. The less injured patients were followed over the yard to Ringerike DPS from the outpatient clinic, and transferred by taxi (free of charge) to the improvised crisis centre at Sundvolden hotel as soon as possible, to join their friends and family there, supported by more than 100 healthcare professionals.

According to the Microsystem theory of Nelson, Godfrey and Batalden et al., this trauma and psychosocial care network can be defined as a mesosystem:

“As the patient’s journey of care seeking and care delivery takes place over time, he or she will move into and out of an assortment of clinical microsystems, such as a family practitioner’s office, an emergency department, an intensive care unit, a surgical suite[...]. This assortment of clinical microsystems—combined with the patient’s own actions to

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46 See Chapter 4.1.2.3. Patient aim

47 See Chapter 4.1.3.2. Complex adaptive systems
improve or maintain health—can be viewed as the patient’s unique health system[...]
referred to as a mesosystem (for example, providing connections between the related
microsystems serving a group of patients). One role of the mesosystem is to actively guide the
dialogue between related microsystems to achieve desired outcomes for patients. The
mesosystem reflects the participation from all related microsystems in feeding information
forward and backward” (Nelson et al. 2008).

The authors conclude that mastering and making use of microsystem principles and methods can
help us knit together care in a fragmented health system to achieve safe and efficient care with
reliable handoffs, attaining the best possible health outcomes.

3.2.2.3. Macrosystem

Macrosystems are larger umbrella organizations in which microsystems and mesosystems are
embedded. Nelson et al. (2009) emphasizes that improvement has to focus on the whole system, as
all parts of the system and all levels of the system are interdependent. A whole-system approach
means leaders and staff are working to improve performance both within and between all
microsystems in the organization, and to align all levels of the organization to improve quality,
reduce real costs, and engage all staff members in both doing their work and improving their work.
An important aspect of this leadership work is a focus on making smooth, safe and effective
transitions between and across related microsystems and supporting systems (mesosystems), such
as clinical service lines, programs or divisions. Horizontal and vertical alignment is essential.

A relevant example is Ringerike hospital. Long before the hospital was merged with three other
hospitals into Vestre Viken Health trust, the hospital worked systematically on the alignment of its
horizontal and vertical processes in a comprehensive quality improvement effort making the care of
the patients as seamless as possible. The continuity system of the care included the interaction with
the municipalities to make the patient’s mesosystem (the journey “from home to home”) as
coordinated as possible. Because of these efforts, the hospital received two collaboration awards.48

When healthcare leaders meet regularly around the same table, their ability to understand and
coordinate each other’s decisions to continually improve the interactions of their units to the benefit
of patients is much easier. At the time of the terror attack at Utøya, the hospital had been part of
the Health trust for several years, and the supporting systems were centralized to a leadership
seated in Drammen, 61 km. away. The respondents to the Sustainability study reported there were

48 See Chapter 3.1.5. Quality improvement history, Ringerike hospital
no problems in interacting with centralized services as e.g. the Radiology department 22-24 July 2011. Remembering how it was before, (and a previous department leader among the volunteers who came to help 22. July) the interaction was reported to be almost as seamless as in “the old days” when their leaders belonged to the same leader team.

Preventable deaths due to errors in trauma patients with otherwise survivable injuries account for up to 10 percent of fatalities in Level I trauma centers. 50 percent of these errors occur in the intensive care unit (ICU). The root cause of 67 percent of events is reported to be communication errors (Gruen 2006, Joint Commission 2007, Stahl 2009, Zakrison 2016). The efforts of Ringerike hospital to provide seamless patient care was included in the emergency preparedness plan. 22. July 2011 each trauma team followed their patient from arrival through the different units (e.g. Radiology, Operating theater, Intensive care) and stayed by the trauma patient until the situation was stable and predictable (at the ward), and it was totally safe to hand over the care to others. The unpredictable trauma situation caused by fragmenting ammunition made this care continuity especially important.

3.2.3. Lean methodology

The Lean approach to continual improvement is rooted in the successful Japanese industry, and the philosophy of Deming, Juran and Ishikawa. According to Nelson, Batalden and Godfrey (2007), Toyota has had a profound, worldwide influence of quality thinking and techniques based on (1) their management philosophy (way of work), (2) the tools and methods for change (lean manufacturing), and (3) the emergent learning process. Fujimoto\(^\text{49}\) notes that the Toyota manufacturing system today is not the result of a “grand design”, suggesting that process elements have been adopted from other settings and combined with relentless reflection and system improvement.

TOOLS AND METHODS OF CHANGE

- Reduction of non-value-adding activities
- Fool proof prevention of defects
- Reduction of excessive workload
- Real-time feedback of production troubles
- On-the-spot inspections by direct workers
- Visual management
- Frequent revision of standard operating procedures by supervisors
- Quality circles
- Standardized tools for quality improvement
- Worker involvement in preventive maintenance

Automatic detection of defects

A recent systematic literature review conclude that Lean interventions do not have significant associations with positive patient satisfaction or health outcomes, but do have a negative association with financial costs and worker satisfaction, and no impact on adverse events. The approach was shown to have no impact on workplace engagement, inclusion and productivity. (Moraros et al. 2016).

Over the last decades, Lean has increasingly been sold in to healthcare leaders as a cost-saving and process efficient approach that is motivating worker engagement and input towards a better quality of the care, and increasing patient satisfaction because the improvements are adding value to the patients. I am afraid this angle to effectiveness and cost-savings may have brought the approach away from its philosophical roots of learning, interaction and empowerment, towards a more Compliance, inspection & control-oriented culture. The merge of the Lean and Six Sigma approaches may be a part of the same movement.

3.2.4. Mindfulness versus mindlessness

3.2.4.1. Mindfulness

As shown by the previous chapter, providing excellent care is challenging. Systematic reviews indicate that mindfulness practice reduces stress in practicing physicians and results in lower levels of burnout, anxiety and depression (Irving et al. 2009, Regehr et al. 2014). According to Levinthal & Rerup (2006) the notion of mindfulness was introduced in 1986 to organizational research by a book of Sims & Gioia, and to psychology in 1989 (at the individual level) by Langer. Mindfulness was presented as a state of active awareness characterized by the continual creation and refinement of categories, openness to new information, and willingness to view contexts from multiple perspectives.

Solhaug et al. (2016) argue that mindfulness also may enhance supportive listening, and empathic understanding, promoting the quality of the therapeutic alliance, which has been found to strongly impact treatment effectiveness. The concept of mindfulness stems from contemplative Buddhist traditions, but different translations into evidence-based treatment models has led to pluralism in definitions. Solhaug et al. are presenting the definition of Kabat-Zinn and Shapiro et al.:"

“An oft-cited definition describes mindfulness as an awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of

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50 See Discussion section, Chapter 7.3. Contribution to the present knowledge
51 See Chapter 3.3.4.2. Lean Six Sigma
experience from moment to moment. Intention, attention, and attitude have been identified as core elements of this definition. Intention refers to one’s reason for practicing mindfulness. Attention refers to one’s ability to focus on the present moment, as opposed to being trapped in thought. Attitude refers to the manner of one’s attention including qualities such as curiosity, openness, and acceptance” (Solhaug et al. 2016).

In 1993, Weick et al. introduced mindfulness into the concept of High reliability organizations suggesting that mindfulness is enriching the capability to discover and manage unexpected events (Weick et al. 1999).

3.2.4.2. Mindlessness

Levinthal and Rerup (2006) suggest that being mindless is like being on automatic pilot. Weick et al. (1999) note that when fewer cognitive processes are activated less often, the resulting state is one of mindlessness characterized by reliance on past categories, acting on ‘automatic pilot,’ with fixation on a single perspective without awareness that things could be otherwise. Kahneman argues that most impressions and thoughts arise in one’s conscious experience without one knowing how they got there. Thus, we are often confident even when we are wrong, and an objective observer is more likely to detect our errors than we are (Kahneman 2011).

Regular training can help reprogramming an increasingly safer ‘automatic pilot,’ with continuous updated knowledge and debriefing based behavior. The quote “In combat you don’t rise to the occasion, you sink to the level of training” was often cited by the head surgeon of Ringerike hospital, John Colin Poole, at his many national and international presentations about the local medical response after the Utøya terror attack. Others have come to the same conclusion (Goralnick 2013).

3.2.5. Organizational learning and mastery climate

3.2.5.1. The learning organization

Peter Senge is an organizational theorist. His vision of a learning organization is a group of people who are continually enhancing their capabilities to create what they want to create has been deeply influential. Here are the five disciplines he sees as central to learning organizations and some issues and questions concerning the theory and practice of learning organizations.

(1) **Shared Vision:** The key vision question is ‘What do we want to create together?’

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55 See Chapter 3.3.6.2. High Reliability Organizations

56 The quote has frequently been credited to an anonymous Navy Seal
(2) **Mental Models:** One key to change success is in surfacing deep-seated mental models - beliefs, values, mind-sets and assumptions that determine the way people think and act.

(3) **Personal Mastery** is centrally to do with ‘self-awareness’ – how much we know about ourselves and the impact our behavior has on others.

(4) **Team Learning** happens when teams start ‘thinking together’ – sharing their experience, insights, knowledge and skills with each other about how to do things better.

(5) **Systems Thinking** is a framework for seeing inter-relationships that underlie complex situations and interactions rather than simplistic (and mostly inaccurate) linear cause-effect chains.\(^{57}\)

Senge describes extensively the role of what he refers to as "mental models," which he says are integral in order to "focus on the openness needed to unearth shortcomings" in perceptions. His book also focuses on "team learning" with the goal of developing "the skills of groups of people to look for the larger picture beyond individual perspectives." In addition to these principles, the author stresses the importance of "personal mastery" to foster the personal motivation to continually learn how actions affect [the] world (Senge 1994).

### 3.2.5.2. Double loop learning

Argyris’ Double loop learning in organizations theory (1991, 1997) is adding another dimension by arguing that by uncovering their own hidden theories of action, managers can detect and correct errors:

> “Organizational learning is a process of detecting and correcting error. Error is for our purposes any feature of knowledge or knowing that inhibits learning. When the process enables the organization to carry on its present policies or achieve its objectives, the process may be called single loop learning. (...) When the plant managers and marketing people were detecting and attempting to correct error in order to manufacture Product X, that was single loop learning. When they began to confront the question whether Product X should be manufactured, that was double loop learning, because they were now questioning underlying organization policies and objectives” (Argyris 1997).

### 3.2.5.3. Interpersonal trust and knowledge sharing

In a review of the literature, organizational researchers (Nerstad et al. 2017) found that imparting and exchanging knowledge and information is positively associated with team and organizational performance. The organizational context in which processes of sharing and combining knowledge occur is a central component of actual knowledge transfer. The work achievement context in which employees perform daily tasks plays an important part in enhancing the likelihood that knowledge is

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\(^{57}\) See Chapter 4.1.3.1. *Systems theory*
shared. In a performance *climate*, knowledge sharing may be actively obstructed because of intra-
team competition and social comparison among employees, with rewards restricted to the best
performers.

By contrast, a *mastery climate* values, supports, and rewards employees’ efforts of cooperation,
learning, mastery and development of skills. In this climate, employees are encouraged to do their
best, by self-referenced goals and several opportunities of improvement. When employees perceive a
mastery climate, they are more likely to feel trusted by their leaders (supervisors) at both the individual
and group levels (Nerstad et al. 2017).

Interpersonal trust is associated with a range of adaptive outcomes, including knowledge sharing.
Interpersonal trust refers to an employee’s willingness to be vulnerable to another party based on a
positive expectation of the other person’s actions. Interpersonal trust involves two parties, trustor and
trustees, in a dynamic relationship. Feeling trusted involves the perception and realization of others’
positive expectations and exposes their willingness to be vulnerable.

Although motivational climate perceptions are an individual-level phenomenon, experiences shared
within the same work group may translate into a collective phenomenon. This is because work
members share stories and information regarding mastery climate experiences to produce a collective
perception of climate. Most members of a particular group are likely to rely on positive group
experiences in concluding that helping and cooperating with coworkers and sharing their knowledge
will be of value and benefit to other members, including themselves.

### 3.2.5.4. Organizational culture and patient outcomes

In a systematic review, Braithwaite et al. (2017), define culture as the sum of jointly held
characteristics, values, thinking and behaviors of people in workplaces or organizations. A positive
organizational and workplace culture is defined as a cohesive, supportive, collaborative, inclusive
culture. In a systematic review of quantitative studies, they found that overall, positive
organizational and workplace cultures were consistently associated with a wide range of positive
patient outcomes such as reduced mortality rates, falls, hospital acquired infections and increased
patient satisfaction. In a systematic review of qualitative studies of healthcare organizations
struggling to improve quality, Vaughn et al. (2018) found five domains characterising struggling
healthcare organizations:

1. Poor organizational culture

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58 See definition in Chapter 1.6. *Glossary & abbreviations*
a) Limited involvement and ownership, non-collaborative environment, hierarchical orientation (lack of empowerment/punitive approaches to problems) (anxiety and fear) and disconnected leaders (unsupportive, non-transparent) etc.

2. Inadequate infrastructure
   a) Inadequate QI infrastructure and processes, insufficient staffing/high turnover, poor information technology services and general lack of resources, etc.

3. Lack of cohesive vision and mission
   a) Mission conflicting with other stated missions, externally motivated by finances/penalties etc.

4. System shocks
   a) Occurring as the result of planned and unplanned institutional change, underwent restructuring, unanticipated leadership turnover, sporadic involvement of senior management etc.

5. Dysfunctional external relations
   a) With other healthcare facilities, stakeholders or governing bodies associated with dire consequences, especially where financial performance was dependent on external collaboration.

3.2.5.5. Organizational readiness for change

Weiner (2009) define organizational readiness for change “as a 'shared team property'- that is, a psychological state that organizational members hold in common”.  

Weiner is referring to social cognitive theory (Bandura 1997) suggesting that when organizational readiness for change is high, organizational members are more likely to initiate change (e.g., institute new policies, procedures, or practices), exert greater effort in support of change, and exhibit greater persistence in the face of obstacles or setbacks during implementation.  

Weiner is further suggesting that:

“Motivation theory not only supports these hypotheses, but suggests another. When organizational readiness is high, organizational members will exhibit more pro-social, change-related behaviour—that is, actions supporting the change effort that exceed job requirements or role expectations” (Weiner 2009).

59 Klein & Kozlowski 2000
60 Bandura 1997
61 Meyer & Herscovitch 2001
3.2.5.6. Normalization Process Theory (NPT)

Normalization Process theory stems from sociology, defined as the work that actors do as they engage with some ensemble of activities. The activities may include new or changed ways of thinking, acting, and organizing to become routinely embedded in already existing, socially patterned, knowledge and practices. May & Finch (2009) define Normalization Process theory as the social organization of the work (*implementation*), making practices routine elements of everyday life (*embedding*), and sustaining embedded practices in their social contexts (*integration*).

NPT provides a set of sociological tools to understand and explain the social processes that frame the integration of new practice: The theory presented by May & Finch (2009) proposes that:

a) New practice become routinely embedded in social contexts as the result of people working, individually and collectively. The change processes involve patterns of dynamic interactions within a specific context, over time.

b) In this context, implementation is operationalized through four generative mechanisms: coherence; cognitive participation; collective action; and reflexive monitoring. These mechanisms are affected by factors that promote or inhibit the routine embedding, or normalization, of a practice in its social contexts.

c) The embedding of a new practice is thus dependent on organized and organizing agency, and the theory therefore proposes that the production and reproduction of new practice requires continuous investment by agents in ensembles of action that carry forward in time and space.

3.2.6. Innovation theories

Innovation is crucial to the continuing success of any organization, and its relation to many different approaches has led to a pluralism in definitions. Govindarajan and Trimble (2010) defines innovation to be a two-part challenge. First you have to come up with a great idea, then you have to execute it. Execution is the other side of innovation, and is always in conflict with ongoing, day-to-day operations, that are typically much stronger than the forces behind innovation. Leadership engagement is crucial, and so is a dedicated team, and a plan that will make the innovation happen. Hypothesis driven experimenting is part of the plan.

3.2.6.1. Diffusion of innovation
Everett Rogers’ theory of diffusion is considered the single most influential theory in the broader field of knowledge utilization (Eastbrooks et al. 2008). The professor of communication studies was famous because of his theory on how innovations, defined as idea, products, and practices perceived as new by an individual diffuse to members of a social system. Preparing for his doctoral dissertation of 1957⁶², he discovered that main findings in studies of innovation in kindergartens, schools and healthcare was strikingly similar to his own findings in the agriculture environment.

Rogers found that peoples’ categories of willingness to change (adoptability) is statistically normally distributed in early and late adopters in a social system. The adopter categories are 1) Innovators, 2) Early adopters, 3) Early majority, 4) Late majority, and 5) Laggards.

Diffusion manifests itself in different ways and is highly affected by the type of adopters and innovation-decision process. The criterion for the adopter categorization is innovativeness, defined as the degree to which an individual adopts a new idea. According to Roger’s theory, an innovator must align with early adopters if he want to convince the early majority (one standard deviation to the left of the mean) of the benefits of an innovation.

The late majority (one standard deviation to the right of the mean) represent the 34 percent who are skeptical about the new idea (Eastbrooks et al. 2008).⁶³ The late majority adopt new ideas just after the average member of a social system, and the “Laggards” are the last in a social system to adopt an innovation. The laggards possess almost no opinion leadership. When they finally adopt an innovation, it may already have been superseded by another more recent idea that is already being used by the innovators.

In a systematic review of diffusion of innovation in service organizations, Greenhalgh et al. (2004) distinguishes among diffusion (passive spread) and dissemination, as an active and planned efforts to mainstream an innovation within an organization, and sustainability, making an innovation routine until it reaches obsolescence. See recommendations in Chapter 4.3.1.3. Condition for improvement studies.

3.2.6.2. Radical versus incremental innovation

⁶² Analysis of diffusion of several agriculture innovations in an American rural community.
⁶³ To my experience, the late majority is good at maintenance, and are willing to adopt a change if the results are convincing. It will take time to be accustomed to the change, but by some kind reminders like checklists, pop-ups etc., they will eventually get an ownership to the change. When the innovator and early adopters have lost their interest in the case (because they like change), the late majority will sustain the adopted changes.
The Plan-Do-Study-Act cycle is what Norman and Verganti (2014) describe as incremental innovation. While *incremental* innovation is a kind of hill climbing, guided by (measurable) aims and (less measurable) visions, *radical* innovation is guided by changes in technology, and *changes in meaning*. Norman and Verganti found that every *radical* innovation they investigated was done without design research, and without carefully analysis of a person’s or even a society’s needs.

“Although *the hill-climbing procedure guarantees continual improvement, with eventual termination at the peak of the hill, it has a well-known limit*: “Climbers” have no way of knowing whether even higher hills might be scaled in some other part of the design space. (...) *Incremental innovation tries to reach the highest point on the current hill. Radical innovation seeks the highest hill*” (Norman & Verganti 2014).

See example of how radical innovation and incremental innovation has worked together towards sustainability and success in Chapter 3.1.6. *The Norwegian team-training concept*. (BEST).

See also Chapter 3.3.6.2. *High Reliability Organizations* describing a new wave of hospital innovation.

### 3.2.7. Peer review

A pragmatic approach to support quality and safety in intensive care is peer review. The approach consists of mutual visits by colleagues who conduct standardised peer reviews. These reviews focus on the systematic evaluation of the quality of an ICU’s structure, its processes and outcome. The common goal of all stakeholders is the continuous and sustainable improvement in intensive care with peer reviews significantly increasing and improving communication between professions and disciplines. Peer reviews secure the sustainability of planned change processes and consequently lead the way to an improved culture of quality and safety (Kluge & Bause 2015).

The intensive care unit (ICU) is one area of the hospital in which processes and communication are of primary importance. Errors in intensive care units can lead to serious adverse events with significant consequences for patients. (Gruen et al. 2006, Joint Commission 2007, Stahl et al. 2009, Pronovost & Hudson 2012, Zahrion et al. 2016). Therefore, quality and risk-management are important measures when treating critically ill patients.

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3.3. Compliance, inspection & control approaches

3.3.1. Scientific management

Taylor’s *Scientific Management* method (also called “Taylorism”) is an extreme example of the Compliance, inspection & control approaches. Taylor rigorously separated the planning of the work, done by engineers such as himself, from the execution of the work, done by an unskilled, cheap labor force. In the beginning, scientific management was a momentous achievement, but it came at a high price to the nature of work itself. The worker’s job was to follow the rules as spelled out in manuals and enforced by supervisors. If a worker had an idea about how to build a better axle, he should keep it to himself; after all, the new axle might not fit the standard (Berwick 2003).

3.3.2. New Public Management and Corporate governance

New Public Management (NPM) is the dominant intellectual force in public management since the 1980’s (Nølte 2009). NPM is based on different approaches (e.g. Corporate governance) to running public service organizations used in government and public service institutions and agencies, at sub-national and national levels. Hood’s six basic principles of NPM are:

1. Management, allowing leaders the freedom to manage freely and open up discretion.
2. Performance standards. It is important to maintain explicit standards and measures of performance in a workforce. Using this method promotes clarification of goals/intent, targets, and indicators for progression and success.
3. Output controls, measured by quantitative performance indicators.
4. Decentralization, a system in which managers gain flexibility and are not limited to agency restrictions.
5. Competition in the public sector, which could turn in lower cost, eliminate debate and possibly achieve a higher quality of progress/work through the term contacts.
6. Private-sector management, establishing short-term labor contracts, develop corporate plans or business plans, performance agreements and mission statements. It also focuses on establishing a workplace in which public employees or contractors are aware of the goals and intention that agencies are trying to reach.
7. Cost reduction, focusing on keeping cost low and efficiency high. "Doing more with less".


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3.3.3. Accreditation and Certification

Accreditation and certification relate to the activities it covers. Organizations receive accreditation for specific activities whereas certification relates to the company as a whole.

Certification represents a written assurance by a third party of the conformity of a product, process or service to specified requirements. Accreditation, on the other hand, is the formal recognition by an authoritative body of the competence to work to specified standards (Murthy 2017).

The Joint Commission's predecessor organization grew from the efforts of Ernest Codman to promote hospital reform based on outcomes management in patient care. Codman’s efforts led to the founding of the American College of Surgeons Hospital Standardization Program. In 1951 the Joint Commission on Accreditation of Hospitals was created by merging the Hospital Standardization Program with similar programs run by the American College of Physicians, the American Hospital Association, the American Medical Association, and the Canadian Medical Association. In 1987 the company was renamed the Joint Commission on Accreditation of Healthcare Organizations (JCAHO, pronounced "Jay-co"). In 2007 the Joint Commission on Accreditation of Healthcare Organizations underwent a major rebranding and simplified its name to The Joint Commission. The rebranding included the name, logo, and tag line change to "Helping Health Care Organizations Help Patients."65

Beginning in the mid-1980s, American organizations were paying more attention to quality, and customer satisfaction, and in 1987, the criteria for the first Malcolm Baldrige National Quality Award were published. At the same time, ISO 9001, Quality Systems—Model for quality assurance in design, development, production, installation, and servicing was published. By the end of 2004, 150-plus countries were using the ISO 9000 standards and more than 670,000 quality system certificates had been issued. Many industry specific quality management system documents have evolved from ISO 9000. More than 2 million copies of the Malcolm Baldrige National Quality Award criteria have been distributed, and many state and local quality award programs have developed their own criteria based on the national award criteria. Health-care and education versions of the award criteria have been published in the last few years, further expanding the applicability and value of the criteria.66

The certification of a service is based on a comprehensive evaluation of a process, system, product, event, or skill, typically measured against some existing norm or standard. Industry and/or trade associations will often create certification programs to test and evaluate the skills of those performing services within the interest area of that association. Testing laboratories may also certify

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66 Bauer et al. 2006
that certain products meet pre-established standards, or governmental agencies may certify that a
company is meeting existing regulation.\textsuperscript{67}

The concepts of certification and accreditation differ, but they are rooted in the Compliance,
\textit{inspection \& control} paradigm. Based on research, more of the Learning, interaction \&
empowerment thinking has been gradually included in their approaches in different ways so that
their historical roots are not immediately visible.

3.3.4. Six Sigma \& Root Cause Analysis

3.3.4.1. Six Sigma

Six sigma is a set of management techniques intended to improve business processes by greatly
reducing the probability that an error or defect will occur. The following definition is from ASQ (2018):

“Six Sigma is a method that provides organizations tools to improve the capability of their
business processes. This increase in performance and decrease in process variation lead to
defect reduction and improvement in profits, employee morale, and quality of products or
services. Six Sigma quality is a term generally used to indicate a process is well controlled
(within process limits $\pm 3\sigma$ from the center line in a control chart, and requirements/tolerance
limits $\pm 6\sigma$s from the center line).”

I have categorized Six Sigma in the Compliance, inspection \& control paradigm because of the
commitment to standardization, “belts” and tolerance limits, also called Pre-control-limits (Woodall
2000). Tolerance limits are not statistically derived. They are limits based on what leaders and experts
find acceptable. Control limits (SPC), however, are based on statistical calculations of the actual
process variation, making it possible to differ between variations caused by routine practice, and
variations caused by special causes. By paying almost all the attention on the quality of the simple, and
complicated parts of the care, the importance of the complex part of the care may be underestimated.
Without well-functioning (complex) interrelationships and effective communication, quality and safety
is threatened.\textsuperscript{68}

3.3.4.2. Lean Six Sigma

In 2002, George and Lawrence introduced the combination of Lean and Six Sigma in their book \textit{Lean
Six Sigma: Combining Six Sigma with Lean Speed}.\textsuperscript{69} Lean Six Sigma refers to the eight types of waste it
strives to eliminate as “DOWNTIME,” which is an abbreviation of "defects, overproduction, waiting,

\textsuperscript{67} Wikipedia 21.01.18
\textsuperscript{68} See Chapter 7.3.1.4. The complexity of a successful healthcare service
\textsuperscript{69} See Chapter 3.2.3. Lean methodology
non-utilized talent, transportation, inventory, motion and extra-processing." Simply put, any use of resources that does not create value for the end customer is considered a waste and should be eliminated. Lean Six Sigma training uses "Belt" levels similar to Six Sigma. A systematic review of the literature on lean interventions concluded the approach does not lead to improvements in healthcare (Moraros et al. 2016).

3.3.4.3. Root Cause Analysis (RCA)

Lean Six Sigma emphasises reducing the number of errors in a process and looks at Root Cause Analysis to determine the source of errors. The procedure usually advocated for identifying the underlying reasons for adverse events is root cause analysis (RCA). This process was imported from aviation, and initially applied to healthcare by the US Department of Veterans Affairs. Braithwaite et al. (2006) report that in Northern Ireland and Scotland, it is mandatory for health managers to set up an RCA team to investigate serious events that could recur. Incidents with lower ratings such as near misses are investigated at the manager’s discretion. Usually an RCA team meets on three occasions. First, the team identifies what is known and what is unknown. What is known is documented, and what is unknown is investigated, a flow chart of events is developed, the root causes are determined and recommendations made. The process focuses attention on system problems and avoids personal blame. Braithwaite et al. found that little research has been conducted on the outcomes of RCAs for participants and broader systems. The RCA process is complex, and outcomes from adopting this procedure are not fully understood. Ledema et al. (2006) concluded that:

"conducting an RCA is difficult work ... the talk vacillates between interpersonal and ideational issues on the one hand, and, when addressing interpersonal issues it swings back and forth between affective and critical talk”.

The authors speculate whether the adoption of RCA

"will lock the clinical gaze into a micro-sociology of error [and thereby make it difficult] to influence matters superordinate to the specifics of practice and the design of clinical treatments; that is, the over-arching governance and restructuring of hospital care.”

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70 Investopedia 2018
71 US DeChapterment of Veteran Affairs (VA) National Center for Patient Safety Root Cause Analysis tools RCA Tools REV.02.26.2015
3.3.5. Evidence-based practice and Implementation science

3.3.5.1. Evidence-based practice

The roots of evidence-based practice are in evidence-based medicine and evidence-based nursing. Evidence-based nursing can date back to Florence Nightingale, and her “Notes on Nursing” published in 1859. As she worked to guide the medical practices of her day, her idea remained that “What you want are facts, not opinions”. However, practice-oriented research was first targeted in the 1960s, in line with the development of nursing theories. The education of nurses in terms of research design and conduct began, working alongside other related disciplines that had more expertise to teach such courses.

The history of evidence-based medicine has been well documented and includes primitive experiments to test the effectiveness of practices such as bloodletting (Claridge and Fabian, 2005). In 1972, Archie Cochrane pointed out the importance of properly testing the effectiveness of health care strategies, and stressed the role of randomized controlled studies to provide evidence on which health care is grounded. The term Evidence-based medicine was introduced by Guyatt et al. in 1992 to shift the emphasis in clinical decision making from “intuition, unsystematic clinical experience, and pathophysiologic rationale to scientific, clinically relevant research”.

The formalized concept was embraced by many, but also elicited some criticisms, including that evidence-based medicine relies too heavily on research, and not taking into account the knowledge about the mechanisms by which implementation is more likely to succeed. This is the reason why I have categorized EBM as in the Compliance, Inspection & Control paradigm, as it reflects a belief that a desired change will happen by just telling practitioners what to do.

Consequently, evidence-based medicine was still described by some as a “new approach” almost twenty years later, suggesting that it has taken some time to become integrated into the medical profession worldwide. In a recent BMJ essay about evidence-based medicine Greenhalgh et al. (2014) conclude:

“Such problems have led some to argue for the rejection of evidence-based medicine as a failed model. Instead, we argue for a return to the movement’s founding principles—to individualise evidence and share decisions through meaningful conversations in the context of a humanistic and professional clinician-patient relationship. To deliver this agenda, evidence-based

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73 Mackey & Bassendowski 2017
74 WebNotes on Nursing 2018
medicine’s many stakeholders—patients, clinicians, educators, producers and publishers of evidence, policymakers, research funders, and researchers from a range of academic disciplines—must work together”.

As written above, there is not the same, distinct border between the two paradigms as it was in the last century. Especially within the Compliance, inspection & control approach, has gradually included elements from the Learning, interaction & empowerment paradigm, influencing the renewal of the methods.

3.3.5.2. Implementation science

Implementation science is a fast-growing research field that has emerged in the wake of the evidence-based movement, recognizing that it is not enough to lecture the professionals about evidence-based practice, expecting necessary changes to be implemented as lectured (Brownson et al. 2012, Grol & Wensing 2013, Grol & Wensing 2014, Nilsen 2015).

Another problem is, that Implementation is a political loaded term that in itself is underestimating the work that has to be done to make evidence-based practices become routinely embedded and integrated into the social context of a healthcare service. May & Finch (2009) wrote:

“[…] Following others in this field, we refer to such purposive direction as implementation although we recognize that this is a politically loaded term. This work takes place in what we call interaction chains, socially patterned points in time and space which are connected by the flow of social processes.” […] In the sense that it is used in the management literature, ‘implementation’ is a highly purposive and directed set of activities, but how practices become routinely embedded and integrated into their social contexts – how they become normalized, or not – needs to be understood as a matter of more than external direction (May & Finch 2009).

Batalden & Davidoff (2007) are using the term incorporating generalizable scientific knowledge. They describe the incorporation process in a formula combining five knowledge systems, where the last part is the knowledge required to execute, what you need to know to “make things happen.”

Early implementation research was empirically driven and did not always pay attention to the theoretical underpinnings of implementation. Eccles et al. (2005), remarked that this research seemed like “an expensive version of trial-and-error”. However, Nilsen (2015) argues that the last decades of

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75 See chapter 3.2.5.6. Normalization Process Theory (NPT)
implementation science has seen wider recognition of the need to establish the theoretical bases of implementation and strategies to facilitate implementation, applying theories borrowed from disciplines such as psychology, sociology, and organization theory, as well as theories, models and frameworks that have emerged from within implementation science.

3.3.6. Resilience Concept & High Reliability Organizations

3.3.6.1. Resilience concept

Resilience is a broad, multifaceted, and loosely organized cluster of concepts, each one related to some aspects of the interplay of transformation and persistence.\(^{76}\) The translation of the theory into different approaches has led to pluralism in definitions. Historically, Resilience concept is related to adverse events in healthcare, and should not be confused with the resilience theory and the adaptive cycle, referring to ecological sciences.\(^{77}\)

Professor Erik Hollnagel explain different definitions of the term on his web-site. Here are some:\(^{78}\)

‘Resilience’ (...) was first used to describe a property of timber, and to explain why some types of wood were able to accommodate sudden and severe loads without breaking. Almost four decades later, a report to the Admiralty referred to a measure called the modulus of resilience as a means of assessing the ability of materials to withstand severe conditions Many years later, Holling (1973) referred to the resilience of an ecosystem as the measure of its ability to absorb changes and still exist.

Hollnagel argue the ability to perform in a resilient manner is not about avoiding failures and breakdowns. Pointing out that things that go wrong happen in (more or less) the same way as things that go right, he makes the following definition of resilience engineering:

“The intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations under both expected and unexpected conditions.”

Resilience concept focuses on how and what we can learn from success and error avoidance rather than simply a reactive search for “causes” and simplistic remedies. It has the potential to provide significant advances in patient safety by shifting the focus from an emphasis on a reactive “human error” and error counting, towards a proactive approach, preventing these errors from being repeated.

\(^{76}\) Walker and Salt 2006.

\(^{77}\) See also Chapter 4.1.3.3. Resilience theory, and Chapter 3.3.6.1. Resilience concept

\(^{78}\) http://erikhollnagel.com/ideas/resilience-engineering.html
Aiming to develop conditions that makes it easier for the professionals to do a good job, the errors can be prevented or caught before they reach the patient.

Braithwaite et al. (2015) argue there is a revolution ahead, advocating a potentially powerful new approach which switches the focus from preventing things going wrong to purposefully enabling them to go right. The new approach seeks to reconcile work-as-imagined and work-as-done. It aims to ensure that the tools we use correspond to the problems of today, rather than the problems of “yesteryear”.

“All levels of healthcare need to accept that it is impossible to reduce the number of errors by increasing the bureaucracy imposed on clinicians. Instead of accelerating efforts to constrain performance, or mandating how work should be done, we should pay attention to how clinical care can be supported so that the number of intended and acceptable outcomes becomes as high as possible”. (Braithwaite et al. 2015).

The new approach (Safety-II), turns things on their heads, defining safety as the ability to make things go right and not merely the absence of failures or adverse outcomes (Safety I). Safety-II is intended as a complement to Safety-I rather than as a wholesale replacement. Braithwaite et al. argue that the two perspectives on safety must co-exist, at least for a long time ahead. They find it necessary to analyse (when possible) the relatively few cases where things go wrong, but patient safety requires more than prevention, elimination and compliance. They conclude by emphasizing it is essential to learn from the more frequent cases where things go right and develop ways to support, augment and encourage these (Hollnagel 2013, Braithwaite et al. 2015, Ghaferi 2016, Hollnagel 2015).

3.3.6.2. High Reliability Organizations

The concept of resilience is often compared with broader work on the theory of High Reliability Organizations (HROs). HRO theory describes core principles of organisations that have few accidents despite operating in highly dynamic, technologically rich and hazardous industries (Weick & Sutcliffe 200679). Already in 1993, Weick & Roberts introduced mindfulness into the concept of High reliability organizations, involving ambiguous outcomes in ways that have influenced learning, and encoding stimuli in ways that match context with a repertoire of routines (Weick et al. 1999, Weick & Sutcliffe 2006, Levinthal & Rerup 2006). Researchers argue that the theory and practice of HROs provides

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lessons for the medical domain. Jeffcott et al. (2009) argue that this is readily understood because HROs take a systems approach to error, team work decision-making and problem solving.

Although there is some overlap with the concept of resilience, these two distinct ideas are according to Jeffcott et al.:

“(…) modelling on the practices of HROs will not achieve resilience in healthcare because there are significant differences in the nature and complexity of healthcare work. Healthcare’s variation, diversity, limited resources, specialisation and ad hoc teams mean that HRO characteristics, such as redundancy and extensive training, are simply not achievable. Reliability in HROs is often accomplished by standardisation and simplification. In contrast, resilience values behaviors/resources which contribute to a system’s ability to respond flexibly to new and unexpected demands. Full explanations of each of the five characteristics of HROs can be found in Weick and Sutcliffe 2006” (Jeffcott et al. 2009).

A new wave of hospital innovation has moved High Reliability Organizing away from standardization, reward and punishment systems for compliance, towards a culture of trust and strong relationships, shedding light on how the organization can better organize their efforts to sense, cope with, and respond to the unexpected (Ghaferi et al. 2016).

Research across many industries is indicating that leadership support for responding to and learning from errors and a cultural shift towards teamwork, care coordination and continual improvement is needed to ensure safe outcomes. This new wave of innovation is indicating a paradigm shift from Compliance, inspection & control towards Learning, interaction and empowerment.

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80 Jeffcott et al. 2009 is here referring to:
Shapiro 2003 (see reference list)
Hudson 2003 (see reference list)
85 The philosopher of science Thomas Kuhn, introduced the term paradigm shift as an often-painful transition to a new way of thinking in science. He argued that “normal science” represented a consensus of thought among scientists when certain precepts were taken as truths during a given period.
86 See PART V DISCUSSION, Chapter 7.3.1. What is the present knowledge, Table 8B.
PART III METHODS

Chapter 4. Rationale

4.1. Theoretical underpinnings

4.1.1. Continual improvement

4.1.1.1. Informing change by combining knowledge domains

The grand theory of the learning collaboratives of NMA is “Continual improvement” as it was defined and translated to healthcare by Paul Batalden and colleagues in 1993. The theory has been used in the guidance of the eight hospital-related learning collaboratives and their 189 improvement projects.

The source of the improvement knowledge components in Batalden’s model is the engineer and statistician William Edwards Deming’s “System of profound knowledge” 87. Batalden’s conviction was that healthcare needed a knowledge based and cross-disciplinary interaction in a never-ending cycle of system and performance improvements (Batalden and Stolz 1993). The local emergency care service (Paper 3) should be analysed in the frame of this theory, as described in details below (Figure 1).

Figure 1. The continual improvement definition (Batalden & Stolz in 1993)

Reprinted with permission from Paul B. Batalden

87 Deming 1986
Batalden translated Deming’s theory from the context of industry to the context of healthcare by combining professional knowledge with Deming’s system of profound knowledge in his definition of continual improvement. Appreciating the processes and structures of a system, the improvement process must be managed with a delicate balance between the elements of professional and improvement knowledge, and with quality as a system property.

In this thesis, continual improvement is always referring to this definition. See also Chapter 1.6. Glossary & Abbreviations for more information about this definition and the definition of continuous improvement.

We need improvement knowledge to design and guide the improvement efforts in a complex healthcare context, along with accurate and powerful measurements of what is happening over time and the associated variation in practice and outcomes. We also need to understand the psychology and epistemology of change. Continual improvement, as described by Batalden and Stolz in 1993, is the theoretical framework of this study, and is expected to represent the intellectual underpinnings of the findings, based on an updated knowledge within the four components Knowledge of a system, Knowledge of variation, Knowledge of psychology, and Theory of knowledge (epistemology).

4.1.1.2. Appreciation of a system

The theoretical framework of this thesis belongs to the Learning, interaction and empowerment paradigm. Deming, Batalden and Berwick and other pioneers related their quality management philosophy to systems theory, grounded on the principle that each organization is composed of a system of interrelated processes and people which make up system’s components.

A system can only be understood as an integrated whole, because it is composed not only of the sum of its components but also by the relationship among those components. (Ackoff 1994, Plsek & Greenhalgh 2001, Zimmerman et al. 2008, Holmes et al. 2011). For example, the whole of the emergency care network (from Utøya to discharge from Ringerike hospital) is a network of microsystems embedded in a mesosystem. The mesosystem is an emergency medical and psychosocial service network, and our findings should reflect the theory that the whole of the mesosystem is the sum of its parts AND the sum of the interaction of its parts. See also chapter 4.1.3.1. Systems theory and 4.1.3.2. Complex adaptive systems.

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88 See Chapter 73.1. What is the present knowledge  
89 See Chapter 3.1.3. Shewhart, Deming, Juran & Ishikawa  
90 See Chapter 4.1.3. Complexity theory  
91 See Chapter 3.2.2.2. Clinical Mesosystems
4.1.1.3. Knowledge about variation

Embedding knowledge-based changes into practice is shaped by factors that promote or inhibit the actors (staff) participation. Reflexive monitoring is another component in Normalization process theory\(^2\), indicating that patterns of collective action and their outcomes must continually be evaluated, both formally, and informally. Embedding a change in practice is dependent on work that defines and organizes the everyday understanding of practice. The shift from explicit to tacit appraisal by participants is an important signal of the routine embedding of a practice.

Instead of focusing on outcomes only, continual improvement focuses on the processes and systems that generate the outcomes (Figure 2).

*Figure 2. The clinical value compass*

The Clinical Value Compass presents a balanced approach to measuring and displaying value in health care. It is a measurement system that is designed for identifying and monitoring those key indicators of care that enable one to assess the quality of health care (Nelson et al. 2007).

Rather than trying to manipulate the results directly, it works to improve the system that causes the result, preventing adverse events. A process can provide good results for a long time, even if some part of the process may be at the brink of chaos. One example of what brings a process to the brink of chaos is poor handover communication where important messages are misunderstood and crucial observations are not followed up; sooner or later bad outcomes will occur (Wheeler 1995, Gruen 2006, JCAHO 2007, Stahl 2009, Zakrison 2016, Ghaferi et al. 2016).

\(^2\) See Chapter 3.2.5.6. Normalization process theory
Rather than distorting the system or distorting the data, the continual improvement approach seeks to use the data produced by the system, to understand the system by its variation, as a basis for improving the system. Continual improvement requires a methodology for studying processes and systems and a way of differentiating between the different types of variation presented in processes and systems (Wheeler 2003).

4.1.1.4. Statistical Process control

One of the most valuable statistical techniques is statistical process control (SPC), but it is not always relevant. SPC is for example not relevant when the data are produced simultaneous, such as by training, courses, meetings etc., qualitative data collection methods, e.g. observations and videotaping of teams who are training in non-technical skills (e.g. interprofessional communication) is a good alternative\(^\text{93}\), especially in combination with debriefing.

There is a growing interest in using control charts for monitoring clinical performance (Neuburger et al. 2017). A control chart can take one of several forms, depending on the type of data. Three kinds of data are relevant for SPC: continuous (e.g. length of hospital stay\(^\text{94}\)), count data (e.g. complications), or binary (e.g. mortality yes/no, or “performed according to a checklist for good practice” yes/no). Shewhart control charts were designed for monitoring batches of results (Shewhart 1931). In healthcare a batch might be a series of operations performed over a period of time.

A widely observed phenomena in population health is regional and small area variation in care. All processes, including all aspects of medical care, are assumed to be subject to common-cause variation. A process with only common cause variations is stable and predictable. When a process in stable and predictable, it does not necessary mean the process is good, from a professional perspective. Practitioners may assess the level (center line/average) too high or too low, or they find the variation should be reduced.

Uncertainty about which chart to use has been identified as a barrier to the use of control charts in clinical settings (Thor et al. 2007). Another challenge is to define key variables to monitor process and outcomes. The clinical value compass can be of help (see above).

Control charts are a graphical display that supports statistical thinking by including reference lines that separate data more likely to be signals from those more likely to be noise. Control charts are most often useful to show that what looks «special» is in fact common cause variation. Schmidke et al.

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\(^{93}\) See Chapter 3.2.6.2. Radical versus incremental innovation

\(^{94}\) See Appendix 4
(2017) found that control charts make it easier for hospital decision makers to see special cause (compared to a run chart), but they are limited in their ability to apply the new knowledge.

A process with special cause variations is out of control. Special cause variations like one point or more above/below the 3 sigma control limits is not due to routine practice, they have a special cause that is not due to the process itself (routine performance). Special cause variations like a trend (six descending/ascending points in a row) or a shift of level (> 8 points in a row above or below the centerline) is signaling a change in the process itself (Rogers CA, et al. 2004, Wheeler 2003).

Reducing random variation or changing the performance level for a process that is in control requires changing the process itself. Reducing special-cause variation requires identifying factors that cause the process to go out of control and taking appropriate corrective action.

All this statistical information, in combination with professional assessments makes it easier to understand the variation of the target process and what decisions should be made to make the process move towards a stable and predictable state, on an acceptable quality level, and with the best possible outcomes.

Run charts present time-series comparisons like control charts, but run chart have no statistically calculated control limits. Perla et al. 2010 are describing a run chart this way:

“A run chart is a graphical display of data plotted in some type of order. The horizontal axis is most often a time scale (e.g., days, weeks, months, quarters) but could also include sequential patients, visits or procedures. The vertical axis represents the quality indicator being studied (e.g., infection rate, number of patient falls, readmission rate). Usually, the median is calculated and used as the chart’s centreline. The median is required when using the probability-based rules to interpret a run chart” (Perla et al. 2010).

Analyses of run charts are often guided by four basic rules to determine whether a process is unstable, these rules are discussed among experts. Here are the rules proposed by Langley et al. (2009) and Perla et al. (2010):

- **Shift**—six or more consecutive points either all above or all below the median.
- **Trend**—five or more consecutive points all going up or all going down.
- **Runs**—too few or too many runs or crossings of the median line, with “too many” given according to tabled critical values one must look up.
- **Astronomical point**—a point that is different from the rest of the points.
Carey and Lloyd Nelson et al. 2007 are proposing a shift to be eight or more consecutive points in a row (seven if less than 20 data-points), and a trend to be seven or more consecutive points all going up or all going down.

Perla et al. (2010) argue that using control chart language with run charts can create confusion because the two methods include different rules for identifying non-random patterns. Shewhart’s control charts identify deviations from the centerline (mean, not the median) using control limits. Determining if a process is stable is important to understand if improvements have been sustained and to predict future performance which will impact decision making. To determine if a process or system is in a stable state, a Shewhart (control) chart is needed.

Schmidke (2017) made a study of the ability of hospital decision makers to respond accurately to the presence or absence of a special cause datum on a run chart, versus a control chart. The findings indicates a proportion of decision makers able to identify the recommended course of action from a run chart was 4 percent, and 79 percent from a control chart (p>.001). The test-charts were displaying average waiting times per month in an Emergency department.

Perla et al. (2010) is recommending the use of run-charts because they are so easy to construct and simple to interpret, but have found some limitations:

“Run charts are designed for the early detection of signals of improvement or degradation in a process over time. However, run charts are not capable of determining if a process is stable (as defined by Shewhart in relation to control charts only). Using control chart language with run charts can create confusion because the two methods include different rules for identifying non-random patterns. (Perla et al. 2010).

4.1.1.5. The psychology of change

The psychology of change is related to meaning, commitment, reflexive monitoring, collective action95 (May & Finch 2009), perceived mastery climate, felt trust and knowledge sharing96 (Nerstad et al. 2017). Training is the source of technical skills (Brethauer 2004) and of non-technical skills like leadership, interprofessional interaction and communication97 (Wisborg & Brattebø 2008b).

Typical of the Learning, interaction and empowerment paradigm, the teams of workers (improvement teams) are essential elements of achieving safe and effective healthcare systems (Institute of Medicine

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95 See Chapter 3.2.5.6. Normalization process theory, and 2.1.4. Individual quality versus system quality
96 See Chapter 3.2.6.3. Interpersonal trust and knowledge sharing
97 See Chapter 3.2.6.2. Radical versus incremental innovation, and 2.1.4. Individual quality versus system quality
2000, Joint Commission 2007). Although motivational climate perceptions are an individual-level phenomenon, experiences shared within the same work group may translate into a collective phenomenon. This because work members share stories and information regarding mastery climate experiences to produce a collective perception climate (Nerstad et al. 2017).

Greenhalgh et al. (2004) distinguishes among diffusion (passive spread) and dissemination, as an active and planned efforts to mainstream an innovation within an organization, and sustainability, making an innovation routine until it reaches obsolescence. It may be of help to understand that people are different in their willingness to change⁹⁸, as described in Rogers’ diffusion of innovation theory. The theory focuses on engaging “early adopters” and “product champions” acting entrepreneurially in embedding with the “new”, giving the improvement efforts a good start. Moreover, that the “late majority” must finally be engaged to fully integrate the change in the system (practice), and make it sustainable, and the “early majority” are the first ones to understand how to engage the late majority (Rogers 1983).

4.1.1.6. Theory of knowledge

A NEVER-ENDING LEARNING AND IMPROVEMENT CYCLE; In his Statistical Process Control book from 2003, the statistician Donald Wheeler describes his quality improvement paradigm by referring to his dialogue with Deming in the early eighties, arguing that Deming went beyond the simplistic level of wishes and hopes. Wheeler defined quality to be a never-ending cycle of continual improvement --- a process by which people could start where they are and work to improve, gradually over a period of time, their products, their processes and their organizations.

“This is why continual improvement is different from all other approaches to quality. It provides a method for assessing the present and working to improve the future. (...) It is more than goal setting, it is more than positive reinforcement, it is more than an appeal to an archetype, and it is much more than “everyone is doing their best.” Continual improvement is not a magic formula that you can invoke. It is not a “quick fix” — “Do this and you will get that.” It is instead a way of thinking, a way of acting, and a way of understanding the data generated by your processes that will collectively result in improved quality, increased productivity, and an advantageous competitive position”. (Wheeler 2003)

Different epistemologies (theories of knowledge) meet in knowledge-based, interprofessional healthcare improvement. The terms used by improvement theorists are related to their different

⁹⁸ See Chapter 3.2.6.2. Diffusion of innovation
scientific environments. Coherence is a component of Normalization process theory\textsuperscript{99} developed by sociologists. Coherence means that a practice – an ensemble of beliefs, behaviors, and acts that manipulate or organize objects and others – is made possible by a set of ideas about its meaning, uses, and utility; and by socially defined and organized competencies (May & Finch 2009).

Cognitive participation belongs to what May & Finch (2009) call a “purposive interaction change” that makes up the process of translating knowledge into practice. The change must be understandable and predictable and what the change means to practice must be clear. Relational integration refers to the way that a practice is mediated and understood within the networks of people around it. A material practice\textsuperscript{100} will also affect not only the knowledge required by its users, but also the ways that they understand the actions of people around them. See also Chapters 4.1.3.3. Resilience theory and 4.1.3.3. The adaptive cycle.

4.1.1.7. Model for improvement

4.1.1.7.1. CONTINUAL IMPROVEMENT IS A VISIONARY APPROACH

Figure 3. The Continual Improvement Cycle

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{continual_improvement_cycle.png}
\caption{The Continual Improvement Cycle}
\end{figure}

Figure 3 is an alternative version of the Model for Improvement, Shewhart’s Plan-Do-Study-Act cycle, and Demings three fundamental questions (at the front of the base). We published the figure in Paper

\textsuperscript{99} Se Chapter 3.2.5.6. Normalization process theory

\textsuperscript{100} Material practice is defined by the sociologists May & Finch as “the things that people do to perform certain acts and meet specific goals”.

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1, illustrating that the Plan-Do-Study-Act-approach is meant to be a visionary *upwards cycle.*

Shewhart is the source of the IHI Model for improvement. Shewhart’s thinking was published by Deming (Deming 1986, Deming 1991) and popularized for healthcare by Langley et al. (1992, 2009). Batalden and Berwick and colleagues of IHI included the Plan-Do-Study-Act cycle in the Institute for Healthcare Improvement (IHI) learning collaborative program (Batalden & Stolz 1993, IHI 2003).

The learning and improvement cycle of Shewhart combines his management thinking with statistical analysis. The constant evaluation of management policy and procedures leads to continual improvement. Deming marketed the cycle to the masses – which he called the Shewhart cycle – most people referred to it as the Deming cycle. Deming was a fan of Shewhart and also saw the PDSA as the perfect way to generate knowledge in his 4-part model.

The Shewhart cycle has the following four stages

- **Plan:** identify what can be improved and what changes is needed
- **Do:** test a change
- **Study:** measure and analyse the process and/or outcome
- **Act:** according to the results

The point of the cycle is to test improvements on a small scale before it is implemented, and when you “return” to a stage where you have been before, it should be on a new (hopefully higher) level.

### 4.1.1.7.2. ASKING WHAT AND HOW, NOT SO MUCH WHY

Aiming to close the gap between what we do and what we know, the three fundamental question on the front of the shelf (Figure 3) regarding aims, measurement and change efforts, promotes a visionary approach. By a visionary approach we mean looking forward together with our leaders and peers in the system, spending limited time and efforts looking back to find the causes of the quality gap. We try not to create a scapegoat climate as it is not very helpful, because it may spread a feeling that the improvement team is looking over the shoulders of their peers, instead of engaging them in a positive approach towards improvement.

I added a quote often attributed to Arthur Ashe “*Start where you are, use what you have, do what you can*” to the base of the model, illustrating the importance of empowerment and respect for the professional knowledge of the practitioners engaging in continual improvement efforts.

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101 For some reason the Norwegians have a habit to refer to it as a circle and not a cycle, which seem mostly impossible to weeds out.

102 see Chapter 4.4.1. *The learning collaboratives of the NMA*

103 See also Chapter 3.3.6. *Resilience Concept and High Reliability Organizations*
I added the symbol of eternity at the top of the cycle. The eternity symbol is, by the help of complexity science is linking the PDSA-cycle to the ecological theory of Resilience and the Adaptive cycle\textsuperscript{104}. The adaptive cycle is emphasizing the importance of the creative ability, offering a new way of understanding the world and a new approach to managing resources (see Chapter 4.1.3.3. Resilience theory, and Chapter 7.2.3. When sustainability and resilience work together).\textsuperscript{105}

4.1.7.3. BENEFITS AND CHALLENGES OF THE PDSA CYCLE

In a systematic review of clinical registries and quality measurement in surgery, Stey et al. (2015) found that clinical registries have advanced surgical quality definition, measurement, and modeling as well as having served as platforms for local initiatives for quality improvement. The major limitations are: 1) Bias from context and means of data collection threatening internal validity of registry quality measurement. 2) The cost of participation, which threatens the external validity of registry quality measurement.

The Plan-Do-Study-Act (PDSA) cycle is a commonly used improvement process in health care settings including measurement, although its documented use in pragmatic clinical research has been rare. In a systematic review of the application of the PDSA cycle Taylor et al. (2014) found that less than 20 percent (14/73) fully documented the application of a sequence of iterative cycles. Furthermore, a lack of adherence to the notion of small-scale change is apparent and only 15 percent (7/47) reported the use of quantitative data at monthly or more frequent data intervals to inform progression of cycles.

Reed & Card (2016) are discussing the problem that the oversimplification of the Plan-Do-Study-Act cycle approach, has been translated into healthcare with failure to invest in a rigorous and tailored application of the approach.

\textit{“While the PDSA method is conceptually simple, simple does not mean easy. That said, PDSA is a powerful approach, and projects that make successful use of PDSA can solve specific quality problems and also help shape the culture of healthcare organisations for the better. So, the effort required to apply PDSA successfully has a substantial return on investment. But the resources and supportive context required for success (including funding, methodological expertise, buy-in and sustained effort) are often underestimated”} (Reed & Card 2016).

\textsuperscript{104} Resilience theory should not be confused with the Resilience concept (see Chapter 3.3.6.1.), which is related to engineering resilience.

\textsuperscript{105} The famous Tennis Player Arthur Ashe gets lots of credit for his quote «Start where you are, Use what you have, Do what you can”. It may probably be a play on President Roosevelt’s story of someone he met who said, «Do what you can with what you’ve got, where you are». The Quote Attributed to Squire Bill Widener Found in Chapter IX of Theodore Roosevelt: An Autobiography (1913)
Leis & Shojana (2016) are referring to Taylor et al. (2014) confirming that Quality improvement rarely works out smoothly, and that sometimes PDSA seems more like a quality improvement catch phrase than it does a recognizable scientific process. Referring to Berwick (1996), and Davidoff (2011) they are arguing that Plan-do—study—act cycles are the building blocks of iterative healthcare improvement. Although frequently regarded as separate from research, this quality improvement method remains rooted in the scientific method. The P in PDSA usually stands for ‘plan’ but could just as easily refer to ‘predict’. Each cycle combines prediction with a test of change (in effect, hypothesis testing), analysis and a conclusion regarding the best step forward—usually a prediction of what to do for the next PDSA cycle (Reed & Card 2016).

“Too often, however, improvement teams go through the motions of PDSA cycles without really embracing its spirit or applying its scientific method. For example, an improvement team might talk about having used PDSA when in reality the original change idea remained roughly unchanged throughout the project, with no refinements to the intervention or the plan to implement it. Quality improvement rarely works out so smoothly” (Leis & Shojana 2016).

4.1.2. The Improvement Formula and Patient aim

4.1.2.1. The quality improvement formula

Paul Batalden, the IHI learning collaborative innovator, has together with his colleague Davidoff, defined a quality improvement formula of five knowledge systems is a theory that will be of help in the planning and execution of a concrete improvement programme on how to “close the gap between what we know and what we do” (Figure 4).

The Batalden and Davidoff explain their formula like this:

1. “The generalisable scientific knowledge we need (element #1) is constructed from empirical studies that work to control context as a variable, thus minimising or eliminating its effect on what is being studied.

2. A knowledge of particular contexts (element #2) is developed by enquiry into the identity of local care settings—their processes, habits and traditions.

3. Knowledge on the effect of improvements on system performance (element #3) requires special types of measurement, techniques that include time in the analysis, as all improvement involves change over time; gaining this knowledge also requires the use of
balanced measures that accurately reflect the richness and complexity of the phenomena under scrutiny.

4. The “+” symbol (element #4) represents knowledge about the many modalities, including standardisation, forcing functions, academic detailing, and so on, which are available for applying and adapting generalisable evidence to particular contexts.

5. The “→” symbol (element #5) represents the knowledge required for execution—what you need to know to “make things happen”, the drivers of change, in a particular place

Figure 4. The Quality Improvement Formula$^{106}$

The formula is reflecting a deep understanding of healthcare as a complex adaptive system.$^{107}$

Batalden and Davidoff (2007) argue, “Healthcare will not realize its full potential unless change-making becomes an intrinsic part of everyone’s job, every day in all parts of the system”.

They define Quality improvement to be the combined and unceasing efforts of everyone—healthcare professionals, patients and their families, researchers, payers, planners and educators—to make the changes that will lead to better patient outcomes (health), better system performance (care) and better professional development (learning).

4.1.2.2. The Improvement formula

In 2018, Paul Batalden published a modified version of the improvement formula, emphasising the patients’ role in the coproduction of health, where patients and professionals bring different expertise, knowledge and experience to their shared interactions of a healthcare service:

“Coproduction of health describes the interdependent work of users and professionals who are creating, designing, producing, delivering, assessing, and evaluating the relationships and actions that contribute to the health of individuals and populations. At its core are the

$^{106}$ Formula illustrating the way in which knowledge systems combine to produce improvement

$^{107}$ See Chapter 4.1.3. Complexity theory
interactions of patients and professionals in different roles and degrees of shared work” (Batalden 2018).

The modified improvement formula is:

(Patient aim + Generalizable science informed practice) x Particular context → Measurable improvement.

Batalden defines Patient aim as: Reason to seek help, grounded in the reality of the patient’s life. The circumstances surrounding that aim matter: a “well” patient may have different requirements for a coproduced service then a “sick” one. The “+” symbolize connecting patient and science informed practice in design of intervention. The “x” symbolizes “Contextualising the planned change”, and the arrow symbolizes “Testing the change” by mobilisation of the strategic, operational, and human resources realities that contribute to making changes happen.

4.1.2.3. Patient aim

Including the patient in the coproduction of health is not only an ethical issue, it is a rewarding investment in supporting the patients’ personal control. A multidisciplinary meta-analysis conducted by the Norwegian professor of psychology Odd Havik in 1989, indicates that patients’ emotional reactions to physical illness have an almost linear impact on the clinical and cost saving effects of the care. The findings emphasize the importance of being in a state of as good personal control as possible, to be able to master the challenges of illness and participate in the medical treatment as good as possible. Personal control has three, interrelated dimensions:

1. Cognitive control require predictability, provided by relevant patient information regarding illness, hospital routines, treatment and consequences. Lack of cognitive control can lead to ambiguity and confusion.
2. Instrumental control require influence on one’s own situation, coping and adaption, provided by good patient (and family) education, and personal influence on the decisions made on behalf of the patient. Lack of instrumental control can lead to passivity and human helplessness.
3. Emotional control means affiliation, self-respect, encouragement, empowerment and hope, provided by paying the patient personal respect, uncover and drive out (irrational) fear by realistic information, and provide emotional support. Lack of emotional control can lead to stress and anxiety.

(Havik 1989)
4.1.3. Complexity theory

Wilson T. et al. (2001) summarize their paper about Complexity science and clinical care by the following points:

“Human beings can be viewed as composed of and operating within multiple interacting and self-adjusting systems (including biochemical, cellular, physiological, and social systems). Illness arises from dynamic interaction within and between these systems, not from failure of a single component. Health can only be maintained (or re-established) through a holistic approach that accepts unpredictability and builds on subtle emergent forces within the overall system” (Wilson T. et al.2001).

4.1.3.1. Systems theory

Across all disciplines, at all levels, and throughout the world, health care is becoming more complex. Healthcare has developed from a simple doctor–patient relationship, to be an increasingly complex system, including even more healthcare units, disciplines and services. “Complex” implies diversity, a great number of connections between a varieties of elements (Plsek & Greenhalgh 2001).

Systems theory is an interdisciplinary field of science which studies the nature and processes of complex systems of the physical and social sciences, as well as in information technology. Grounded on systems theory, the whole is defined to be more than the sum of its parts. This “more” means interdependence and interaction between the parts.

For example, it does not help much to give the patient excellent care in one part of the system, if important parts of the care is not followed up by the other parts of the patient’s journey through healthcare. Complexity thinking suggests that current organizational leaders in both policy and operations should begin looking more across the parts and at the system as a whole. Plsek & Wilson describe the differences between machine metaphors versus complexity thinking:

Current management thinking largely assumes that a well-functioning organisation is akin to a well-oiled machine. This leads to the notion that performance is optimized when work is specified in detail and shared out to distinct operational units. Clinicians often object to these

\[108\] Plsek & Wilson 2001, are here referring to:


detailed specifications, while managers bemoan a lack of cooperation” (Plsek & Wilson 2001)

“Management thinking has viewed the organisation as a machine and believed that considering parts in isolation, specifying changes in detail, battling resistance to change, and reducing variation will lead to better performance. In contrast, complexity thinking suggests that relationships between parts are more important than the parts themselves, that minimum specifications yield more creativity than detailed plans. Treating organisations as complex adaptive systems allows a new and more productive management style to emerge in health care” (Plsek & Wilson 2001).

4.1.3.2. Complex adaptive systems

4.1.3.2.1. ADAPTIVE

“Adaptive” suggests the capacity to alter or change, and the ability to learn from experience. A “system” is a set of connected or interdependent things. “Things” are individual agents (i.e., components or elements) with the freedom to act in ways that are not always totally predictable, and whose actions are interconnected, so the one agents’ action change the context of the other agents. A complex, adaptive system has a densely connected web of interacting agents, each operating from their own schema or local knowledge. In human systems, schemata are the mental models individuals use to make sense of their world (Zimmerman et al. 2008). While systems can be broken down into parts which are interesting in and of themselves, the real power lies in the way the parts come together and are interconnected to fulfil some purpose (Plsek & Greenhalgh 2001).

“The science of complex adaptive systems provides important concepts and tools for responding to the challenges of health care in the 21st century. Clinical practice, organisation, information management, research, education, and professional development are interdependent and built around multiple self-adjusting and interacting systems. In complex systems, unpredictability and paradox are ever present, and some things will remain unknowable. New conceptual frameworks that incorporate a dynamic, emergent, creative, and intuitive view of the world must replace traditional “reduce and resolve” approaches to clinical care and service organisation” (Plsek & Greenhalgh 2001).

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4.1.3.2.2. SIMPLE RULES
Creative progress towards a difficult goal can emerge from a few, flexible, simple rules (minimum specifications). This in contrast to the assumption that a plan must be completely specified in great detail and implemented at that same level of detail across the board.

Minimum specifications typically provide: 1) direction pointing, 2) boundaries, 3) resources, and 4) permissions. These minimum specifications provide wide space for innovation and encourage shared actions. Because the specifications are the product of organizational dialogue, they are not perfect, and will evolve over time (Plsek & Wilson 2001).

4.1.3.2.3. ATTRACTION FOR CHANGE
Best practices are often frustratingly slow to spread in healthcare. Leadership inspired by complexity theory recognizes that change occurs naturally within the system, and that individuals engage in this effort for a variety of reasons. For example, the desire to focus on underserved patient groups, can serve as an "attractor" to a change that will benefit the patient (Plsek & Wilson 2001).
According to the research of Nerstad et al. (2017) perceived mastery climate, felt trust and knowledge sharing may serve as such attractors for continual improvement.\textsuperscript{111}

4.1.3.3. Resilience theory
4.1.3.3.1. DEFINITION
Resilience theory is based on ecological sciences. The translation of the theory into other approaches like High reliability organizations and Resilience concept, however has led to pluralism in definitions.\textsuperscript{112}

Resilience theory\textsuperscript{113} has evolved within complexity science, offering a new way of understanding the world and a new approach to managing resources. It embraces human and natural systems as complex entities continually adapting through cycles of change, and seeks to understand the qualities of a system that must be maintained or enhanced in order to achieve sustainability (Gunderson & Holling et al. 2002)\textsuperscript{114}.

\textsuperscript{111} See Chapter 3.2.5.3. Interpersonal trust and knowledge sharing
\textsuperscript{112} See Chapter 3.3.6. Resilience Concept and High Reliability Organizations
\textsuperscript{113} Resilience theory belong to the ecological sciences
\textsuperscript{114} Lance Gunderson and C. S. Holling, in their book Panarchy: Understanding Transformations in Systems of Humans and Nature coopted the term Panarchy, saying: The term was coined as an antithesis to the word hierarchy (literally, sacred rules). Their view is that Panarchy is a framework of nature’s rules, hinted at by the name of the Greek god of nature, Pan.
Resilience is the capacity to experience massive change and yet still maintain the integrity of the original. Resilience is not about balancing change and stability. It is not about reaching an equilibrium state. Rather, it is about how massive change and stability paradoxically work together. (Westley, Zimmerman and Patton 2007).

4.1.3.3.2. A GUARANTY FOR CONTINUED EXISTENCE

The Canadian professor emeritus of ecological sciences C.S. Holling began his work on resilience by looking at ecosystems, particularly forests. Protecting them from fire was not the way to guarantee their continued existence. Rather, forests seemed to use these massive changes as a part of their ongoing evolution.

4.1.3.3.3. THE ADAPTIVE CYCLE

Holling began to visualize this capacity by an adaptive cycle of four stages: release (fire), reorganization (after the fire), exploitation (growth) and conservation (before the fire). The cycle is continuous and simultaneous, and ubiquitous to healthy ecosystems.

Holling argued that the fire is a disaster that is releasing trapped resources and nutrients for new life. Even as the fires are crackling through the branches of pines, birch and spruce, the start of new tree growth is already popping. The heat from the burning trees pops open the cones on those trees, releasing seeds that have been waiting to get loose for years. Growing into little seedlings they are nurtured by the ashes of the fire, and enlightened by the sun without large threes shadowing their growth.

The term Wood Wide Web has come to describe the complex mass of interactions between trees and their microbial counterparts underneath the soil. Each three in a forest has its own mushrooms, building a Wood-Wide-Web under the surface, ready to grow up in the new forest. Referring to Harrison 1999115 and Høgberg et al. 1999116, Sen (2000) argue that over the past decades, there has been increasing interest in the development and functioning of the plant-fungus interface within mycorrhizas.

Finding the same pattern in social and political systems, Holling and his colleagues were beginning to understand one of the key properties of healthy systems: Resilience (see Chapter 7.3.2. Resilience and the invisible web of interaction).

4.1.3.4. TWO TRAPS

In resilience cycle there are two kinds of traps to avoid: (1) the rigidity trap is failure to release the creativity for the next stage in the adaptive cycle (from release to reorganization) (2) the poverty trap, is which happens when none of the new ideas seem to take root or thrive, making renewal impossible to achieve. In the adaptive cycle, some of the richness and variety must let go, in order to move to the exploitation stage, where the system invest in the winning proposal, drawing heavily on the available resources (Holling 2001, Westley, Zimmerman & Patton 2007).

4.1.4. Improvement process guidance (coaching\textsuperscript{117})

In this thesis (and in Paper 2) I am using the term process guidance, which is a translation of a Norwegian term that does not exist in English. My approach to process guidance is most of all influenced by my collaboration with Dr. Lill de Grève, a Norwegian clinical psychologist and researcher, with postgraduate studies in Transactional Analysis, Systems theory, “The-team-as-a-whole”- theory and Group Psychotherapy by Dr. Petruska Clarkson. De Grève was also sharing her knowledge at the coaching courses of the learning collaborative of NMA.

Theoretically, the term process guidance is covering a combination of what Caplan defines as guidance, consultation, and teaching (Lauvås & Handal 1994, Caplan 1970), and what our respondents define as help (with measurements). The Norwegian approach can be viewed as a combination of Schön’s “knowing-in-action” and “reflection in action”, and Eddy’s (1988) analytic approach. Which approach is most relevant, is determined by the situation (Schön 1987, Eddy 1988).

Process guidance is also rooted in Schön’s “Reflective practitioner” (1987) Tuckman’s “Five stages of group development” (1965 and 1984), and Clarkson’s “The-team-as-a-whole” (1988), who integrated the theories of Tuckman, Berne (1975), Watzlawick (1974), and Minuchin (1981). Clarkson emphasises the role of the coach is to work with the team leader to help their success with personal guidance, without intervening with the team in a way that could take the authority from the team leader. When joining an improvement team meeting, the coach sits outside the meeting table, unless the leader invites the coach to sit in for a while, for teaching a certain theory, showing the use of an application, or how to make a control chart etc.

\textsuperscript{117} See also Chapter 4.3.1.3. Conditions for improvement research


4.2. Two learning concepts informing this thesis

4.2.1. The IHI learning collaborative concept

The Institute for Healthcare Improvement (IHI) is an independent organization with the goal of transforming health care in the United States. Inspired by the quote of Margaret Meade: “A small group of thoughtful people could change the world. Indeed, it is the only thing that ever has”, a group of physicians created (IHI) in 1991.

Realizing that with the traditionally methods for spreading knowledge, it would take at least 25 years to achieve some kind of transformation. Tom Nolan, an IHI consultant with a PhD in statistics, argued that IHI had to help hospitals solve the real-world clinical problems they faced every day.

The first IHI Chairman, Professor Paul Batalden argued that IHI’s primary focus should be on the clinical subject matter, not quality improvement methodologies (Kilo 1998, Kennedy 2008). This was a temporary but necessary strategy to engage the physicians (see Discussion section).

Batalden designed the first draft of a learning collaborative model on a tablecloth in 1993, dining with his pediatric colleague Professor Donald Berwick, who became the first CEO of IHI. (Kilo 1998, IHI 2003, Kennedy 2008).

Kilo (1998) emphasize the learning collaborative model was meant for organizational improvement, seeking to have a greater and more immediate impact on health care outcomes that earlier improvement efforts:

“...IHI strongly advocated the work of improvement should be a part of the normal daily activities of participants, and not seen as an extra burden, something done only in special meetings, with a “Project-mentality” where individuals participate as long as the project, in this case the collaborative – is under way and quickly disband when some end points is reached. The IHI strives to create organizations that continue working towards improvement well into the future” (Kilo 1998).

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118 IHI called their Learning collaborative concept “Breakthrough Series”. The Anglo- American literature normally referred to the approach as “Breakthrough collaboratives”, Quality improvement collaboratives, Improvement collaboratives or Quality collaboratives.

119 Kennedy 2008

120 See White paper, Institute for Healthcare Improvement 2003

121 Personal communication with Paul Batalden in 2008, the same year as C. Kennedy published the historical background of IHI, confirming the information.
Berwick (1989) and Batalden (1993) created the knowledge basis for improvement by translating the continual and continuous \textsuperscript{122} improvement theories of Deming and Juran to healthcare, and in cooperation with their IHI colleagues, they developed a learning collaborative approach aimed to spread improvement knowledge as fast as possible. The model was aimed to work at two corresponding levels:

1. The learning collaborative approach (national level)
2. The systematic approach to improvement (organizational level).


**HERE IS A SELECTION OF FUNDAMENTAL PRINCIPLES:**

**Learning collaborative focus**

- Focus on the gap between knowledge and performance
- Focus on undesired variation
- Focus on systems and not on individuals
- Focus on good examples of improved clinical practices to be described and disseminated
- Focus on spreading improvement knowledge (the body of science about testing and performing measures in real time, aiming to understand variation and exploiting it for improvement, and using psychology and methods for interprofessional collaboration and dissemination of desired changes).

**Learning collaborative elements**

- Three Face-to-face learning sessions with action periods in between
- Interest circle calls (phone meetings of improvement teams of multiple sites)
- Clinical level coaching (not always provided\textsuperscript{123})

**Learning collaborative strategy**

- Multidisciplinary collaboration involving multiple sites
- Organizing multiprofessional improvement teams selecting targets for improvement from the expert panel’s list of improvement opportunities related to the topic of the collaborative

\textsuperscript{122} See the definitions of continual and continuous improvement in the Glossary section.

\textsuperscript{123} Clinical level coaching is needed, but limited provided in many learning collaboratives (Øvretveit 2002)
• Facilitate the exchange of improvement ideas and knowledge to learn from each other and from recognized experts in the topic area
• IHI Model for improvement including Plan-Do-Study-Act cycles
• IHI self-evaluation tool

**Time frame**

• Seeking improvements within less than one year
• National congress (about one year) after the end of the collaborative

Since 1994, the learning collaborative concept of IHI has been deployed by health care systems throughout the world (Wilson T, et al. 2003, Mittman 2004, Mills & Weeks 2004, Minkman et al. 2005, Reinertsen et al. 2007, Franco & Marques 2011). In Norway, the learning collaborative approach has increasingly been used to achieve rapid improvements in healthcare, and to spread the continual improvement theory. First, from 1998 by the Norwegian Medical Association, and latest by the clinical pathway efforts of the South-Eastern Norway Region, and the national Norwegian patient safety program[^124]. The learning collaborative method has also been used by many hospital trusts to coordinate and facilitate quality improvement activities and mutual learning (e.g. Ullevål University Hospital) or in large clinics within a Health Trust (e.g. Mental Health Clinic, Vestre Viken Hospital Trust).

The science of change (Moen et al. 1991), is including experiential learning theory (Kolb 1984), small tests of changes by performing measurement in real time (Wheeler 1995, Langley et al. 1996), understanding variation and exploiting it for improvement (Nolan & Provost 1990), psychology of change (May & Finch 2009) and methods for the diffusion of innovation (Rogers E. 1983, Greenhalgh et al. 2004).

The aim of the collaborative is to spread this knowledge and build a culture of continual improvement by guiding the improvement teams to follow a systematic approach to make desired changes happen with a sharp focus on the patient, shared vision, specific aims, and variation before, during and after change.

Other fundamental principles are reducing undesired variation, and reducing interprofessional boundaries with focus on the system (not on the individuals):

> “**Systems and processes of care produce outcomes, not individuals. To optimize the outcomes, the focus must be on the systems. A basic tenet of improvement is that all systems must be**

perfectly designed to achieve the results they achieve. In order to change the results, the systems must be redesigned” (Kilo 1998, p. 3).

Our findings indicates that improvement team members have learned improvement knowledge by participating in the learning collaboratives of NMA (Brandrud et al. 2011). However, the Norwegian outcomes may not be representative abroad, because NMA has always included a team of improvement knowledge and measurement coaches to help and guide the improvement teams much more closely than described by IHI (2003), Kilo (1998), and Wilson T. (2003).

A potential barrier to make successful improvements within other topics after participating a NMA learning collaborative, is that they were served by an expert panel in creating ideas for improvement. The first job of the collaborative chair is to create a planning group (expert panel) with first-hand-experience and knowledge about the topic. The subject matter experts define specific steps required for improvement in the topic area, including measurement proposals, before the participants meet face-to-face at the first learning session. The importance of doing this without overwhelming the participants with more information than actually needed is explained by Kilo (1998):

“The challenge is to distill and codify the few pieces that will safely propel organizations towards their goals. Early on learning session binders were filled with handouts, journal reprints, bibliographies, lists of potential changes, and more—nearly a hundred pages of material. This approach effectively served to overwhelm the participants and distract their focus. (...) IHI maintains focus by limiting learning session handouts to approximately 10 to 20 pages that contain critical information”.

The planning group guides the formation of new knowledge—knowledge of how to put the ideas and findings in the literature into action. Although there may be hundreds of ideas worth testing, a shorter list of changes which carry the best chance of achieving improvement are presented at the first learning session (Kilo 1998). This means the participants are not trained in this initial part of an improvement process. Consequently, access to improvement knowledge coaching as a part of an infrastructure of improvement in every healthcare organization has been recommended (Brandrud et al. 2011, Godfrey et al. 2014).

The efforts of the planning group are supported by a visionary (positive) approach to improvement. The improvement teams are guided to spend as little time on causes and who is to be blamed for the existing gap between knowledge and practice as possible. The model for improvement with the Plan-
Do-Study-act cycle is guiding the improvement teams to look forward, ask what they want to achieve, what to measure (to know they are on the right track), and how to get there.\textsuperscript{125}

The involvement of local leadership in every stage of the improvement efforts may not have been sufficiently addressed in the learning collaborative concept of IHI.

A systematic review of learning collaboratives from 2017 found that the IHI model or a variant of this approach has been adopted widely as an approach to shared learning and improvement in healthcare. The collaboratives reviewed were largely effective in improving some of the processes and outcomes they addressed, with significant improvement in at least one primary effect measure in 83 percent of the 64 studies reviewed. However the review concludes there are not enough formative evaluations during the collaborative and the outcomes are not clear (Wells et al. 2017).

4.2.2. The Norwegian team-training concept (BEST)

4.2.2.1. The BEST foundation

The successful local medical response 22 July 2011 was rooted in the Norwegian Better & Systematic Team Training (BEST) concept. BEST is a national non-profit foundation and an interprofessional trauma care concept with simulated trauma patients, organized locally at each hospital, with the contribution of a complete trauma team. The aim of the foundation is that every acute care hospital in Norway should be able to undertake the initial treatment of trauma patients, despite well-developed air ambulance and trauma centers at university hospitals.\textsuperscript{126} The concept has been described in details elsewhere by its innovators (Wisborg & Brattebø 2006, Wisborg 2008A). This chapter is based on one interview and several follow up-conversations with the same innovator that was introducing and supervising the initial integration of the BEST concept at Ringerike hospital in 2003.

4.2.2.2. Traditional improvement

In the early nineties, two air ambulance (HEMS) anesthesiologists\textsuperscript{127} shared their concern about the huge performance variations in trauma treatment within and between the hospitals. Their concern was leading to many years of common efforts in closing the knowledge gap. First, they were spreading the approach to trauma patients according to the American Advanced trauma life support (ATLS)

\textsuperscript{125} See Chapter 4.1. Continual Improvement, 4.1.1.6. Theory of knowledge and 4.1.1.7. Model for improvement

\textsuperscript{126} See the BEST foundation website http://bestnet.freka.net/node/56 Accessed March 2018.

\textsuperscript{127} Gutterm Brattebø and Torben Wisborg
training program among Norwegian trauma team members. Later, an equivalent Trauma Nursing Core Course (TNCC) and the Norwegian trauma nursing course (KITS) was established (Figure 5).

The increasing professional knowledge and identity provided by ATLS, TNCC and KITS belong to what Bataelden & Stolz (1993) define as traditional improvement of healthcare. Typically, it was highly difficult to achieve a common mindset among their peers on how to practice their updated knowledge when the professionals came back from their external course sessions.

Figure 5. The innovation of the Better & Systematic Trauma care (BEST) concept

Better & Systematic Trauma Care (BEST)
Purpose: Every acute care hospital should be able to undertake the initial treatment of trauma patients, despite well-developed air ambulance and trauma centers at university hospitals.

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<td>TNCC (Trauma Nurse Care Course), etc.</td>
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<td>2006 BEST Training &amp; initial trauma treatment at 45/50 Norwegian ED hospitals</td>
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<td>BEST Multi-professional facilitator Courses. &amp; Courses in Hemostatic emergency surgery. The entire team is participating in the course.</td>
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Meaning driven innovation

(Brandrud & Brattebø 2019)

It was also a problem that the ability to practice their updated knowledge was inhibited by the fact that very few Norwegian hospitals get enough trauma cases to enable the professionals to perform optimally just by doing the regular work. This led to the idea that regularly team training could make up for this gap between expected and actual experience. The idea lead to one of the most successful

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*ATLS is developed and followed up by the American College of Surgeons, and the program has been adopted worldwide in over 60 countries. ATLS is now widely accepted as the standard of care for initial assessment and treatment in trauma centers. Available from: [https://www.facs.org/quality-programs/trauma/atls](https://www.facs.org/quality-programs/trauma/atls)  (April 2018)*
professional, and social innovation processes of Norwegian healthcare. The theory of Norman & Verganti (2014) can be used to enlighten the innovation process of the BEST concept, and vice versa.

### 4.2.2.4. Radical Innovation

1. A totally different way of professional thinking and practice (a radical innovation) was initiated in the early nineties (Figure 5) when some physicians got the idea that all healthcare disciplines and roles contributing in the trauma care process should learn to **Work together as a team**
2. **Learn together as a team**
3. **Train together as a team (in the hospitals own Emergency Department)**
4. **Monitor their own performance as a team (video recording and observation)**
5. **Reflect on their own practice as a team (aiming to learn, not to blame)**
6. **Improve the system and their own performance as a team**

Observing the teams’ performance, the innovators were increasingly convinced that the quality of the trauma care also depend on a good interaction among the healthcare professionals within acute teams. In 1996, an air ambulance accident indicating that adverse human factors and poor communication could lead to a disaster, they made another radical innovation. A **Crew Resource Management training** (CRM) program was integrated in the BEST training concept, developing common rules for leadership and communication, related to the roles of every team member in the training sessions and the real events.

Crew resource management is a team-training program that refers to how members of a team interact and are aware of factors that influence performance like cooperation, leadership, workload management, situational awareness and decision-making. The program stems from aviation. Communication failures may be more likely to occur in healthcare than in aviation cockpit settings for a variety of reasons, including the wide range of staff and distractions /interruptions that are prevalent in the many clinical interactions (Helmreich 1996, Kapur et al. 2015).

The next radical innovation was to use anaesthetized animals for training surgical damage control procedures. Because this could not be done in the local hospitals due to regulations, the complete trauma team was expected to participate in the external session together with the trauma surgeons (Brattebø et al. 2002). The aim was to show and train the surgical teams how to stop life-threatening bleeding before a trauma patient was be transferred to a trauma centre.
4.2.2.5. Incremental Innovation

An incremental innovation process (Plan-Do-Study-Act) was initiated in the years from 1997 to 2003 to spread the team training program to the first 28 Norwegian hospitals, and the participants valuated the intervention positively (Wisborg & Brattebø 2006). In 2006, 45 of 50 acute care hospitals had participants in the course (Wisborg & Brattebø 2008b). In 2003 one of the innovators supervised the professionals at Ringerike hospital when applying and adapting the BEST program here. The trauma system at Ringerike hospital was developed in accordance with the principles of the BEST foundation, the national trauma system, and the trauma manual of Oslo University hospital, and followed up by a continuous improvement process of monthly training sessions.

4.3. Other studies informing this thesis

The nine Chapters of this thesis is citing more than 300 papers and books. What appeared to be the most useful sources of this literature, is what Greenhalgh and Peacock (2005) describe as

(1) “Snowballing” (emerging as the study unfolded), scanning the reference lists of full text papers, using judgment to decide whether to pursue these further.

(2) “Personal knowledge” (what I know and who I know), my existing knowledge, personal contacts and academic networks.

(3) “Serendipitous discovery” (such as finding a relevant paper when looking for something else). The latter has been extremely inspiring, keeping up my spirit in this comprehensive study.

Formal search strategy as electronic search by index terms, free text, and named author has been made, but was not the most rewarding approach. It has been a problem that the index terms are not covering the wide variety and range of terminology and language within quality and safety improvement, innovation and change, knowledge translation and implementation science etc.

In addition to the studies referred to in Chapter 4.1. Theoretical underpinnings, this chapter includes studies that have been informing the early stages of the project. For studies informing later stages of the Multi-method study, see PART IV. DISCUSSION.

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129 See Paper 3, Box 1, page 808, and the Supplement of Paper 3, Chapter I
4.3.1. Inspiring literature

4.3.1.1. Research on positive deviance methods

The positive deviance approach originated within international public health. It is a bottom-up approach which identifies and learns from those who demonstrate exceptional performance on an outcome of interest. The approach assumes that problems can be overcome using solutions that already exist within communities. (Marsh 2004, Bradley 2009, Gabbay 2013, Lawton 2014, Baxter et al. 2016).

A systematic review of positive deviance methods, identified many different methods, some of which appear to lack validity and/or reliability such as selecting annual award winners. The authors suggest the positive deviance approach would be better served with another title (Baxter et al. 2016). See also Chapter 5.1.1. Learning from high performers.

Kilo et al.’s (1998) description of the learning collaborative (Breakthrough series) model of IHI makes it easy to understand why the positive deviance approach is relevant when studying the conditions for change in the wake of an IHI learning collaborative. Under the headline “Fundamental Principles” he is arguing:

“Examples of improved practices exist but are poorly described and disseminated to other organizations. Although no health care organization is demonstrably superior to outcomes across the spectrum of health care concerns, most organizations contain some examples of excellent performance that, if described, could be replicated elsewhere for the improvement of patient care. The challenge is to identify, describe, and learn from these examples and to use the learning to construct systems of improved performance” (Kilo 1998, p.3).

4.3.1.2. Research on contextual factors

Systematic reviews and single studies of quality improvement efforts indicate that a systematic and knowledge-based approach is not enough to succeed without the presence of certain conditions for improvement, also described as contextual factors (Spencer & Walshe 2009, Kaplan et al. 2010, Øvretveit 2011, Kringos et al. 2015).

The mixed effect and success rates of QI strategies are in part due to the different contexts in which the interventions are planned and implemented (Kaplan 2010, Dixon Woods 2011, Øvretveit 2011).

Arguing that the contextual factors affecting the implementation and implementation and effectiveness of quality improvement (QI) strategies are not well understood, Kringos et al. (2015) made a systematic review of 56 systematic reviews of studies of contextual factors related to the
effectiveness of quality improvement interventions. They found that the availability and functionality of information technology and facilitated data collection improved the effectiveness of the quality improvement intervention.

The most reported contextual factors were:

- Improvement team
- QI support and capacity
- Organization
- Microsystems
- External environment

In 2002, Øvretveit et al. found that failure or success for a quality collaborative improvement team mostly depends on five general factors. (1) their ability to work as a team; (2) their ability to learn and apply quality methods; (3) the strategic importance of their work to their home organisation; (4) the culture of their home organisation; and (5) the type and degree of support from management.

4.3.1.3. Conditions for improvement research

Greenhalgh et al. in 2004\(^{130}\) in their systematic review of the diffusion of innovation in service organizations inspired the planning of my PhD-project. They made the following recommendations for further research:

- *Research on the combination of factors that tend to produce adoptable changes in healthcare organization,*
- *Studies on the sustainability of complex service innovation.*
- *The research should be theory driven, process oriented, multidisciplinary and multi method, using “on the ground” service practitioners as partner in the research process*

Little is known about which conditions for improvement are most important, whether these are different for different quality interventions or whether some become less or more important at different times in carrying out an improvement. More research indicates which aspects are “conditions for improvement”, which influence improvement success (Øvretveit 2011).

Øvretveit argues that the definition of a boundary between the improvement “intervention” and the “context” is relatively arbitrary. To be useful to others, Øvretveit suggest that research on an

\(^{130}\) See Chapter 2.2. *The research questions of the thesis*
intervention implemented and any evidence of the conditions which influenced the intervention need to be described precisely (Øvretveit 2011).

The aim of this dissertation study is to understand which conditions influence improvement and how they do so. The importance of studying a sample of 189 (132) improvement projects that have been guided according to the same theories and approaches, makes it easier to identify conditions for improvement that may be useful to others. Even if the material is only covering the intervention stages of continual improvement processes.

Nilsen (2015) argues that more research is needed indicating which aspects are ‘conditions for improvement’ which influence improvement success. Little is known about which conditions are most important, whether these are different for different quality interventions or whether some become less or more important at different times in carrying out an improvement. Knowing more about these conditions could help speed up, spread improvements, and develop the science (Nilsen 2015).

Kringos et al. (2015) found in a systematic review of systematic reviews of the influence of context on the effectiveness of quality improvement strategies in hospitals that context factors were poorly reported. When they were reported, they seemed to explain differences in quality improvement Results. Publication bias may have contributed to the differences.

Knowing more about these conditions could help speed up and spread improvements and develop the science. Consistent with earlier studies (Batalden & S 1993, Institute of Medicine 2001, Berwick 2003), we found that the improvement knowledge and skills of individuals are important elements of a culture of continual improvement, but this is not enough to achieve sustainable changes. As much as 90 percent of the focus group statements reflected the need for a system of continual quality improvement to be able to solve the problems that organizations experience in trying to make lasting improvements. (Brandrud et al. 2011). See also Chapter 4.3.1.2. Research on contextual factors.

4.3.1.4. Improvement guidance (coaching) research

The role of qualified improvement guidance has received surprisingly little attention in the quality improvement literature (Øvretveit et al. 2002, Spencer & Walshe 2009, Kaplan et al. 2010, Glasgow et al. 2012). For example, in their lessons from research on quality collaboratives in general, Øvretveit et al. (2002) did not report the use of coaching to possible solutions to the following challenges:
“Research shows that collaboratives need to develop the understanding of change theories and issues of individuals, as well as specific change skills. These include skills for breaking down problems, for undertaking project management, and for analysing and managing the politics of change. Some collaboratives do not give sufficient time to this, or developed knowledge but not skills. At the team level, collaboratives need to develop a team’s belief in their ability to make change as well as their skills in planning and implementation. However, research also shows that the change making capabilities of individuals and teams are insufficient to achieve change; management and a supportive culture amplifies these capabilities. Teams need help to understand how best to achieve change within their own organisational culture” (Øvretveit et al. 2002).

An analysis of 35 systematic reviews explored the influence of context on the effectiveness of different quality improvement strategies. Improvement guidance was not found among a broad range of associated contextual factors that contribute to successful improvement. The analysis organized the findings based on the Model for Understanding Success in Quality (MUSIQ) model (Kaplan et al. 2012, Kringos et al. 2015). The MUSIQ model itself was based on a systematic review that included continual improvement interventions, but did not cover the role of improvement knowledge guidance. An instrument developed by Schouten et al. (2010) to measure factors influencing success in quality improvement collaboratives is not including improvement guidance (coaching). A cluster-randomized trial aimed to compare clinic-level coaching with other learning collaborative components, found coaching to be equally effective with interest circle calls (group telephone conferences) in achieving clinical outcome improvements, but coaching was more cost-effective (Gustafson et al. 2013). Godfrey also found positive effects of clinic-level coaching (Godfrey et al. 2013, Godfrey et al. 2014).

In a literature review, Godfrey & Andersson-Gare et al. (2014) found several randomized controlled trials studies (RCT’s), non-RCT’s, pre-and-post-studies, and case studies in Europe and North America have tried to understand the role of facilitators and “helpers” and their influence on health care improvement. (Harvey et al. 2002, Thor et al. 2004, Hogg et al. 2005, Jaen et al. 2010). Their role was ranging from completion of specific tasks such as setting up rooms and recording meeting minutes to guiding improvement activities, but frequently the facilitator’s role that supports practitioners to make improvements is not clearly described. Godfrey refers to Hackman and Wageman when arguing that:

“Team coaching may represent an opportunity to address resources to support interprofessional health care team work productively in their own context between structured improvement learning sessions. Team coaching includes direct interaction with the team with the intention of helping members make coordinated and task-appropriate use of their collective resources to accomplish the team’s work” (Godfrey & Andersson-Gare et al. 2014). There are interesting differences between these descriptions of the role of the coach and the “coaching model” of the learning collaboratives of the Norwegian Medical Association132 that will be discussed in the Discussion section of this thesis, especially regarding leadership.

The study of Godfrey et al. (2014) brings different perspectives on coaching, looking through the eyes of the coachee, the coach and the leader. All three perspectives in both collaboratives reported generally positive perception of team coaching. Four categories—context, relationship, helping, and technical support and 15 subcategories of coaching actions emerged, but the value of helping (mostly encouragement) was most frequently mentioned.

Godfrey’s study of the coaching of interprofessional health care improvement teams compares coaching in two different learning collaborative contexts, one with novice improvement teams, and one with experienced improvement teams. Their findings indicate that learning collaborative coaching must be tailored to the different contexts where the changes are meant to happen, and to the personal needs of the coachees, which are substantially different among novice coachees compared to experienced coachees. Especially valuable is their study of the leaderships’ need for coaching in a learning collaborative, an issue that will be discussed in this thesis, in relation to the findings of our Project study (Paper 2).

4.3.1.5. Research on sustainability

The sustainability of quality improvement is a relatively new research subject. Lennox et al. conducted the first review to consolidate available approaches for sustainability across diverse healthcare settings in 2018. They suggest sustainability of improvements has been recognized as a challenge for some time, and while there is diversity in the literature on how it is defined and how it can be influenced, there is one clear and compelling message:

Sustainability of initiatives requires thoughtful planning and attention. If we do not address it appropriately, we continue to risk wasting valuable resources and losing significant progress and patient outcome improvements. Choosing a sustainability approach to support this process can pose a challenge to those looking to influence sustainability because of the diverse

132 See Chapter 4.1.4. Improvement process guidance (coaching)
approaches reported in the literature. Understanding the purpose, perspectives and constructs within each will aid potential users to make the most of approach choice and application” (Lennox et al. 2018).

Determinant frameworks have been assessed as valuable by quality improvement researchers, suggesting that such frameworks can point to multiple levels of influence and acknowledge that there are relationships within and across the levels at different types of determinants.¹³³ (Holmes et al. 2011, Nilsen 2015). A systematic, knowledge-based approach to improvement is a good start. However, Batalden & Stolz (1993) emphasized that transforming a healthcare organization so that it is capable of continual improvement requires determinants including

1. Development of new knowledge
2. Creation of leadership policy that fosters a shared sense of purpose and promotes organizational learning¹³⁴
3. Mastery of tools and methods that accelerate improvement of work
4. Application of systematic strategies for building and using knowledge to the process of daily work

Evaluation: The continual improvement history of Ringerike hospital, and the Pilot hospital selection by the Norwegian Ministry of Health and Care (Thoresen 2011) indicates that these four conditions for sustainability are met, regarding the successful trauma system at Ringerike hospital that was integrated in 2003. Lennox et al. (2018) identified five distinct definitions for sustainability. I have assessed the hospital part of the local EMS (Ringerike hospital) based on the five definitions:

1. Continued programme activities
   a. The ability of activities to continue appropriate to the local context after withdrawal of external funding.
   b. Evaluation: There was no external funding of the integration of the BEST program in 2003. However, the successful efforts of the hospital 22 July 2011 in collaboration with primary care is an indication that this criterion is met after withdrawal of the Ministry of Health’s funding of the Pilot hospital activities the previous year (Thoresen 2011).

2. Continued health benefits
   a. Sustainability is the ability to sustain population health outcomes.
   b. Evaluation: All 35 trauma victims brought to the hospital survived, even though the capacity was exceeded very quickly.

3. Capacity built

¹³³ See Glossary and abbreviations
¹³⁴ See Chapter 3.2.5. Organizational learning
4.4.1.6. Demystifying theory

Davidoff et al.’s 2015 publication “Demystifying theory and its use in improvement”, inspired this thesis by clarifying the role and value of theory in improvement work in healthcare. In this thesis, theory, particularly the scientific knowledge reflected by the theory, is often referred to as “the intellectual underpinning”. Davidoff et al. explain how theory can help practitioners, managers and others to do their improvement work better and how theory can be of help when designing and implementing interventions with the greatest possible impact in their particular context, which is often small and local. Referring to the research of Kahneman (2011) they suggest more effective use of formal theory in improvement is increasingly important, as personal intuition based on experience alone is often biased, distorted and limited in scope.

Davidoff et al. (2015) suggest that the application of formal theory enables the maximum exploitation and learning from one project, one context, or one challenge to the next. By studying the conditions for change among 132 improvement teams and one emergency care network that were all guided to follow the same continual improvement theory (provided by the learning collaboratives of NMA) we may find both generalizable and local useful conditions for continual improvement.

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[135] See also Chapter 2.1.5. Making sense of theory and its use in improvement
Plsek and Greenhalgh have suggested the use of complexity science for better understanding organizations\textsuperscript{136}. As described in the complexity theory chapter (4.1.3) the systems approach views outcomes as the result of interconnected processes and parts that combine to address some common purpose.

4.3.2. Literature related to terrorist events

4.3.2.1. Other studies of the terror attack on Utøya

After the terrorist event, the Norwegian Ministry of Health provided a national coordinating service under the auspices of the Norwegian National Research Ethics Committee (NEM) to protect those affected by the 22 July event in subsequent research. According to a list on the NEM website, about 60 research articles have been published from 2011-2014 regarding different aspects of the causes and effects of the 22-july terrorism. Most researchers have focused on the psychosocial follow up of the bereaved and survived and their families, posttraumatic stress and other kinds of negative consequences to the victims, the society in general, and different other long-time consequences of the terrorist attack.

As far as I have found, Paper 3 is the only study based on a positive evaluation of the local medical and psychosocial response after the shooting spree at Utøya youth camp, and the only condition for improvement study related to this event. The psychosocial care 22-23 July has been recognized by experts as good, (Dyregrov 2012) but I have found no early or longitudinal study with findings related to the PTSD preventing efforts those days. I have found five studies of the terrorist event at Utøya that provide relevant information to our study, and have referred to all of them in Paper 3. Later, I have found one study of the psychosocial care of the hospitalized patients (Bugge et al. 2018).

We have referred to the efforts of the Chief Medical Officer of the Municipality of Hole (Gaarder 2011), the paper by three surgeons participating in the local mass casualty response to the Utøya terror attack (Waage et al. 2013). A study from the Center for Crisis Psychology provides a precise description of the psychosocial trauma of the bereaved parents, siblings, survivors of the Utøya shooting spree (Dyregrov K. et al. 2015), and finally, there is a paper about the preparedness and role clarity among rescue workers during the 22-july- twin terror attack (Pedersen 2016).

\textsuperscript{136} See Chapter 4.1. Theoretical underpinnings, 4.1.3. Complexity theory, 4.1.1.2. Appreciation of a system and Chapter 7.2.5. Theoretical underpinnings with implications
In addition, I find Dyregrov A. et al. (2012) to be relevant as they provide a reliable description of the psychologic trauma of the bereaved, survivors and families, and the psychosocial support provided by the professionals at the improvised support centre at Sundvolden hotel.

Three descriptive studies of the pre-hospital medical service and situation 22 july 2011 are published. One is related to the Oslo bombing (Rimstad & Sollid 2015), one is related to the Utøya shooting (Larsen & Hole 2013), and one is related to both sites (Sollid & Rimstad et al. 2012)

A study of the emergency preparedness and role clarity among rescue workers during the terror attack in Norway, was published in 2016 by Pedersen et al. The study indicates that the rescue personnel were trained and experienced, and the majority knew their professional role. The police officers reported significantly more lack of control. Being female, having more years of work experience, previous training and the experience of an event with fatalities were all associated with role clarity.

4.3.2.2. Emergency preparedness and response literature

First, we have to make clear the difference between emergency preparedness and emergency response: Emergency preparedness refers to actions performed before an emergency. This includes holding planning and coordination meetings, writing procedures, training staff and volunteers, scheduling emergency drills and exercises, and ensuring that emergency equipment is available, in good repair, and ready to use. Emergency preparedness can help ensure a good outcome.

Emergency response refers to actions taken in response to an unexpected and potentially dangerous event. Emergency response can help to minimize negative effects of emergencies and disasters.

Second, as already described in Chapter 2.3. Delineation of the thesis, and Appendix 5 Delineation of the primary studies, professional subject matter research on trauma care and treatment of trauma patients is not included in this study. However, I have included a review of the emergency preparedness and response literature to be able to understand the structure and the complexity of the system behind the successful service. This resulted in six principles for emergency preparedness as described in Paper 3 pages 6-7, Generalization in the light of the literature.

In a review of 6,521 articles, Oldenburger et al. (2017) made an inductive thematic analysis of 33 yielded selected articles identified characteristics of medical teams in disaster (operating at the scene, with focus on low-resource settings). The findings were 1) adaptability, flexibility and improvisation; 2) creativity and innovation; 3) experience and training; 4) leadership and command structure. An interdependence between the four characteristics were identified.
In addition, I found the following professional subject literature to be relevant: Psychological first aid: Field Operation Guide\textsuperscript{137} (Brymer et al. 2006), Recommendations from American College of Surgeons Committee on Trauma regarding resources for optimal care of the injured patient (2006) and Assessments of the burden of injury in six European countries (Polinder et al. 2007).

As commented in Paper 3, emergency preparedness in American rural hospitals has been limited (Manley 2006). Since then, Obaid et al. (2017) have tested disaster exercises and decision making by rural response partners to improve regional planning, collaboration, and readiness in America. They found functional exercises to be the key tool for testing command-level decision making and response at a higher level than typically achieved in tabletop or short, full-scale exercises. Functional exercises enable evaluation of command staff, identification of areas for improvement, and advancing regional collaboration among diverse response partners.

In a literature review of disaster preparedness among health professionals and support staff, Gowing et al. (2017) found that all types of disaster preparedness activities lead to improvements in knowledge, skills, or attitude preparedness for disasters. However, there needs to be a greater focus on the whole health care team, including allied health professionals and support staff, for both internal and external disasters. The authors call for evaluation during real disasters and the use of validated competencies and tools to deliver and evaluate disaster preparedness will enhance knowledge of best practice preparedness.

In the wake of disasters such as Hurricane Katrina, researchers have recommended systematic training and education of healthcare personnel. (Rodriguez & Aguirre 2006, US Dept. Homeland Security 2008, Obaid et al. 2017). Training interprofessional trauma teams in Norwegian hospitals using simple and low cost local simulations has been conducted since the nineties\textsuperscript{138} (Wisborg et al. 2006). The effect of nationwide training of interprofessional trauma teams in Norwegian hospitals has been evaluated as positive (Wisborg et al. 2008a, 2008b). A survey of the implementation of trauma system in Norway found that six years after it was decided to implement a national trauma system, acute care hospitals in Norway generally fulfil the list of criteria in that system. Some aspects, however, were less well covered, such as use of trauma registries, trauma audits and training of personnel. Shortcomings in requirements for lower-level trauma care hospitals correlate to hospital size and frequency with which the trauma team is activated. In order to fulfill the minimum requirements, smaller hospitals should receive more attention (Dehli et al. 2015).

\textsuperscript{137} See Method Chapter, Chapter 4.4.3. Psychosocial support

\textsuperscript{138} See Chapter 4.2.2. The Norwegian team-training concept (BEST)
As described in Paper 3139, in Norway, multi-professional trauma team training courses in primary care were initiated in 2008, and followed up by general practitioners and health authorities (Utsi 2008, Hjortdahl et al. 2014, 2016). Systematic reviews point out that evidence of good response preparedness based on training is weak because of methodological challenges of the research (Williams et al. 2008, Gowing et al. 2017).

4.3.3.3. Studies of other terrorist events

- In Europe, there have been 56 terrorist events since the beginning of the last century, 17 of which occurred between 16 Feb 2001 (FR Yugoslavia) to August 2017 (Barcelona).140
- In the US ,there were 88 terrorist events during the last century, and 71 events this century, from 11 September 2001 (New York), to 31 October 2017 (New York).141

Aylwin et al. 2006, have published lessons from a reduction in critical mortality in urban mass casualty incidents: analysis of triage, surge, and resource use after the London bombings on July 7, 2005.

Learnings from the Boston marathon bombing in 2013 and the Nice truck attack in 2016 indicates that emergency preparedness, training, a robust command structure and communication is crucial (Walls 2013, Goralnick et al. 2015, Orban et al. 2017). In the extraordinary circumstances after the marathon bombing, successful care came from colleagues working alongside familiar teammates, performing familiar tasks. When challenged, each team performed as if the situation were routine. “In Boston, we fight like we train, and train like we fight” (Orban et al. 2017).

Lessons from the Paris terrorist attack in 2016 are that anticipation, teaching and (daily) trauma training were crucial for a good emergency response. In cases of resource weakness, damage control surgery142 offered an additional benefit by quickly redistributing resources to other patients. This meant stabilized patients had to wait when a great wave of admissions was anticipated (Traumabase group 2016).

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139 Paper 3, page 807.
140 In an overview of terrorist incidents in Europe which resulted in at least ten deaths, Wikipedia is listing attacks on civilians by non-state actors that are widely referred to as terrorism. It excludes transcontinental countries such as Turkey and Russia, which have most of their landmass in another continent. (Accessed 21.03.18 at https://en.wikipedia.org/wiki/Terrorism_in_Europe )
141 In the United States a common definition of terrorism is the systematic or threatened use of violence in order to intimidate a population or government and thereby effect political, religious, or ideological change. (Accessed 21.03.18 at https://en.wikipedia.org/wiki/Terrorism_in_the_United_States )
4.4. Setting

4.4.1. The learning collaboratives

Theory itself is an object of study in this thesis, aimed to confirm, disconfirm or refine the theory of continual improvement. The theory used by the learning collaboratives when lecturing and guiding 189 hospital-related improvement projects from 1998 to 2011, is described in Chapter 4.2.1 *The IHI learning collaborative concept*.

The target of the learning collaborative approach was (1) to make the participants able to “close the gap between what we know and what we do” in healthcare, and (2) embedding the continual improvement method and culture in Norwegian healthcare organizations (Kilo 1998, Brandrud et al. 2011).

The learning collaboratives of the NMA were multidisciplinary, lasted about nine months, and included three learning sessions with action periods in between. Sometimes the NMA in collaboration with the planning group (expert panel) arranged a national, multiprofessional follow-up conference about one year after the end of the collaborative. The primary studies of this thesis do not include this conference, because it was made to only a few of the learning collaboratives in our material, which is focused on the intervention stages of continual improvement only. The learning collaborative initiative of the NMA is further described in Paper 1 (page 109), and in Paper 2 (page 3 with Table 1).

4.4.2. Trauma system

The Sustainability study is based on the evaluated outcome of local medical response after a terrorist attack on a youth camp (from the scene to hospital discharge). The purpose is to understand why and how the service (with focus on the system) could be that successful, by the perspectives of the involved professionals, and by the theoretical and historical roots of the emergency preparedness and response system.\(^{143}\)

*The initial treatment of the trauma patient* is a demanding challenge, and well recognized to be the phase with most protocol deviations and treatment mishaps. The resuscitation must be made in correct order to ensure that no valuable time is lost. In order for people injured outside of the hospital to receive rapid and effective pre-hospital care, there needs to be timely and correct dispatch of services based on an alarm and recognition of need. To patients with penetrating trauma for example,

\(^{143}\) According to the evaluation of three external bodies, (see Paper 3, Pages 806-807).
each minute from injury to treatment is increasing the death rate by 3-4 percent (Brattebø & Wisborg 2018).

According to Wisborg et al. (2017), the Norwegian trauma system consists of four independent health regions, with one trauma centre and four acute care hospitals in each region admitting the most seriously injured patients. The four regional trauma centres have all the medical and surgical capabilities, similar to the level I and II trauma centres described by the American College of Surgeons Committee on Trauma (ACS-COT).144

The number of acute care hospitals decreased from 50 in 2006, to 35 in 2015. Acute care hospitals have 24-h general surgical services and are (if needed) able to stabilize trauma patients before transfer to the trauma centre. Acute care hospitals are similar to the level III centres described by ACS-COT.145 Advanced pre-hospital care is offered by six anesthesiologist-manned search and rescue helicopters and 13 anesthesiologist-manned ambulance helicopters (Wisborg et al. 2017). In the 1970s, Oslo University Hospital HT, Ullevål, established a trauma centre by the surgeon Johan Pillgram Larsen. His trauma care manual was made accessible to other hospitals from 1984. In Norway, surgeons have been educated in emergency surgery procedures as a part of the general surgeon education since 2002.

The Advanced Trauma Life Support® (ATLS®) program for a systematic, concise approach to the care of a trauma patient, was developed by the American College of Surgeons (ACS) Committee on Trauma (COT), and introduced abroad in 1980. The program....

“...provides you with a safe and reliable method for immediate management of injured patients. The course teaches you how to assess a patient’s condition, resuscitate and stabilize him or her, and determine if his or her needs exceed a facility’s capacity. It also covers how to arrange for a patient’s inter-hospital transfer and assure that optimum care is provided throughout the process. If you don’t treat trauma patients frequently, an ATLS course provides an easy method to remember for evaluation and treatment of a trauma victim.” 146

Before the terrorist attack in 2011, about 450 000 persons suffered from injury each year in Norway, and up to 2500 deaths were caused by injuries147. The need for further education and training made

144 The American College of Surgeons - Committee on Trauma. Resources for optimal care of the injured patient, 6 edh. Chicago: The American College of Surgeons - Committee on Trauma, 2014 (Here by Wisborg et al. 2017).
145 The American College of Surgeons Committee on Trauma (ACS-COT)
147 Statistics Norway. (Statistisk sentralbyrå) Available at: www. ssb.no.
the BEST foundation\textsuperscript{148} include the hemostatic emergency surgery training of interprofessional trauma teams from 1999 as a part of the ordinary BEST program. From 2004, Oslo University Hospital has arranged advanced trauma surgery courses, and from 2006, the surgery courses follow the international concept Definitive Surgical Trauma Care (DSTC™):

“\textit{The DSTC is designed to teach qualified surgeons in strategic thinking and decision making in the management of the severely injured patients and provide them with practical surgical skills to manage major organ injuries. It is an intensive 3-day course comprising lectures, interactive case discussions and practical surgical skills training with a faculty consisting of national and international experienced trauma surgeons}.”\textsuperscript{149}

In the autumn of 2007, the first Norwegian national report on trauma treatment and how to organize the trauma care was published by a committee of senior experts within neurosurgery, gastro surgery orthopedic, prehospital care, and anesthesiology. The report was written on behalf of the four Norwegian Regional Health Authorities\textsuperscript{150}. The Norwegian Index for Medical Emergency Assistance (Index) is the dispatch guideline used by the Emergency Medical Coordination Centres (EMCC). The anaesthesiologist, who is part of the air ambulance crew, is responsible for triaging the patient and accepting or declining the mission based on information from the EMCC.\textsuperscript{151}

### 4.4.3. Psychosocial support

An integration of disaster mental health services with emergency medicine is crucial (Ruzek et al. 2004). A significant number of survivors of shootings experience immediate intense reactions of distress.\textsuperscript{152} Studies investigating long-term trajectories of posttraumatic stress disorder (PTSD) indicate great heterogeneity in post disaster health, including resilient, healing, chronic, and late-onset developmental patterns (Dyb et al. 2014).\textsuperscript{153}

A minority of survivors will develop enduring mental health problems, such as PTSD and depression.\textsuperscript{154} The severity of exposure and subsequent life stress are generally the most important predictive factors

\textsuperscript{148} See Chapter 4.2.2. \textit{The Norwegian team-training concept (BEST)} and Chapter 4.4.2. \textit{Trauma system} \hfill \textsuperscript{149} \url{http://traumatologi.no/2018/04/09/datoene-for-dstc-kursene-2018-er-klare-les-mer-og-meld-deg-pa-her/}

\textsuperscript{150} Organisering av behandlingen av alvorlig skadde pasienter. Rapport fra arbeidsgruppe nedsatt av RHF-ene, inkludert vurdering etter høringsrunde 09. oktober 2007

\textsuperscript{151} Østerås, Brattebø & Heltne 2016


\textsuperscript{153} Bonanno, Brewin, Kaniasty, & Greca, 2010, (cited in Dyb et al. 2014, p.1)

for mental health problems after traumatic events, in addition to the emotional reactions during the event, the physical injuries, the loss of close ones, and previous mental health problems.\textsuperscript{155} In addition, post-event factors, such as social support, secondary adversities such as witnessing criminal law trials, involvements in legal claims, extended media coverage of the event may be of particular importance (Dyb et al. 2014)\textsuperscript{156}

As told by one of the experts in the internal research team of the present study (Paper 3), the primary psychosocial support is based on common sense and can be provided by laypersons. It is however, a huge mental strain to witness the consequences of a terrorist event. You need to be a professional to endure the extreme situation, and be able to provide the support needed. The basic objectives of psychological first aid are: \textsuperscript{157}

- Establish a human connection in non-intrusive, compassionate manner
- Enhance immediate and ongoing safety, and provide physical and emotional comfort
- Calm and orient emotionally overwhelmed or distraught survivors
- Help survivors to tell you specifically what their immediate needs and concerns are, and gather additional information as appropriate
- Offer practical assistance and information to help survivors address their immediate needs and concerns
- Connect survivors as soon as possible to social support networks, including family members, friends, neighbors, and community helping resources.
- Support adaptive coping, acknowledge coping efforts and strengths, and empower survivors; encourage adults, children, and families to take AN ACTIVE ROLE IN THEIR RECOVERY.
- Provide information that may help survivors cope effectively with the psychological impact of disasters
- Be clear about your availability, and (when appropriate) link the survivor to another member of disaster response team or to local recovery system, mental health services, public sector services, and organizations

\textsuperscript{157} National Childs traumatic Stress Network & National Center for PTSD 2006.
4.4.4. The trauma population of Ringerike hospital

Ringerike area is harder hit by accidents than most places in Norway because there are about 20,000 tourists a day in the valleys and mountains of Northern Buskerud county. Two heavily trafficked main roads: E16 from north and RV7 from west meet here, and there are frequent closures and accidents on E16 over Sollihøgda mountain.

Since the BEST model was adopted by at Ringerike hospital in 2003, the hospital has conducted monthly trauma-team training. The hospital is investing in updated, and evidence-based, professional emergency care knowledge, with a surgical trauma committee, a trauma coordinator in a 50 percent position, and a continuous improvement system for trauma treatment. All physicians participating in trauma teams complete ATLS-courses in advanced trauma life support and all nurses have KITS courses in trauma care nursing.

In 2004, 45 Russian bus passengers were involved in a severe accident, and they were all brought to Ringerike hospital. This experience made the hospital develop a database that made them able to register and track (anonymously) every trauma patient through the trauma care process. This internal emergency web was crucial on 22 July 2011, as the admission wave was at its most overwhelming.

The trauma population of Ringerike hospital is still growing. In 2010, the trauma team was activated 98 times, admitting 120 patients, of whom 24 had an Injury Severity Score (ISS) ≥16 (Waage et al. 2013). In 2017, the trauma team was activated 174 times, admitting 219 trauma patients, of whom 34 had an Injury Severity Score (ISS) ≥16 (Pedersen 2018).

The local health resources are described in Paper 3, Method (Page 807). It is important to emphasize that Ringerike hospital always transfers the most severe injured patients to the Trauma centre at Oslo university hospital after they have been initial treated and stabilized.
Chapter 5. Research methods

5.1. Design

5.1.1. Learning from high performers

5.1.1.1. The positive deviance approach

This thesis is about learning from high performing clinical improvement teams and horizontal networks about how and why things go right. The purpose is to add knowledge to an increasing amount of literature based on what has been called a “positive deviance approach”, and contribute to improvement science by showing how continual improvement can be developed as a system property (Batalden & Stolz 1993, Berwick 2003). See 4.3.1.1. Research on positive deviance methods for more information about the approach.

According to Nelson et al. (2002) and Hollnagel et al. (2015), there is much to learn by asking high performers about why things go right. In the face of complex working environments, knowledge about constructive working conditions may serve as guiding models of quality and safety health care systems. I was inspired by the study approach of Nelson et al. (2002) when designing my positive deviance studies. Nelson and colleagues were inspired by the work of Quinn (1992) and Donaldson & Mohr (2000) and their approach to learn from High Performing Front-Line Clinical Units.

Referring to the prevention of adverse events in healthcare, Braithwaite et al. 2015 and Hollinger 2015, are suggesting a revolution ahead, advocating a potentially powerful new approach (Safety II), from preventing things to go wrong to purposefully enabling things to go right. It seeks to reconcile work-as-imagined and work-as-done, ensuring that the tools we use correspond to the problems of today, rather than the problems of “yesteryear”. 158

Baxter et al. (2015) published a systematic review159 of empirical research on the use of the positive deviance approach within healthcare. They found 37 articles, whereof most were addressing infections. The reviewed approaches were often poorly defined, the patient and staff involvement was limited, and their methods often required extensive resources. The authors recommend further research to develop high quality yet practical methods which involve staff and patients in all stages of the positive deviance approach.

158 See Chapter 3.3.6. Resilience concept and High Reliability Organizations, and the Discussion section
159 The articles reviewed were published prior to September 2014
Ghaferi et al. (2016) from the *High Reliability Organizing* environment is suggesting a third wave of innovation in order to achieve high performance, that we have to pay more attention to how individuals interact with one another and organize their day-to day-work, and that innovation in surgery has to shift from the technical or structural aspects to emphasizing how people, processes and practices come together in the pursuit of patient safety.

See Chapter 8.2. *Discussion positive deviance approach.*

### 5.1.2. Mixed method design

#### 5.1.2.1. Mixed method approach

“Mixed method approach” is also called “Triangulation”. The aim of triangulation is to increase the understanding of the complexity of the conditions for improvement and excellent care, (Malterud 2001).

> “The idea of triangulation originated from a craft used by land surveyors, who increase the validity of a map by incorporating measures from different angles. Multiple and diverse observations can enrich the description of a phenomenon—ie, an elephant looks very different when seen from above or below” (Malterud 2001).

Mixed methods research entails both philosophical assumptions and technical methods of enquiry, and it is important to maintain the integrity of each component in mixed methods research (Johnson et al. 2007).

> A mixed method design is a plan for a scientifically rigorous research process comprised of a qualitative or quantitative core component that directs the theoretical drive, with qualitative or quantitative supplementary component(s). These components of the research fit together to enhance description, understanding and can either be conducted simultaneously or sequentially” (Janice Morse to Johnson et al. 2007)

The product of a multi method study shall represent more than the sum of the parts. The integration of the qualitative and quantitative components of the analysis and results seem to be the Achilles heel. An important point is that the integration of data does not necessarily require consistent results and findings. On the contrary, inconsistence may be seen as a resource (Bryman 2007). Malterud (2001) argue that when combining qualitative and quantitative studies, the analyst should be prepared to handle contradictory findings, without having to discard one and appoint the other as a golden standard.
“Healthy and innovative meta-analysis should develop methods for reasonable combination of findings from qualitative and quantitative studies, acknowledging and using the potential of the different nature of these approaches. Interpretation of textual materials and purposeful samples is different to the calculation of numerical materials and random samples. Findings from qualitative and quantitative studies can certainly be aggregated and complemented by secondary analysis, contributing to an extended approach to the phenomenon in question, as well as a mutual validation. However, such meta-analysis should be done on the results, and not by accumulating and mixing quantitative and qualitative data, which require fundamentally different procedures for scientific analysis” (Malterud 2001).

In the mixed method approach of this thesis, qualitative and quantitative components are utilized together in a series of related studies. The mixed method approach to my thesis statements identifies the relationships between the pieces of learning we have found in the primary studies, followed up by further data collection and analysis to support my arguments. According to Malterud (2001) sampling is usually done in a stepwise way, including more data from one group or another dependent on what extra material is needed to answer the research question effectively.

Seeking to uncover paradoxes of divergence using complementary methods to investigate (initiation), and because the single studies are providing equally weighted components to my thesis, the approach can be characterized as a pragmatist perspective with a multiphase design\(^\text{160}\) (see Figure 6 and 7, and Chapter 8.3. Discussion mixed method approach).

5.1.2.2. The multiphase design

The multiphase design is a mix of the following methods

I. PROJECT STUDY (PART I):

A qualitative Project study of the conditions for improvement in the intervention stages of continual improvement processes (Brandrud et al. 2011). This was my master study, based on focus group meetings with former improvement team members. (See Appendix 1)

Research questions of the qualitative project study:

1. To what degree are the learning collaboratives of the NMA building a culture of continual improvement?

\(^{160}\) Johnson et al. 2007, Bishop 2014
2. What are the success factors for continual improvement hidden in the experiences of the improvement teams?

Figure 6: The mixed method approach to the thesis statements

II. PROJECT STUDY (PART II):

Aim quantitative Project study part II:

Distinguish successful improvement projects from other projects for a sampling purpose.

A team of four improvement experts validated a change process and outcome scale (Instrument 1) based on a recognized model: the IHI model for improvement. The experts were assessing aims, changes, measurements and outcomes of the 189 written, final reports of the learning collaboratives of the NMA. The scale was published in 2015 (Paper 1) because it supports a recognized theory of a systematic approach to continual improvement in healthcare, emphasizing the use of measurement to reflect on common practice.

III. PROJECT STUDY (PART III):

Online survey of the quantitative Project study (Paper 2): an online survey revealed the conditions for improvement in the intervention stages of the continual improvement processes of 132 improvement teams. The survey was made by an empirically based questionnaire (Instrument 2) citing focus group statements from the qualitative Project study (Brandrud et al 2011).

Research questions quantitative Project study:

1. What combination of what factors tend to produce “adoptable” improvement innovations.

2. How is the effectiveness of the continual improvement method?
IV. SUSTAINABILITY STUDY:

A qualitative study of the context and the historical and theoretical underpinnings of a successful Emergency care network (Paper 3).

Research questions Sustainability study:

1. What are the organizational structures and intellectual underpinnings of the local emergency care network from Utøya to discharge from Ringerike hospital?
2. How are the personnel responsible for the medical and mental care of the Utøya victims explaining its success in a crisis situation which overwhelmed the regular EMS capacity?
3. What are the important prerequisites for well-functioning systems for continuous quality improvement in healthcare?

V. MULTI METHOD STUDY:
The aim of the multi method approach is to increase the understanding of the complexity of the conditions for improvement and excellent care, by revealing and discussing the phenomenon and its historical and theoretical underpinning from as many perspectives as possible, finally developing thesis statements based on a synthesis of the findings.

Research questions multi method study:

1. Learning from high performing clinical teams and networks: What are the conditions for successful improvements and excellent care in the intervention stage vs the sustainability stage of a continual improvement process?
2. What are the theoretical and historical underpinnings of the successful projects and the successful local emergency medical service?

Sub-questions

1. Is there a link between the theoretical underpinnings of the high performing clinical teams and networks?
2. What characterized the improvisations that were made as part of the local medical and psychosocial response to the Utøya terror attack?
3. Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?
4. To what degree was the response to the Utøya terror attack based on continual improvement theory, culture and practice?
5.1.2.4. Study progress

Table 1A. Study progress before my enrollment in the PhD-program

DATA COLLECTION PROJECT STUDY

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 2005</td>
<td>Literature study</td>
</tr>
<tr>
<td>Oct 2005</td>
<td>Multiprofessional research group organized, developing the CPO-scale</td>
</tr>
<tr>
<td>Nov 2005</td>
<td>Pilot testing the CPO scale (Instrument 1)</td>
</tr>
<tr>
<td>2006-2012</td>
<td>Using the CPO scale to assess the written final reports of the learning</td>
</tr>
<tr>
<td></td>
<td>collaboratives of the NMA after the end of each hospital-related</td>
</tr>
<tr>
<td></td>
<td>collaborative</td>
</tr>
<tr>
<td>Aug 2006</td>
<td>Focus group meetings with former improvement team member in each region</td>
</tr>
<tr>
<td>Feb 2007</td>
<td>Developing a focus group-based questionnaire (Instrument 2)</td>
</tr>
<tr>
<td>2007-2012</td>
<td>Submitting the questionnaire to the leaders of the improvement teams of</td>
</tr>
<tr>
<td></td>
<td>the learning collaboratives of the NMA after the end of each hospital-</td>
</tr>
<tr>
<td></td>
<td>related collaborative</td>
</tr>
</tbody>
</table>

THE QUALITATIVE PART OF THE PROJECT STUDY

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr 2008</td>
<td>Starting the process of analyzing the focus group material in a qualitative</td>
</tr>
<tr>
<td>Jan 2009</td>
<td>Starting to write the paper with assistance from the external research</td>
</tr>
<tr>
<td>Jan 2010</td>
<td>Response to the submitted manuscript from the BMJ Quality &amp; Safety reviewers</td>
</tr>
<tr>
<td>Oct 2010</td>
<td>Revised version accepted for publication by BMJ Quality &amp; Safety</td>
</tr>
<tr>
<td>Jan 2011</td>
<td>Published online first by BMJ Quality &amp; Safety</td>
</tr>
<tr>
<td>Mar 2011</td>
<td>Printed version published by BM Quality &amp; Safety</td>
</tr>
<tr>
<td>Apr 2012</td>
<td>The paper has been included in my master study</td>
</tr>
</tbody>
</table>

DATA COLLECTION SUSTAINABILITY STUDY

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 2012</td>
<td>External evaluation reports on the 22-July-terrorism published, deeming</td>
</tr>
<tr>
<td></td>
<td>the local emergency medical response to the attack on Utøya youth camp</td>
</tr>
<tr>
<td>Oct 2012</td>
<td>Interviewing the Ringerike hospital leadership about facts and events</td>
</tr>
<tr>
<td></td>
<td>regarding the local medical response in relation to a quality Improvement</td>
</tr>
<tr>
<td></td>
<td>teaching assignment</td>
</tr>
<tr>
<td>Jan 2013</td>
<td>Deciding to include the case in my PhD study because of its positive</td>
</tr>
<tr>
<td></td>
<td>learning potential. Identifying and inviting the 35 roles of the entire</td>
</tr>
<tr>
<td></td>
<td>trauma care network from Utøya to discharge from Ringerike hospital to</td>
</tr>
<tr>
<td></td>
<td>focus group meetings.</td>
</tr>
<tr>
<td>Mar-Jun 2013</td>
<td>31 professionals participated as informants, covering 30 of the 35 pre-</td>
</tr>
<tr>
<td></td>
<td>and in-hospital network roles. 27 met in 5 focus groups, 3 single</td>
</tr>
<tr>
<td></td>
<td>interviews made.</td>
</tr>
</tbody>
</table>
### Table 1B. Study progress after my enrollment in the PhD-program

**THE PHD-PROJECT**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 2013</td>
<td>ENROLLED in the PhD-program with my analysis project(^{161}).</td>
</tr>
<tr>
<td>Sept 2013</td>
<td>INSTRUMENT 1: statistical validation of the CPO scale</td>
</tr>
<tr>
<td>Feb 2014</td>
<td>INSTRUMENT 2: statistical analysis of the conditions for change</td>
</tr>
<tr>
<td>May 2014</td>
<td>PAPER 2: writing with assistance from eight co-authors</td>
</tr>
<tr>
<td>Nov 2014</td>
<td>PAPER 1: QMHC ask for an updated version because the manuscript has been “lost” in their old QMHC submission system, hence, we included the 2011 collaborative study.</td>
</tr>
<tr>
<td>Jan 2015</td>
<td>SUSTAINABILITY STUDY: organizing two research teams</td>
</tr>
<tr>
<td>Mar 2015</td>
<td>PAPER 1: The updated manuscript submitted to QMHC</td>
</tr>
<tr>
<td>July 2015</td>
<td>PAPER 1: published by QMHC</td>
</tr>
<tr>
<td>Sept 2015</td>
<td>SUSTAINABILITY STUDY: Analyses by the external research team started</td>
</tr>
<tr>
<td>Oct 2015</td>
<td>Two single interviews with professional experts made</td>
</tr>
<tr>
<td>Apr 2016</td>
<td>PAPER 2: Submitted to BMC (Springer)</td>
</tr>
<tr>
<td>Sept 2016</td>
<td>SUSTAINABILITY STUDY: Analyses by members of the internal expert team started</td>
</tr>
<tr>
<td>Dec 2016</td>
<td>PAPER 3: writing with assistance from 14 co-authors</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>PAPER 3: submission process started</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>PAPER 3: BMJQS require emergence preparedness and response literature review. 2000 articles found in PubMed, plus relevant articles from their reference lists. 18 relevant papers were leading to six principles that may explain the success(^{162})</td>
</tr>
<tr>
<td>Jan 2017</td>
<td>PAPER 2: Review and revision of the manuscript by BMC</td>
</tr>
<tr>
<td>Apr 2017</td>
<td>PAPER 3: Revised manuscript accepted by BMJQS</td>
</tr>
<tr>
<td>July 2017</td>
<td>PAPER 3: published by BMJQS (online first)</td>
</tr>
<tr>
<td>Sept 2017</td>
<td>PAPER 2: published by BMC</td>
</tr>
</tbody>
</table>

Jan 2018 – Jan 2019  Multi-method study (see Part III, Methods)

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\(^{161}\) In an 80 percent position from 7.8.2013, to 6.5.2017

\(^{162}\) See Discussion Chapter Paper 3.
5.2. Data collection

5.2.1. Sources & categories of data

The PhD-project started in September 2013 with the mixed methods analysis project. The data to be analyzed is the result of a multiphase data collection from 2006 to date (primo 2018). The data sources are interviews with and reflections together with high performing clinical teams, -experts, -leaders and -networks, and studies of relevant papers, reports, awards and other documents informing the research questions and explaining the theoretical, cultural and historical underpinnings of our findings (see Figure 7).

Figure 7. Sources and categories of data

5.2.2. Data collection Project study

Qualitative and quantitative data have been collected about promoting and inhibiting improvement conditions encountered by improvement teams aiming to close certain quality and safety gaps in their own unit by participating in a learning collaborative. The study was aimed to reveal the conditions for successful improvement efforts in the intervention stages of continual improvement processes, the
effectiveness of the guided improvement methods used by the learning collaborative of the NMA, and the intellectual underpinnings of our findings, because:

“Poor theoretical underpinning makes it difficult to understand and explain how and why quality improvement efforts succeeds or fails, thus restraining opportunities to identify factors that predict the likelihood of successful changes, and develop better strategies to achieve more successful improvement efforts” (Davidoff et al. 2015).

The knowledge provided by the study may be used to develop an infrastructure and a culture in healthcare that promotes the intervention stages of continual improvement processes, (with, or without the help from a learning collaborative).

**Approach I. Learning from focus groups about the intervention stages of continual improvement**

**Sampling:** The NMA had a list with the addresses of 121 improvement team members from the 101 improvement teams of the first four learning collaboratives of the new millennium. The list was used to invite participants to four different focus group meetings, one in each of the four health regions. 21 persons responded positively, and 19 informants actually met, representing physicians, nurses and psychologists from 16 Norwegian hospitals (see Appendix 1 for details).

**Data collection:** The data collection was distributed among the four members of the research team, 1-2 researchers at each group. They collected the data by the critical incident technique (described in Chapter 8.5.1. Why the CIT method was chosen). The four focus groups provided 233 statements.

- The study was published in 2011 and belongs to my Master study, See Appendix 1 for a short presentation and discussion of the results of this qualitative study.

**Approach II. Assessing 189 written, final improvement project reports for a sampling purpose**

**Sampling:** The 189 written final reports from the eight hospital-related learning collaboratives of the NMA. Our research team of improvement experts developed a theory-based Change Process and Outcome (CPO) scale (Instrument 1) to classify 189 written final project reports for a sampling purpose related to the quantitative part of the Project study (a survey).

- The scale was covering the “one-page” IHI report format, especially designed to maintain focus in the quality improvement work (Kilo 1998)

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163 The improvement projects of the learning collaboratives of the NMA lasted from six to nine months, and were based on the continual improvement model, see Chapter 3.2.2. *The IHI Learning collaborative concept.*
The report format was based on the Plan-Do-Study –Act-cycle, operationalized by the three fundamental and visionary questions of the “IHI Model for improvement” (Langley et al. 1996) and the results.

Data collection: A multiprofessional research team of four improvement experts have collected data from the final reports regarding aims, changes, measurements and outcomes. The scale is not meant to cover the many other factors of the highly complex causality connected to successful improvement projects (which to some degree is studied by approach III, IV and V).

The scale can be useful in all parts of a continual improvement process, but in this study, the scale is only covering the initial part of the improvement process, when the improvement teams had access to a knowledge-based support and guidance from a collaborative.

Approach III. Learning about the conditions for success in the intervention stages of CQI by a survey

In this quantitative Part of the Project study we have collected data among high performing clinical improvement teams in the intervention stages of a Continual Quality Improvement (CQI) based on two research questions:

1. What combination of what factors tend to produce “adoptable” improvement innovations?
2. How is the effectiveness of the continual improvement method (used by the learning collaborative)?

The Project study was aimed to:

- Identify the conditions for making successful in the intervention stages of a continual improvement process.
- Understand how to develop and continually improve the conditions for making a good job.

Sampling: The Project study is a survey of the perspectives of healthcare professionals participating in the 132 improvement teams. We had access to their e-mail addresses from the improvement collaborative participant lists. Because of privacy protection rules, it was seldom possible for us to get any information from the 189 Participating hospital departments about the turnover of the former collaborative participants.

The response rate was 70%. The response rate of the cesarean section collaborative from 1999 was 52%, while the response rate in the other collaboratives varied from 69 to 79%.

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164 See Paper 1, Table 3, Page 112.
165 The term effectiveness refer to the definition of Institute of Medicine’s Committee on Quality of Health Care in America: “Effectiveness means providing services based on scientific knowledge to all who could benefit”.

107
The 198 respondents were 53 physicians, 56 nurses, 38 psychologists and 51 others.

52 (39%) of the 132 responding improvement teams belonged to the successful projects. 75% of the uncertain projects were represented by their leader, while only 57 of the successful projects were represented by their leader.

22 of the 132 responding teams belonged to a university hospital.

65% of the 132 responding teams were represented by their team leader.

In 35% of the responding teams’ late responses lead to more than one response from the same team, whereof about 70% were represented by the average ratings of two team members.

Table 2. The questionnaire (Instrument 2) variables

<table>
<thead>
<tr>
<th>Statement</th>
<th>Importance</th>
<th>Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>Senior expert influence</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>Leadership engagement</td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td>Leadership follow up in the project</td>
<td></td>
</tr>
<tr>
<td>Q4</td>
<td>Team leader recognition</td>
<td></td>
</tr>
<tr>
<td>Q5</td>
<td>Project organized well</td>
<td></td>
</tr>
<tr>
<td>Q6</td>
<td>Professional environment</td>
<td></td>
</tr>
<tr>
<td>Q7</td>
<td>Enjoying measurement</td>
<td></td>
</tr>
<tr>
<td>Q8</td>
<td>Team schedule &amp; interaction</td>
<td></td>
</tr>
<tr>
<td>Q9</td>
<td>Team allocation of tasks</td>
<td></td>
</tr>
<tr>
<td>Q10</td>
<td>Q11 The availability of the coach</td>
<td></td>
</tr>
<tr>
<td>Q12</td>
<td>Q13 Measurement guidance</td>
<td></td>
</tr>
<tr>
<td>Q14</td>
<td>Q15 Top management commitment</td>
<td></td>
</tr>
<tr>
<td>Q16</td>
<td>Q17 Patient centred targets</td>
<td></td>
</tr>
<tr>
<td>Q18</td>
<td>Q19 Learned SPC</td>
<td></td>
</tr>
<tr>
<td>Q20</td>
<td>Q21 SPC easy to communicate</td>
<td></td>
</tr>
<tr>
<td>Q22</td>
<td>Q23 Measurements presented continually</td>
<td></td>
</tr>
<tr>
<td>Q24</td>
<td>Q25 Leadership follow up after the project</td>
<td></td>
</tr>
</tbody>
</table>

Data collection: The data were collected by an empirically questionnaire (Instrument 2), based on the 233 focus group statements collected by Approach I (see above), quoting 17 statements with eight additional questions controlling the importance of the statements (see Table 2). The instrument was attached in the invitation e-mail to improvement team members who did not want to use the online-version of the questionnaire.

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166 See the original statements in the questionnaire, Paper 2, Supplement page 4, and how the instrument was developed at page 3 in the same supplement.
5.2.3. Data collection Sustainability study

**Approach IV: Revealing conditions for a successful healthcare service in the sustainability stages of a continual improvement process, and the historical and theoretical underpinnings of the findings.**

The (qualitative) Sustainability study has two research questions:

1. **What combination of what factors tend to produce “adoptable” improvement innovations?**
2. **What are the intellectual (theoretical and historical) underpinnings of the successful local emergency medical service?**

The purpose of the Sustainability study was to understand how to develop and continually improve the conditions for making a good job.

**Sampling:** After a process of excluding persons who for ethical reasons should not be sampled as informants to this study (see Appendix to paper 3, Chapter 2.2.), the list included 260 names from the 25 leaders of the entire emergency care network from Utøya to discharge from Ringerike (including the police). Twenty professionals had moved from the area or were no longer in service, which provided a sample number that is different than the 120 professionals cited in the paper\(^{167}\). See Figure 8 for the details of the sampling process.

- Aiming to cover perspectives as wide as possible on the situation, we wanted to cover the entire care network by five focus groups (see Figure 9), gathering up the different professions and roles into the same focus group who had been working together that days, to discuss the critical incidents with me listening\(^{168}\).

**Table 3. The representativeness of the different professions and their sex**

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicians</td>
<td>6</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Nurses</td>
<td>9</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sum</td>
<td>16</td>
<td>15</td>
<td>31</td>
</tr>
</tbody>
</table>

\(^{167}\)The typos was made by me in one of the most intensive rounds of editing the paper. The findings of psychologist Tom Stafford may indicate how this could happen. When proof reading our own work, we know the meaning we want to convey, and because we expect that meaning to be there, it is easier for us to miss when parts are absent or numbers are incorrect. What we see on the screen is competing with the version that is in our head (Stafford T. For argument’s sake, evidence that reason can change minds. E-book, Amazon 2015).

\(^{168}\)The purpose was to prevent recall bias by making the informants listening to each other’s’ stories and discuss the case.
Figure 8. Flow chart on the sampling process, Sustainability study

N professionals working in the trauma care network from Utoya to discharge

n professionals excluded from the study of ethical reasons (by their leaders)

260 professionals from the trauma care network identified by their leaders as possible informants to the study

20 of the 260 professionals on the list moved from the area/not in service

240 professionals invited to participate as informants in the present study

189 of the 240 invited professionals declined to participate or did not reply

51 professionals (21%) answered they were positive to participate as informants + 1 additional informant

Nine respondents did not follow up and 12 did not get a final invitation because of role redundancy

31 Professionals participated as informants, covering 30 of the 35 professional roles of the care network

The professional roles not covered by the 31 informants are intensive care nurses, orthopedics, radiographs and bioengineers

Figure 9: The interprofessional care network covered by five focus groups
Sampling (continue): The total number of the care network was 35. The 31 informants covered 30 of the 31 most important roles (as informants to the study). Thirty roles of the participants are protected for ethical reasons. The only roles we are allowed to display are the five missing roles (see figure 8 and 9). They belonged to the in-hospital trauma care level, and the orthopedics belong to the most important roles (informants). Some of the victims were suffering from orthopedic injuries due to their flight from the perpetrator. Because of the limited capacity, orthopedics sometimes replaced the surgery in the trauma team. Orthopedic participates in the regularly, monthly team-training.

Representativeness: In the light of the delicate ethical situation making repeated invitations impossible, the representativeness was surprisingly good regarding pre- and in-hospital care levels, trauma treatment and psychosocial care roles, disciplines (by pre-and/or in-hospital employed physicians, nurses and others (one police) and sex (see Table 3 and Figure 9). Fourteen of the 31 informants were in a leadership position in the target situation.

Data collection: Five focus group meetings and three single interviews were conducted from March to June 2013, and two single interviews were conducted in 2015.

I collected the focus group data by the critical incident technique (see Chapter 8.5. Discussion Qualitative study approach), and made audio-recorded single interviews with informants who were not able to meet in “their” focus group. After the informant had told her/his story without interruption, I referred to the critical incidents highlighted by “their” focus group of colleagues (where they were not able to meet), which mostly was confirming the picture made by the “single” informant. That means the data from single interviews with the clinicians did not reveal particular new information or any conflicting pictures of the situation or the system. It is a normal observation in qualitative studies that after conducting “enough” interviews, further interviews do not add more new information (Gremler 2004). One exception was a late informant bringing important perspectives on the managers role that had limited inclusion before.

At the end of each single interview, we made a conversation, aimed to clarify misunderstandings and to produce knowledge regarding the most important conditions for making a good job in the situation focused.

After the interview, I transcribed (quoted) the audio-recorded interview in the same way as I did in the focus group meetings, but now I had to control the data myself, by listening to the record repeatedly until no more corrections had to be made. In two cases, I sent a copy to the informant to validate my transcription, first, to clarify facts and events (if any), and second, to clarify professional knowledge statements beyond my field of knowledge. See more about data validation
5.2.4. Data collection multi method study

Approach V: Developing thesis statements from a synthesis of the data from approach I-IV, and from additional key informant interviews & document studies regarding the following questions:

Global research question:

What are the determinants for an organization to provide excellent and sustainable health care services where sustainability and resilience is paradoxically working together?

Specific research questions

1) Learning from high performing clinical teams and networks: What are the conditions for successful improvements and excellent care in the intervention stages vs the sustainability stages of a continual improvement process?

2) What are the theoretical and historical underpinnings of the high performing clinical teams and networks?

Sub-questions

1. Is there a link between the theoretical underpinnings of the high performing clinical teams and networks?

2. What characterized the improvisations that were made as part of the local medical and psychosocial response to the Utøya terror attack?

3. Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?

4. To what degree was the response to the Utøya terror attack based on continual improvement theory, culture and practice?

Additional data collection:

The research process was flexible and dynamic and the sub-questions growing out of the analysis process were informed by key informants from mid-2015 to mid-2018 in what Moen & Middelthon (2015) define as a professional conversation:

“At their core, most qualitative studies involve conversations that take place directly between a researcher and the people whose lives and circumstances are being inquired into. Such conversations are fundamental interactional, (…) as an interview where knowledge is
constructed in the interaction between the interviewer and the interviewee. An interview is literally and interview, an inter-change of views between two persons conversing about a theme of mutual interest”.\textsuperscript{169} “The hyphens in this quote are significant. However guided or free flowing an interview might be, it will always be an interactional event in which personas who interact are engaging in a collaborative “meaning-making-occasion” (Moen & Middelthon 2015)

For the Multi method study I have collected additional information from the members of the internal expert team and other professionals, and three quality advisors and two former CEO’s regarding the continual improvement history of Ringerike hospital. I also studied relevant articles, internal and external reports, quality awards, and the leadership’s comments written at important pages in the quality improvement book of Øvretveit (1992) that was guiding the leadership in the intervention stages of their continual improvement process.

5.3. Data analysis

5.3.1. Qualitative data analysis

5.3.1.1. Inductive analysis

In the Project study and in the Sustainability study we first analysed the data by induction. Induction means there is no theoretical framework with preconceived categories guiding the coding process. Instead, the research team allow the categories and names of categories to flow from the data (Hsieh and Shannon 2005).

Induction was used in the qualitative part of the Project study to understand to what degree the Learning collaboratives of NMA are building a culture of continual improvement, and identify the success factors of continual quality improvement hidden in the experiences of the improvement teams (see Brandrud et al. 2011).

An inductive analysis was also performed in the Sustainability study of “What combination of what factors tend to produce “adoptable” improvement innovations,” (innovations like the team-training concept BEST, and the reduction of trauma care handoffs etc). The inductive analysis process has been described shortly in paper 3, pages 808-809, and in details in Appendix to paper 3, Chapter 2.3. Pages 9-10.
5.3.1.2. Abductive analysis

I have used an abductive analysis method to study “the (intellectual) theoretical and historical underpinnings of the successful projects and the successful local emergency medical service.” The purpose of this second (specific) research question of the multi method study is to contribute to the science of continual improvement, analysing how and why some improvement projects and services are successful and what theories may explain the success.

Abduction is to first observe a fact, and then explain how it happened by using a theory. Since there may be more theories that can explain the same fact, abduction implies an inference to find the best explanation. Theories that do not produce the observed fact can be eliminated early in the process. Since there may be more than one theory that can explain the same fact, abduction implies an inference to find the best explanation.

Abduction operates by adding a possible causal link to the existing repertoire, based on the observed anomaly in the following data (Valsiner (2012)).

(1) The evaluation result: The positive evaluation result, represented by three external reports, making it possible to analyse why and how the success was possible (instead of using our resources on bringing evidence to the success by a hypothetical deductive analysis method).

(2) The case (facts and events) Facts and events are vulnerable to recall bias, and have to be as reliable as possible, and have been checked and double checked in this study by many written and verbal sources. An example is study Approach V, sub-question 3 “Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?

(3) The interview results: Categories of statements developed by an inductive analysis process.

(4) Relevant theories that may explain the success of the local trauma care network in action.

5.3.2. Factor analysis

The purpose of the factor analysis in Approach II CPO-scale validation and Approach III Quantitative Project study was to summarize the questionnaire variables so that the relationships and patterns asked for in the research question can be easily interpreted and understood (Yong & Pearce 2013). Factor analysis used mathematical procedures for the simplification of interrelated measures to
discover patterns in a set of variables\textsuperscript{170}. According to common practice, factor scores were calculated without weights (Yong and Pearce 2013).

### 5.3.2.1. Factor loading

The factor loadings are equal to the correlation between the factor and the items (Fayes & Machin 2009). Factors can be identified by the largest loadings, but it is also important to examine the zero and low loadings in order to confirm the identification of the factors\textsuperscript{171}(see the factor loadings in Paper 2, Table 4 Page 5).

> For something to be labeled as a factor it should have at least 3 variables, although this depends on the design of the study\textsuperscript{172}. As a general guide, rotated factors that have 2 or fewer variables should be interpreted with caution. A factor with 2 variables is only considered reliable when the variables are highly correlated with each other ($r > .70$) but fairly uncorrelated with other variables. (…) When interpreting the factors, you need to look at the loadings to determine the strength of the relationships. Factors can be identified by the largest loadings, but it is also important to examine the zero and low loadings in order to confirm the identification of the factors\textsuperscript{173}. (…) There should be few item crossloadings (i.e., split loadings) so that each factor defines a distinct cluster of interrelated variables (Yong and Pearce 2013).

Limitations of the factor loading is presented in Chapter 8.6.1.2. 	extit{Limitations of factor analysis}.

### 5.3.2.2. Crossloading

A crossloading is when an item loads at .32 or higher on two or more factors (Costello & Osborne, 2005). Depending on the design of the study, a complex variable (i.e., an item that is in the situation of crossloading) can be retained with the assumption that it is the latent nature of the variable, or the complex variable can be dropped when the interpretation is difficult (Yong and Pearce 2013).


Factor I (Measurements & Guidance), and Factor IV (Group process) are the only factors without crossloadings (see Paper 2, Table 4 Page 5, for factor loadings, and Table RR for Q-definitions). The limitations related to crossloadings are presented in 4.2.6.4. Limitations of the factor analysis.

5.3.2.3. Varimax rotation

In a factor analysis, it is usual to rotate or transform the factors until a solution with a simpler structure is found. The two possible methods of rotation we were considering was Varimax rotation and Oblique rotation. As we considered these to be equally appropriate for our purpose, we decided to use Varimax rotation because it is commonly used in medical research.

“...the aim of rotation is to simplify the initial factorization, obtaining a solution that keeps as many variables and factors distinct from one another as possible. Thus, rotation is an essential part of the factor analysis method, as the initial factor solution is frequently uninterpretable. The simplest rotations are orthogonal, which assumes that the underlying factors are not correlated with each other, and of these Varimax is the most widely used and generally appears to yield sensible solutions (...) In practical terms, Varimax results in a ‘simple’ factor decomposition, because each factor will include the smallest possible explanatory variables” (Fayers and Machin 2009)

Regarding the analysis of the CPO-scale data, I did not find indications that an Obligue rotation would have been a better 8.6.1.2. Limitations factor analysis.

5.3.2.4. Eigenvalues greater than 1

The use of eigenvalue >1 is preventing that too many or too few factors are mistakenly entering the model, yielding analysis solutions that are extremely difficult to interpret. The eigenvalues are a measure of how much of the variation in the 25 items is accounted for by each factor. Therefore the eigenvalues indicate the importance of each factor in explaining the variation and correlations in the 15 process items, and the sum of eigenvalues equal the number of items. The proportion of each factor is obtained by expressing the eigenvalues as percentage.

Another widely used method is screen plot, which is simply a plot of successive eigenvalues. They assess the approach to be fairly good at separating the important factors from the later factors, and although the interpretation of scree plots is subjective, frequently, a change in slope is fairly evident. Despite reservations, in practice, Fayers and Machin (2009) have found both approaches to have reasonable characteristics.
We considered the two approaches be equally appropriate for this purpose, but decided to use eigenvalue > 1 both in the validation of Instrument 1, and in the survey based on instrument 2, because this is a well-known approach in the medical research literature.

5.3.3. Logistic regression analysis

First, we analysed the associations between the 25 items of instrument 2 (the questionnaire) and success. Logistic regression analyses were performed, with success as the dependent variable, and the 25-questionnaire item (see Table 2) as independent variables (explaining success). Only items which were significant in a bivariate analysis (defined as p<0.05) were included in the multivariate regression analyses. The results from the regression analyses are presented as odds ratios with 95 percent confidence intervals and corresponding p-values. A significance level of 5 percent was used.

Finally, we analysed the multivariate associations between the five domains (defined by the factor analysis) and success. Logistic regression analyses were performed, with success as the dependent variable, and the five success domains as independent variables (explaining success). Only domains which were significant in a bivariate analysis (defined as p<0.05) were included in the multivariate regression analyses. The results from the regression analyses are presented as odds ratios with 95 percent confidence intervals and corresponding p-values. A significance level of 5 percent was used.

5.3.4. Interpretive synthesis

As described in Chapter 5.2.1. Sources and categories of data behind the thesis statement, the multi method research involves five different data collection approaches from different sources of information. By deploying an interpretive, narrative analysis approach\footnote{The method is described by Dixon-Woods et al. 2005}, I have developed a synthesis of the qualitative and quantitative data, here reflected in the result – and discussion chapters. A summary of the synthesis result is presented in Chapter 7.1 Thesis statement.

Dixon-Woods et al. (2005) argue that an interpretive synthesis of primary studies must be grounded in the data reported in those studies, and crucially related to the form and nature of the research questions being asked (see Chapter 2.2. The research questions of the thesis). An interpretive synthesis may be able to address questions that are difficult to address in an integrative (aggregated) synthesis, but is including both interpretive and integrative elements.

The main product of interpretive reviews is not aggregations of data, but theory, mostly middle-range theories. According to Nilsen (2015) mid-range theories are explaining limited sets of phenomena,
while programme theories are empirical generalizations\textsuperscript{175}. My thesis statement is providing some mid-range theories, but mainly empirical generalizations.

5.4. Ethical considerations

5.4.1. Ethical approval

The dissertation proposal was evaluated by the Regional Ethics Committee of South-East and waived from formal approval. Later, the Data Protection Authority of Oslo University Hospital assessed the study as required by Norwegian law, and approved the study. Thus, all necessary approval has been in place.

5.4.2. Ethical challenges

Learning from healthcare professionals voluntarily participating in a focus group or a survey implies the need to treat the people who participate in research, as informants or otherwise, with respect. As a general principle, those who are made the subjects of research are entitled to have their personal information treated confidentially. As a researcher, I must prevent any use and communication of information that might inflict damage on individuals who are the subjects of research.

Sampling respondents regarding the local medical response to the terror attack at Utøya was an ethical challenge. How do you ask people to participate in a study that requests them to remember a situation that was so horrible? A study of sick leave and help seeking among rescue workers after the terror attack found that a small minority of the professionals reported sick leave for more than 14 days, and a few had sought psychological help (Gjerland et al. 2015). The problem of the local hospital was that so many local professionals knew some of the victims personally or their family and friends.

The entire research process had to be handled with dignity and respect for the healthcare personnel, especially those who in addition were personally affected by losing a sibling, family friend or neighbor at Utøya, and those who might have had health problems and absence from work in the wake of the terrorist event. The process of sampling and protecting the informants against negative consequences of their participation in the Sustainability study has been described in details in the Appendix to Paper 3, Chapter 2.2.

\textsuperscript{175} See Chapter 7.2.5. Theoretical underpinnings with implications
5.4.3. Who are the informants?

One of the greatest challenges to me as a researcher was that I was not allowed for ethical reasons to reveal the different roles of the informants from the emergency care network in a sufficient detail when publishing the results. Consequently, I was prevented from bringing evidence to the fact that the study was provided with an almost surprisingly representative sample of informants (roles), in spite of the difficult sampling situation.

Aiming to cover perspectives as wide as possible on the situation, the entire trauma care network from Utøya to discharge from Ringerike hospital was covered by five focus groups (see Figure 9). In spite of the extreme situation, we were able to gather up the 30 of the 31 most important of the professionals’ 35 roles working together 22-24 July 2011 to discuss the conditions for their successful service with me listening.

The same challenge was the case in the Project study. To protect the privacy of the many improvement team members serving as my informants, I did not publish which hospitals had participated in the study. Hence, I was prevented from presenting evidence to the fact that our findings reflect the conditions for improvement under the influence of a learning collaborative in hospitals of all levels and in all parts of the country from 1999-2011.
Part IV. RESULTS

Chapter 6. Selected outcomes

6.1. Qualitative Project study outcomes

The elements of an emerging culture of improvement in Norwegian hospitals was revealed by the qualitative study, reflecting the eight domains of knowledge, as a product of collaborative learning. As much as 90 percent of the material reflects the need for a system of continual improvement to solve the problems that organisations experience in trying to make lasting improvements. A pattern of three success factors for the intervention stages of continual improvement processes emerged (Table 4), (see Appendix 1 and Brandrud et al. 2011 for more information):

Table 4. Three factors for successful quality improvement

<table>
<thead>
<tr>
<th>Success factor I: INFORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Provide continual and reliable information about best practice</td>
</tr>
<tr>
<td>2. Provide continual and reliable information about current practice</td>
</tr>
<tr>
<td>3. Benchmark systems and outcomes to others</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Success factor II: ENGAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Anchor the improvement work to the leadership at all stages</td>
</tr>
<tr>
<td>5. Focus on and engage the patient and family in all stages of the improvement work</td>
</tr>
<tr>
<td>6. Anchor the changes to the professional environment</td>
</tr>
<tr>
<td>7. Engage the staff in all stages of the improvement work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Success factor III: INFRASTRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Base the infrastructure on improvement knowledge</td>
</tr>
<tr>
<td>9. Multidisciplinary improvement teams tailored to the topic</td>
</tr>
<tr>
<td>10. Develop a learning system tailored to the different target groups</td>
</tr>
<tr>
<td>11. Develop a system to facilitate the improvement work</td>
</tr>
<tr>
<td>12. Develop a follow-up system to secure sustainability</td>
</tr>
</tbody>
</table>

6.2. Quantitative Project study outcomes (Paper 2)

6.2.1. The sampling process (Paper 1)

For a sampling purpose, a multiprofessional team of physicians, nurses and psychologists validated a theory-based CPO scale (Instrument 1). The scale was used to assess and discuss 189 written final quality improvement project reports. The 189 reports belonged to the improvement teams of the eight hospital-related learning collaboratives of The Norwegian Medical Association (NMA) from 199-
2011. The findings indicated that 38 percent (72 of 189 projects) were successful, ranging from 17 percent to 60 percent within each of the eight collaboratives. A majority (78%) of the successful projects presented their outcomes as a shift of level in a desired direction on a control chart. Their projects were characterized by a clear link between their visions – measurable aims – change efforts and measurements. The successful projects were also best at written communication, making easy understandable final reports.

6.2.2. The online survey outcomes (Paper 2)

*Table 5. The items of the two domains associated with successful improvements*

<table>
<thead>
<tr>
<th>Item</th>
<th>Domain 1: Measurement &amp; guidance</th>
<th>Factor loading</th>
<th>Positive scores* (n=54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q13</td>
<td>Is good guidance and help with measurements of any importance to succeed with the improvement work?</td>
<td>0,8</td>
<td>59%</td>
</tr>
<tr>
<td>Q21</td>
<td>Is it of any importance for successful changes that the control-charts are easy to communicate to the peers in the site?</td>
<td>0,8</td>
<td>67%</td>
</tr>
<tr>
<td>Q19</td>
<td>Is the measure method SPC of any importance to succeed with improvement efforts?</td>
<td>0,8</td>
<td>76%</td>
</tr>
<tr>
<td>Q20</td>
<td>The control-charts were easy to communicate to our peers in the site.</td>
<td>0,7</td>
<td>78%</td>
</tr>
<tr>
<td>Q12</td>
<td>We had good guidance and help with measurements</td>
<td>0,7</td>
<td>81%</td>
</tr>
<tr>
<td>Q11</td>
<td>Is the availability of the coach between the LS of any importance to make successful improvements?</td>
<td>0,7</td>
<td>83%</td>
</tr>
<tr>
<td>Q18</td>
<td>The improvement team learned SPC</td>
<td>0,5</td>
<td>77%</td>
</tr>
<tr>
<td>Q7*</td>
<td>Someone in the improvement team enjoyed working with measurement</td>
<td>0,4</td>
<td>87%</td>
</tr>
<tr>
<td>Q10*</td>
<td>We got hold of our coach when needed between the Learning sessions</td>
<td>-0,4</td>
<td>74%</td>
</tr>
</tbody>
</table>

**Domain 3: Professional environment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Domain 1: Measurement &amp; guidance</th>
<th>Factor loading</th>
<th>Positive scores* (n=54)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q16</td>
<td>We based the improvement efforts on patient-focused aims</td>
<td>0,7</td>
<td>94%</td>
</tr>
<tr>
<td>Q23</td>
<td>Is it of any importance to present measurements continually maintain motivation?</td>
<td>0,7</td>
<td>74%</td>
</tr>
<tr>
<td>Q22</td>
<td>We presented measurements continually to maintain motivation</td>
<td>0,6</td>
<td>83%</td>
</tr>
<tr>
<td>Q17</td>
<td>Are patient-focused aims of any importance to engage the healthcare professionals in the improvement efforts? (No negative scores to this Q)</td>
<td>0,5</td>
<td>94%</td>
</tr>
<tr>
<td>Q6</td>
<td>The project was well grounded in the professional environment</td>
<td>0,5</td>
<td>74%</td>
</tr>
<tr>
<td>Q5</td>
<td>We organized the improvement efforts well in spite of the difficult resource situation (time and personnel)</td>
<td>0,5</td>
<td>83%</td>
</tr>
<tr>
<td>Q1</td>
<td>Referring to the senior expert team made our change ideas more feasible to the peers in the site</td>
<td>0,5</td>
<td>75%</td>
</tr>
</tbody>
</table>

*) Positive score means a score of 4 or 5 on a scale from 1-5, where 5 is the most positive assessment
A questionnaire based on empirical data (Instrument 2) quoting and assessing focus group statements by 25 variables followed up with a quantitative study of the conditions for change encountered by 189 improvement teams. The response rate was 70 percent (132 projects), where 54 were successful. Two success domains were found in the final model of a multivariate logistic regression analysis: Measurement & guidance, and Professional environment to be associated with successful improvement innovations (in the intervention stages of continual improvement processes). The items are presented in Table 5.

6.3. Sustainability study outcomes (Paper 3)

6.3.1. Conditions for innovation and excellent care

The conditions for making things go right when the local trauma care network responded to the Utøya terror attack was presented in Paper 3 as a combination of the following four determinants:

1. Structure and competence based on continuous planning, training and learning
2. Management based on knowledge, trust and data collection
3. Empowerment through interprofessional networks
4. Ability to improvise based on structure and competence

The determinants are based on conversations among the healthcare professionals and further described in the result section of paper 3 with Appendix chapter 4 Selected statements).

6.4. Multi method study outcomes (Thesis)

6.4.1. Outcome global research question

Global research question: What are the determinants for an organization to provide excellent and sustainable health care services where sustainability and resilience is paradoxically working together?

Outcome: The entire Result and Discussion section is aimed to answer this global question.
6.4.2. Outcome specific research questions

Specific research question 1: Learning from high performing clinical teams and networks: What are the conditions for successful improvements and excellent care in the intervention stages vs the sustainability stages of a continual improvement process?

Outcome, see:

- Chapter 7.2.4. Comparing intervention and sustainability stages
- Table 6 and Appendix 3

Specific research question 2: What are the theoretical and historical underpinnings of the high performing clinical teams and networks?

Outcome, see Discussion section, especially:

- Chapter 3.1.5. Quality improvement history, Ringerike hospital
- Chapter 4.1. Theoretical underpinnings
- Chapter 4.2.2. The Norwegian team-training concept (BEST)
- Chapter 7.2.5. Theoretical underpinnings with implications
- Chapter 7.2.5.2. The complexity of a successful healthcare service

6.4.3. Outcomes sub-questions

6.4.3.1. The learning collaborative of NMA & the local EMS

Sub-question 1: Is there a link between the theoretical underpinnings of the high performing clinical teams and networks?

Outcome, see:

- Chapter 3.1.5. Quality improvement history, Ringerike hospital
- Chapter 4.1. Theoretical underpinnings
- Chapter 4.2.1. The IHI Learning collaborative concept
- Chapter 4.2.2. The Norwegian team-training concept (BEST)
- Chapter 4.4.1. The learning collaboratives
- Chapter 7.2.1. The link between the EMS and the collaboratives
- Chapter 7.2.2. Creativity and the Swiss cheese metaphor
6.4.3.2. What characterizes the many improvisations?

Sub-question 2: What characterized the improvisations that were made as part of the local medical and psychosocial response to the Utøya terror attack?

22 July 2011, at least 22 improvisations were made, mainly to protect or restore the invisible web of interaction, to protect or substitute the crucial logistic, communication and interaction of the professionals, their leaders, the trauma victims and their family possible.

Fourteen logistic-related improvisations

1. **Road blockade:** The dangerous situation\(^\text{176}\) made the police block the main road.
2. **Preferring the local hospital:** Going north to Ringerike hospital for initial or total trauma care was an improvisation, but the safest choice for the road and air ambulances\(^\text{177}\).
3. **Three helicopters down at the same time,** at a place meant for one. To be able to bring the trauma victims to proper care as soon as possible, the third helicopter landed at the entrance of the hospital making the doors open and the reception desk papers flying into the air.
4. **The emergency dispatch centre was overloaded,** and unable to lead the distribution of patients. Sever injured trauma victims arrived the local hospital in large waves. The number of patients Ringerike had agreed to handle by the major incident plan was surpassed after 40 min, and the capacity had to be exceeded\(^\text{178}\).
5. **A lot of trained professionals volunteered** from holiday, leisure and turnover to participate in the trauma care in addition to those who were committed to meet, making it possible to exceed the capacity.
6. **Simplified triage.** The triage consultant classified the patients into two categories (not four as stated in the hospital’s major incident plan). This was an ad hoc decision made by the triage consultant as the extent of the incident became evident. Patients with minor injuries were sent to the outpatient department staffed by medical doctors and nurses, and moderately to severely injured patients were sent to the emergency department\(^\text{179}\).

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\(^{176}\) See chapter 6.4.3.3. *Why were so many trauma patients brought to Ringerike?*

\(^{177}\) See chapter 6.4.3.3. *Why were so many trauma patients brought to Ringerike?*

\(^{178}\) No one in the trauma care network from Utøya to the hospital knew the extent of the attack until late in the evening. How many terrorists were attacking? Was it a local or a national attack?

\(^{179}\) Waage et al. 2013
7. **The role of orthopedic surgeons.** Owing to a lack of general surgeons, who normally would assess all injured patients, those with apparent isolated extremity injuries were taken care of by an orthopedic surgeon, while patients with head and torso injuries were placed under the care of a general surgeon.\textsuperscript{180}

8. **Dual commander.** The leader of the surgical department (a trauma surgeon) volunteered from his holiday, serving as a dual commander, walking around, stepping into different situations where his competence was needed.

9. **Tailored trauma teams.** Each trauma patient got a trauma team with professionals tailored to their individual symptoms, according to the plan.\textsuperscript{181} With the greatly strained resources, anaesthetists were prioritized to the most severely injured patients and to patients requiring immediate surgery.\textsuperscript{182}

10. **Hypothermia prevention:** Empty ambulances were used to send Oxygen tubes and blankets from the hospital back to the scene, to care for wet and ice cold youngsters having escaped by swimming the 200 meters to the opposite shore. When there (consequently) were no more blankets at the hospital to warm up freezing terrorist victims, the staff filled empty plastic bottles with warm water and placed them under the arms of the victims.

11. **Lifesaving improvisation:** Some of the ammunition the terrorist used included fragmenting ammunition, hence damage could suddenly occur in other parts of the body caused by tiny bullet fragments. A youngster brought to ex-ray suddenly developed alarming symptoms of a life-threatening intra-thoracic injury. He was immediately treated by the surgeon in the corridor darkness with a lifesaving chest tube. There was no time to bring him to an emergency room.\textsuperscript{183}

12. **An improvised outpatient clinic near the scene was** established at Sundvolden hotel by Hole and Ringerike municipality, to be able to treat the large amount of victims without sending them into the dangerous traffic situation towards ordinary outpatient clinics.

13. **No victims were sent home** after being discharged from the outpatient Clinic at Ringerike hospital. They were all followed by the technical staff across the yard to Ringerike DPS to be followed up with professional psychosocial care.

14. **Free of charge transport.** Discharged victims were brought from DPS to Sundvolden hotel for reunion with friends and family members, and further psychosocial care as soon as possible.

\textsuperscript{180} Waage et al. 2013
\textsuperscript{181} The trauma team generally consisted of a surgeon/orthopedic surgeon, an anaesthetist nurse, an emergency department nurse and an operating room nurse.
\textsuperscript{182} Waage et al. 2013
\textsuperscript{183} Sources: The surgeon as informant, and https://www.vg.no/nyheter/innenriks/i/3vM5e/maatte-operere-livstruende-skadet-utoeya-offer-i-moerket
Maxi-taxies were ordered as the patient busses did not have enough capacity. The taxi-drivers were glad to help, and did not want to be paid for their efforts.

Eight communication-related improvisations

15. **Family crisis centre #1.** The improvised outpatient clinic at Sundvolden hotel, also served as a family crisis centre, to be able to provide psychosocial support from the professionals to the victims and their families near the scene, and to help the families meet or identify their child.

16. **Ringerike DPS sent a psychosocial support team** to the scene (Sundvolden), Modum Bad and other healthcare institutions did also send professionals for psychosocial support.\(^{184}\)

17. **Crisis centre #2.** Hundreds of parents and other family members of the victims were searching desperately to find their child when contacting the hospital personally and by phone. There were hundreds contacting the hospital, and the system was totally overloaded. Consequently, Ringerike DPS improvised a crises centre at the hospital for the bereaved and survivors with family.

18. **Crisis centre #3.** Many parents and other family members desperate to find their child were met with a road blockade at Sollihøgda and were not allowed to drive to the scene. Consequently, Ringerike hospital and local municipality healthcare personnel improvised family crisis centre #3 at Sollihøgda café.

19. **Patient lists.** The tactical leader team decided to provide lists of hospitalized terror victims continually to the police to minimize the mental trauma of the many family members desperately searching for their child.

20. **Log registration.** The tactical leadership improvised a log registration system (on Excel) to collect data and document every detail that was happening. The purpose was to keep an overview of the situation, make good decisions based on real events, and to be able to make reliable answers to the many questions from the society.

21. **Police liaison.** The need for information, communication and collaboration between the tactical leadership and the police and the society made it necessary to have a police liaison at the hospital.

22. **Terror threat.** The hospital got a terror threat by telephone, and the technical staff used plastic ribbons to communicate that the hospital was closed for unauthorized visits, and patrolled the area wearing luminous vests.

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\(^{184}\) There were about 200 professionals and 1000 family members and survivors at Sundvolden hotel
The Norwegian law of privacy was unclear at this point. Many parents had been talking with their hunted child until their child was shot by the terrorist. Knowing if their child was hospitalized was the one of the best news they could hope for. The patient lists were based on an IDENTITIY-web, which is a communication related improvisation developed after a traffic accident with a tourist bus in 2004, where 45 Russian tourists were brought to the hospital. The identity challenges that day lead to the development of a database (IDENTITY-web) providing each trauma patient with an improvised ID number (“man 1, woman 1, woman 2 etc.”). This helps the professionals able to track the patients through the system until their real identities are known. The IDENTITIY-web was checked by the tactical leader a few weeks before the terrorist attack and was ready for use. This was crucial, especially regarding the children that were speechless because of their psychological and physical trauma. See also Chapter 7.2.2. Creativity and the Swiss cheese metaphor.

6.4.3.3. Why were so many trauma patients brought to Ringerike?

Sub-question 3: Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?

According to the regional requirements, severe trauma patients shall be brought to the trauma centre (in Oslo) if the distance to go is ≤30 minutes by car/air ambulance, as it normally is between Utøya and Oslo. If the transport time is >30 minutes, the patients shall be brought to the nearest (trauma)hospital for stabilization before transfer to the trauma centre. Our findings suggest the reason for bringing as much as 35 to Ringerike was a combination of four adverse conditions making the main road (E-16) and the air towards Oslo impassable to the ambulances. See also Chapter 7.2.2. Creativity and the Swiss cheese metaphor.

1) The second E-16-tunnel after Sollihøgda was closed due to the renovation of Nestunnelen. The bypass along the fjord was a long, narrow and twisty local road passing the evacuation area (Utvika). E-16 passes about approximately 12,000 vehicles daily.

2) Because of a possible bomb in the terrorist’s car, the police had to block the road at the first tunnel after Sollihøgda, sending the cars back via the roundabout nearby. This was leading to a heavy traffic congestion in both lanes over E-16 Sollihøgda, which is main road to the much larger hospitals in Oslo, Bærum and Drammen.

185 See also: Chapter 7.2.2. Creativity and the Swiss cheese metaphor, and Chapter 7.3.6. Creativity as a resource
186 Source: Statens vegvesen Region Sør «Rehabilitering Nes tunnel» Beskrivende del, Rapport 2012
187 Source: 1) Tactical leadership, 2) Dual commander, 3) one of the professionals at the improvised Family centre at Sollihøgda café, 4) Stiftelsen Tinius 2011 (media).
3) The ambulances were unable to pass through the narrow part of E-16 over Sollihøgda, because of a combination of traffic congestion and comprehensive cement barriers separating the road lanes (to prevent meeting accidents). Consequently, the ambulances had to decide if they should go the long and winding road around Lake Tyri and Drammen, increasing the distance to the trauma centre in Oslo by 90 km. and the larger hospital in Drammen by 50 km. and in Bærum by 97 km.

4) In addition, the flight following function over the Utøya area was insufficient, the air was foggy and was trafficked by up to seven helicopter-ambulances at the same time.

What seemed to be and adverse decision to the Norwegian Directorate of Health (Lereim et al. 2012), appeared to be a life-saving improvisation made by the ambulance professionals.

6.4.3.4. The underpinning of the local EMS

Sub-question 4: To what degree was the response to the Utøya terror attack based on continual improvement theory, culture and practice?

Outcome: In 2011 Ringerike hospital was permeated by a continual improvement culture that was initiated in 1995 and followed up by stepwise improvement efforts year by year (Thoresen 2011). In 2003, the facilitator of the BEST program was met by a leadership with the same quality improvement mindset when integrating the BEST program in their emergency preparedness and continual improvement system.

See:

- Chapter 3.1.5. Quality improvement history, Ringerike hospital
- Chapter 4.2.2. The Norwegian team-training concept (BEST)
- Chapter 7.2.1. The link between the EMS and the collaboratives
- Chapter 7.2.3. When sustainability and resilience work together

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188 Lereim et al. 2012
189 Professor Lereim, Dagsavisen 29. mars 2012
190 See Chapter 7.2.2. Creativity and the Swiss cheese metaphor, and Chapter 7.3.6. Creativity as a resource.
PART V. DISCUSSION

Chapter 7. What does this all mean?

7.1. Thesis statement

This PhD-project analyses the conditions for improvement and excellent care among high performing clinical teams and networks, aimed to contribute to the knowledge about why things go right in healthcare. Six conditions for improvement and excellent care were found through an interpretive synthesis of the results of three primary studies of successful improvement teams from the Learning collaboratives of NMA, and one study of a successful trauma care system:

1) *Invisible web of interaction.* Professionals with defined roles & tasks are working and learning together in multiprofessional teams, continually improving the care in an environment of mutual empowerment and a common desire to make a positive difference to the patient.

2) *Management by trust, knowledge and data collection.* Leading and continually improving the system, developing common, easy available plans with clearly defined roles & responsibilities.

3) *Fostering creative ability.* No plan can cover everything that may happen. In unpredictable situations the system can be insufficient or failing. With a good structure, knowledge and trust, improvisations can be made, maintaining communication, collaboration and interaction among professionals, patient and family, creating good solutions, protecting patients from the adverse consequences of an event, and allowing the team to be able to do what the situations demands

4) *Minimizing the number of handoffs* in the care process prevents adverse events

5) *Monitoring current practice and change.* Identifying key process and outcome variables, reflecting together on the variation, using control charts where time is a variable, and/or video-recording where the data appear simultaneous as it does at training sessions. Make decisions based on the findings. Reduced variation after an improvement can be an early sign of sustainability, as an ultimate target when based on interprofessional agreements. The power can be understood by the theory that the whole is more than the sum of its parts, and that this “more” is the interaction of the parts.

6) *Professional and improvement knowledge guidance.* Continual information about best practice, with easily available coaching when needed, integrated into daily work like yeast in a bread.

In the multi-method part of the PhD project, additional information about the historical and theoretical underpinnings of the high performing teams and networks has been collected. The trauma system was found to be in the sustainability stages of a continual improvement process, partly rooted in the same continual improvement thinking provided to the successful projects by the Learning collaboratives of NMA.

These results may be of help to leaders and stakeholders in making complex healthcare systems healthy enough to be able to produce health in collaboration with the patients in predictable and unpredictable situations, where sustainability and resilience is paradoxically working together.
7.2. Discussion related to the research questions

7.2.1. The link between the EMS and the collaboratives

Sub-question 1: Is there a link between the theoretical underpinnings of the high performing clinical teams and networks?

The rationale for this research question was to clarify to what degree the local EMS was a product of sustainable improvements based on the same managerial and quality improvement theory as the learning collaborative projects of the NMA. Ringerike hospital has included evidence-based quality improvement in their efforts of being a learning organization since 1996. The five learning organization (Senge 1994) disciplines are included in the continual improvement theory of Batalden & Stolz (1993).

leadership.

Box 1: The link between the theoretical underpinnings of the successful projects of the learning collaborative of the NMA and the theoretical underpinnings of the local Emergency Medical Service.

One of the most successful projects of the eight hospital-related learning collaboratives of the NMA, belonged to the intensive care (ICU) collaborative. The leader of the successful improvement team happened to be one of the innovators of the team-training program BEST.

The improvement team adapted and integrated a multiprofessional observation and communication system regarding the sedation of the ventilator patient in the ICU. The changes were based on the evidence that ventilator patients tend to be too heavily sedated, resulting in an unfortunate prolonged ventilator time. By multiple Plan-Do-Study-Act cycles, they were setting measurable aims, choosing appropriate small changes followed up by measurement to see whether the changes do lead to improvements. If so, the changes were incorporated in the department’s routines. Before this project, the management of sedation was at the doctors’ discretion. After the change the average ventilator time increased significantly. The project was published by BMJ (Brattebø 2002).

No follow up study has been made of the sustainability of the changes.

The team leader however, was applying the continual improvement approach when spreading the BEST program to 45 of the 50 Norwegian trauma hospitals from 2003 to 2006 (Wisborg 2008b).

Our qualitative Project study suggest that healthcare professionals learn improvement knowledge by participating in the learning collaboratives of the NMA (Brandrud 2011). The finding was confirmed in
a *professional conversation*\(^{191}\) with Professor Guttorm Brattebø that was aimed to produce knowledge about the issue. Brattebø learned the improvement theory and dissemination when he was leading one of the most successful improvement collaborative projects of the NMA, described in Box 1 (Brattebø et al. 2002). Brattebø and his innovation colleague Professor Torben Wisborg, (together with a surgeon and a medical educator) designed the spread of the trauma-team-training program BEST to the Norwegian hospitals on continual improvement theory. The innovators of the BEST program were using Plan-Do-Study-Act-thinking when spreading the concept to 45 of the 50 trauma hospitals. In addition, enthusiasm and creativity made the innovators and the local leadership able to apply and adapt the program the context of each hospital, in a way that is very well illustrated by the quality improvement formula of Batalden and Davidoff (2007)\(^{192}\). They were for example underpinning the sustainability by facing the limited resource situation that every Norwegian hospital is struggling with.

As illustrated in Figure 5, the quality of the BEST-program has been continually improved since the mid-nineties. This makes the program a “gold standard”, but it is still not a “magic bullet” that can guarantee sustainability without adapting it to the particular context, and being followed up by the Dixon-Woods & Martin (2016) comment on the context challenge:

> “The dynamic interplay between intervention and context means that it is often difficult, and indeed not always helpful, to separate intervention from context to the extent that transplanting a programme in its entirety from one setting to another is rarely straightforward. Excessive attention to QI interventions in the narrow sense (...) risks overlooking the impact of context on intervention implementation and, perhaps more importantly, the critical role of context itself as generative of safety and quality” (Dixon-Woods & Martin 2016).

At Ringerike hospital, creative solutions were found to limit the costs of their monthly training sessions. The training is held every second Thursday a month. The professionals who already are at duty that day are the ones who are training. The session is conducted in the hour between 08:00-09:00 without disturbing daily care because there are learning sessions scheduled at the same time every Thursday. The training is conducted in the ED room where trauma patients normally are admitted, using the equipment’s already there, at the place where they will find it in a real emergency care situation. The professional and improvement knowledge is baked into the session as effective as yeast in a bread. About ten years after the spread of the BEST program, about 50 percent of Norwegian acute care hospitals are fulfilling the criteria for competence and do regular trauma-team training (Dehli et al. 2015).

\(^{191}\) This qualitative data collection approach is defined in Chapter 5.2.4. *Data collection Multi method study*

\(^{192}\) See Chapter 4.1.2. *The Improvement Formula and Patient aim*, and Figure 4
7.2.2. Creativity and the Swiss cheese metaphor

Sub-question 2: What characterized the improvisations that were made as part of the local medical and psychosocial response to the Utøya terror attack?

7.2.2.1. Life-saving improvisations

Sub-question 3: Why were as many as 35 Utøya-victims brought to the local hospital, instead of bringing them to the trauma centre (as required by the Regional Health Authority)?

The Norwegian Directorate of Health reported failure in the distribution of trauma patients from Utøya to hospital (Lereim et al. 2012, Page 58). According to the regional requirement, within a transport time of <35 minutes trauma patients shall go to the Regional trauma centre. In other cases, the patient shall be brought to a nearer trauma hospital for stabilizing the patient before transferring the patient to the trauma centre.

Among the 55 trauma patients brought from Utøya to hospital, 45 were brought to Vestre Viken, and 12 to the trauma centre at University hospital 40 km away from Utøya, with normally a transport time of <35 minutes. Of the 45 patients brought to Vestre Viken, 35 were brought to Ringerike, seven to Bærum, and one to Drammen.

As illustrated by Reason’s “Swiss cheese” model, the hazards of complex systems are prevented from leading to adverse consequences by a series of barriers. Each barrier has unintended weaknesses, or holes – hence the similarity with a series of slices of Swiss cheese. These weaknesses are inconsistent – i.e. the holes open and close randomly. When by chance, all holes are aligned, the hazard causes harm (Reason 2000). Our findings suggest a series of five barriers where holes by chance were aligned 22 July 2011, making the road and the air towards Oslo impassable to the ambulances, as illustrated in the result section.\textsuperscript{193} The ambulance professionals represented the first human-related barrier preventing further human losses from the Utøya terror attack. The ambulance professionals did as recommend in the “third wave” of patient safety theory, that competent professionals are able to respond to the unexpected and rescue the patients from the consequences of adverse events (Ghaferi 2016).

\textsuperscript{193} See Result Chapter 6.4.3.2. What characterizes the many improvisations - 14 logistic related improvisations, Chapter 6.4.3.3. Why were so many trauma patients brought to Ringerike?
Creativity

The barriers to adverse events have to be system-related, and the better barriers innovated, the easier it for the professionals to avoid adverse events, but that is not enough.

Things go right because of the creative ability of highly competent individuals working, learning and training together in in multiprofessional teams, in a context of available equipment and a culture of trust and mutual empowerment, making them able to meet the needs of the patients in expected and unexpected situations.

Time matters in trauma care. By penetrating injuries, each minute from injury to treatment is increasing the death rate by 3-4 percent (Brattebø & Wisborg 2018). As described in the Result section by improvising a better alternative to the bad roads around Lake Tyri, the ambulances professionals were saving lives. The emergency preparedness at the local, trauma hospital 15 km north of Utøya island. Ringerike was the first of several “system-related barriers” that was functioning well, providing what the report of the Swedish Disaster Medicine Study Organization described as:

“the more than adequate reception at Ringerike hospital, clearly illustrating the importance of nurses and doctors having undergone trauma education (...) so that the hospital was capable of receiving patients in an incident like this” (KAMEDO 2012).

The second human-related barrier preventing further human losses, was the expansion of the capacity after 40 minutes. Almost all (34 of 35) patients arrived within 1 hour and 44 minutes (19:21 – 21:05,) and the most severe injured arrived from 19:45 to 20:25. The planned capacity of Ringerike hospital was 3-4 severely injured and up to 10 patients with minor injuries, but because the many trained professionals volunteering from holiday, leisure and turnover to participate in the trauma care, Ringerike was never short of personnel.

Fourteen of the trauma patients suffered from 28 gunshots, 14 had injuries from their flight from the perpetrator (fractures, wounds, an/or hypothermia from swimming in cold water) etc. Many victims had severe anxiety, respiratory problems and other trauma reactions, making some unable to speak. Three trauma patients were immediately transferred to the trauma centre in Oslo after initial treatment at the local hospital, four were transferred the next day for further treatment. All the 35 trauma patients brought to the local hospital survived (Waage et al. 2013).

194 Chapter 6.4.3.3. Why were so many trauma patients brought to Ringerike?
195 Dyregrov 2015
**Why things go right**

“Things do not go right because people behave as they are supposed to, but because people can and do adjust what they do to match the conditions of work.”

(Hollnagel et al. 2015)

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### 7.2.2.2. Good improvisations build on what exists and is working

We have identified 22 of the many improvisations made by the multiprofessional trauma and psychosocial care network that saved lives and prevented post-traumatic stress syndrome to the Utøya victims and their family 22 July 2011.

Our findings suggest that good improvisation were possible because of the good emergency preparedness system. When the interaction among the parts is limited, healthcare as a system (e.g. the EMS) may fall apart. The 22 improvisations presented in the Result section, were made to different kinds of compensate for interaction- and communication problems.

Their effectiveness can be explained by the theory of the ancient Greek philosopher and scientist Aristotle, that a system can only be understood as an integrated whole, because it is composed not only of the sum of its components but also by the relationship among those components²⁹⁶ (Ackoff 1994, Plsek & Greenhalgh 2001, Plsek & Wilson 2001, Zimmerman et al. 2008, Holmes et al. 2011).

This phenomenon is called emergence in complexity theory. Emergence is a product of the interaction of the parts. In complex systems like a healthcare service, relationships are key, producing more (something else) than the parts alone are able to produce.

Our findings indicates that a healthy emergence involves creativity. Emergence however must build on what exists and is already working (Westley et al. 2007).

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**Good improvisations build on what exists and is already working**

- “Cooperation, and that we knew each other well helped us manage the situation. It would have been very difficult to be alone. We needed each other in making the right decisions”.
- “Structure and competence makes room for improvisation”.
- “The action cards freed up mental capacity to improvise (…)”.
- “Easier to improvise because we have regular training, both as individuals and together with the others in the team. Enough to understand each other and to know where we had to improvise.”

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²⁹⁶ See Chapter 4.1.3. Complexity theory and 4.1.3.2. Complex adaptive systems
7.2.3. When sustainability and resilience work together

Sub-question 4: To what degree was the response to the Utøya terror attack based on continual improvement theory, culture and practice?

7.2.3.1. Sustainability and Continual improvement

In 2011 Ringerike hospital was permeated by a continual improvement culture that was initiated as early as 1995\(^{197}\), and followed up by stepwise improvement efforts year by year (Thoresen 2011). In 2003, the innovator and facilitator of the BEST program\(^{198}\) was met by a leadership with the same quality improvement mindset when integrating the BEST program in their emergency preparedness and continual improvement system.

Sometimes quality improvement projects (like those in a national wide learning collaborative) are the right way to solve particular quality and patient safety challenge of healthcare, for example where experience and evidence suggest a plausible solution (Dixon-Woods & Martin 2016).

The outcome of our Project study suggest a few generalizable conditions that may be of help in the improvement process of others (Paper 2). Our qualitative project study (Brandrud et al 2011) suggest that the learning collaboratives of the NMA primarily have spread the knowledge of how to make improvements in a complex healthcare system. A personal conversation with Dr. Batalden (one of the IHI learning collaborative innovators) convinced me that this was exactly what he and the other the innovators were hoping for.

After studying the successful horizontal trauma care network, their achievements, culture, roots and history, the extent of making an innovation sustainable was rolled out. First, sustainable improvements needs a god start. A good start is possible if we develop a dedicated team to take care of the change-making, progressing step by step in accordance with the Model for Improvement. Our findings also indicates that if the change can be seen as an experiment that has an end (a project), it may be easier to engage the professional environment in testing the changes, because they do not feel so tied up, waiting for the result before deciding to fully integrate the changes in their daily work.

Sustainability, however, is not only dependent on a good start. Threats to sustainability may be identified both at the beginning of a project and later (Silver et al. 2016). While an experiment may

\(^{197}\) See Chapter 3.1.5. Quality improvement history, Ringerike hospital, Chapter 4.2.2. The Norwegian team-training concept (BEST), and Chapter 7.2.1. The link between the EMS and the collaboratives.

\(^{198}\) See Box 1
go well without much management involvement in the first place, ultimately sustainability is totally dependent on the management’s responsibility and follow up. After a change has been made, and daily work takes over again, sustainability can be as difficult as “turning a tanker in a puddle”.

In the daily work of a healthcare professional, we always have to prioritize our attention. Providing excellent care is challenging. Systematic reviews indicate that mindfulness practice reduces stress in practicing physicians and results in lower levels of burnout, anxiety and depression. Solheim et al. (2016) argue that mindfulness may enhance supportive listening, and empathic understanding, promoting the quality of the therapeutic alliance, which has been found to strongly impact treatment effectiveness. As professionals, we have a lot of difficult tasks and decisions to make that can be in conflict with the attention we need to pay the new routines to be able to perform the difficult tasks right. Skipping new routines on behalf of old habits is tempting, because it will free our capacity to concentrate on what is really challenging our efforts in the actual situation, and therefore this is so easy for us to do, even if we agree to the new routines.

This means reprogramming our inner autopilot well, is a time-consuming task. Training, however will speed up the process towards sustainability. A good structure of easily available guidelines with clear roles and responsibilities, developed together with the performers to increase their ownership to necessary changes, and reminders of different kinds, are feeding our ability to “multitask well”. Action cards appeared to be crucial to the trauma teams in action 22 July 2011, serving as checklists for good practice, making it easier to meet the unexpected and free the creative capacity to make necessary improvisations.

Pop-ups on a computer, white boards or wall papers with control charts displaying the variation of core processes and improvement huddles are other examples of reminders that can be of help in combination with a mindful awareness including qualities such as curiosity and openness to the actual situation.

The sustainability of quality improvement approaches in healthcare is an area of emerging research. In a systematic review Lennox et al. (2018) identified five distinct definitions of sustainability. Assessing the hospital part of the local EMS network by the five definitions of sustainability, I am suggesting that the hospital part of the local EMS was based on a sustainable trauma care and training

199 Se Chapter 3.2.4. Mindfulness versus Mindlessness
200 Kahneman 2011
201 Hysong et al. 2005
202 Silver et al. 2016
203 See Chapter 7.2.4.1. Discussing intervention & sustainability stages - Findings of others Item 17 & 19: The manager’s follow up/sustainability
204 See Chapter 4.3.1.5. Research on sustainability
system (BEST), embedded in a sustainable emergency preparedness system (structure, competence and a continuous improved emergency preparedness plan), embedded in a continual improvement culture.\textsuperscript{205}

We must not forget, that enthusiasts “burning” for a particular change with impact on the leadership and the professional environment to sell it in, has been powerful drivers in the BEST-innovation movement (Wisborg 2008b). Even with the perseverance of the management, and a culture and history that are able to embrace the change, it can still take many years before a change is made sustainable, in the way that BEST is integrated in the trauma system at Ringerike hospital as target for continual improvement. Batalden & Stolz (1993) suggest that transforming a healthcare organization so that it is capable of continual improvement requires determinants including:

- Development of new knowledge, and creation of leadership policy that fosters a shared sense of purpose and promotes organizational learning\textsuperscript{206}
- Mastery of tools and methods that accelerate improvement of work, and application of systematic strategies for building and using knowledge to the process of daily work.

When Dr. Brattebø and colleagues were supervising the professionals at Ringerike hospital in applying and adapting the BEST model, he was met by a leadership characterized by a combination of enthusiasm, knowledge and creativity. The continual improvement history, and the Pilot hospital selection by the Norwegian Ministry of Health and Care (Thoresen 2011) indicates the conditions for sustainability are met.

**Reduced variation as an early sign of sustainability**

Reduced variation is an observable, first sign of sustainability, when based on interprofessional communication and agreement.

Interaction based on interprofessional training and communication was a crucial condition for the successful local medical response after the Utøya terror attack 22 July 2011.

The power of interprofessional communication and agreement is explained by the theory that the whole is more than the sum of its parts, and this “more” is provided by the interaction of the parts.

\textsuperscript{205} See Chapter 3.1.5. *Quality improvement history, Ringerike hospital*

\textsuperscript{206} Ref. Chapter 3.2.5. *Organizational learning and mastery climate*
We have found in the Project study that control charts are easy to understand and communicate to the peers in the site. As shown in the example in Appendix 4, control charts can be used to promote sustainability, if the leader is following up the changes by the help of a control chart. A good sign of sustainability is when the process is varying stable and predictable around a desired performance level on a control chart, and the variation is significant reduced (because the professions agree on the changes they have made).

7.2.3.2. Resilience and Continual improvement

Resilience theory comes from ecological science, and should not be confused with the Resilience concept, which is related to engineering resilience. Resilience theory is emphasizing the importance of the creative ability, offering a new way of understanding the world and a new approach to managing resources. It embraces human and natural systems as complex entities continually adapting through cycles of change, and seeks to understand the qualities of a system that must be maintained or enhanced in order to achieve sustainability (Gunderson & Holling et al. 2002).

In Paper 3 we are assessing the interaction of four determinants to be universally applicable in the continual improvement of health care services, reflecting important conditions for resilient and safe care, without particularly discussing how we came to the conclusion regarding resilience, which will be discussed here.

Abduction is an analysis method where we first observe a fact, and then explain how it happened by using a theory. Since there may be more theories that can explain the same fact, abduction implies an inference to find the best explanation. The study of what conditions high performing clinical teams and networks need to make things go right is suggesting four determinants: 1) structure and competence based on continuous planning, training, and learning; 2) leadership based on knowledge, trust, and data collection; 3) empowerment through multi-professional networks; and 4) ability to improvise based on structure and competence.

The question is if our findings are reflecting important conditions for resilience. From a complexity science perspective, resilience theory show how ecological, social and political systems works:

"Resilience is the capacity to experience massive change and yet still maintain the integrity of the original. Resilience is not about balancing change and stability. It is not about reaching and

\[\text{Resilience theory}\]
\[\text{Resilience concept}\]
\[\text{Complex adaptive systems, Resilience theory (the adaptive cycle), The Clinical Microsystems concept, and Normalization Process Theory (NPT)}\]
equilibrium state. Rather, it is about how massive change and stability paradoxically work together” (Westley, Zimmerman and Patton 2007).

Complexity scientists have defined healthcare as a complex adaptive system. The adaptive cycle in ecological resilience theory (see Chapter 4.1.3.3. Resilience theory) is underpinning the readiness for change to meet the continual changes in the environment (society), and yet still maintain the integrity of the original.

Making sustainability and resilience work together

“Laurels are food—they are not to rest on”

“You have no guarantee that a preparedness that was functioning well in one situation will continue to perform well in future situations. This is why it is so important to continually improve the entire emergency preparedness system.”

(May Janne Botha Pedersen 2018, Director Ringerike hospital)

The history of Ringerike hospital show their resilience by how they are avoiding the two traps of the adaptive cycle. The rigidity trap (failure to release the creativity ability of innovation), and the poverty trap (renewal impossible to achieve because the process of testing new ideas is rejected).

The continual planning training and learning at Ringerike in collaboration with the municipalities has been an adaptive resilience cycle of “Patient-focused-redesign”-efforts over many years, making the care as seamless as possible, which was leading to a position as a national pilot hospital in 2009 (Thoresen 2011). The healthcare system in action 22 July 2011 was a resilient product of the emergence between the “BEST-culture” and the “Patient-focused-redesign-culture” at Ringerike hospital. A resilience culture that was continually responding to changes in the environment and in the evidence-based practice by necessary changes.

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210 Psek 2001 (Crossing the quality chasm Appendix B). See also Chapter 4.1.3. Complexity theory
211 See also Chapter 7.2.5.2. The complexity of a successful healthcare service
The invisible web of interaction

Resilience theory is comparing the adaptive cycle with a burning forest,
that is storing seeds and nutrition under the soil,
in an invisible “wood wide web” of roots and mushrooms
making a new and healthier wood grow out of the ashes *).

The adaptive cycle of Ringerike hospital is not that dramatic,
but we have found a crucial, but invisible “web of interaction” under the surface,
making the professionals able to find creative solutions to unexpected situations
and still maintain the integrity of the emergency care of the patient and family,
even when the unthinkable happens.

*) A personal conversation with a researcher at the Norwegian Institute for Nature Research in January 2019 is confirming that research on the “wood wide web” is a growing field of science. 212 (See also Chapter 7.3.2. Resilience and the invisible web of interaction).

Efforts at the local hospital has been made to spread the team-training program to other disciplines since 2011, entail hard priorities within a limited resource situation, illustrating a never resting improvement desire of the leadership as a sign of resilience. I am suggesting that the four determinants we have found in the study of the conditions for this successful and sustainable healthcare service can be universally applicable by others, as conditions for the development of a resilient and safe care. The determinants however, are closely related to the theoretical underpinnings reflected in this thesis.

212 Tor Erik Brandrud – Norwegian Institute for Nature Research
7.2.4. Comparing intervention and sustainability stages

Specific research question 1: Learning from high performing clinical teams and networks: What are the conditions for successful improvements and excellent care in the intervention stages vs the sustainability stages of a continual improvement process?

This chapter is focusing on what we have learned from high performers about why things go right in the intervention stages and in the sustainability stages of continual improvement processes. Table 6 is comparing conditions for success in the intervention versus the sustainability stages of continual quality improvement (CQI), showing what item is found as a result in the Project study (the intervention stages and the theoretical underpinnings of the learning collaborative approach) versus the Sustainability study (the local EMS in action 22 July 2011) and in the multimethod study of the historical and theoretical underpinnings of the service. Table 6 is indicating the sources of the items, while the reference frame of each item is described in Appendix 3 table A and B.

Definitions Table 6:

*) Source means the source behind the identified practice related to each item. In the intervention stages of a continual improvement process, each item belong to the learning collaborative concept of IHI, or to the Norwegian version of the IHI learning collaborative organized by the Norwegian medical association (NMA). In the sustainability stages, each item belong to the BEST-program in general, or to the hospital wide continual improvement program of Ringerike hospital (RS).

**) Over 90 percent of the improvement teams were emphasizing the importance of this item.

***) Ringerike hospital was a pioneer on Statistical process control. SPC was first used as a multi-professional management tool at the Maternity ward over many years, and was later included in the Pilot hospital project to make it a hospital wide part of the care. An electronic monitoring system (“MAP”) on existing data from the recording system was developed to bring continual information based on real-time data to the professionals and their leaders at the micro- meso- and macro level. Just as the prototype was ready for use, the hospital was merged into Vestre Viken Health trust.\textsuperscript{213}

\textsuperscript{213} See what happened in the footnote of Chapter 3.1.5. Quality improvement history, Ringerike hospital
<table>
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<th>Items belonging to the six conditions for making things go right</th>
<th>Intervention stages of continual improvement</th>
<th>Sustainability stages of continual improvement (Local EMS)</th>
</tr>
</thead>
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<td></td>
<td>yes</td>
<td>yes</td>
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<td></td>
<td>limited</td>
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<td>Source*</td>
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</tbody>
</table>

**Part A: Connecting patient aim and science informed practice with the particular context**

| 1  | Training & coaching multiprofessional teams | v       | IHI | v       | BEST |
| 2  | Senior expert influence                    | v       | IHI | v       | BEST |
| 3  | Grounded in the professional environment   | v       | IHI | v       | BEST |
| 4  | Patient aims                               | **      | NMA | v       | BEST/RS |
| 5  | Cont'd info about best & current practice  | v       | NMA | v       | BEST |
| 6  | Web of (multiprofessional) interaction     | v       | IHI | v       | BEST |
| 7  | System focus                               | v       | IHI | v       | BEST |
| 8  | Improvement efforts well organized         | v       | NMA | v       | BEST |

**Part B: Facilitating multiprofessional reflection and interaction**

| 9   | Monitoring practice and change efforts     | v       | NMA | v       | RS    |
| 10  | Small-scale testing (PDSA)                 | v       | IHI / NMA | video | BEST |
| 11  | Self-assessments of teams                  | v       | IHI | v       | BEST |
| 12  | Available measurement guidance             | v       | NMA | v       | video |
| 13  | Good guidance & help with measurements     | v       | NMA | v       | RS*** |
| 14  | Learning SPC (important to succeed)        | v       | NMA | v       | RS*** |
| 15  | Control charts easy to communicate         | v       | NMA | v       | RS*** |

**Part C: Managing sustainable improvements and excellent care**

| 16  | Decreasing the number of handoffs          | v       | v    | RS     |
| 17  | Manager engagement & empowerment           | v       | v    | BEST  |
| 18  | Knowledge based creativity                 | v       | NMA | v       | BEST |
| 19  | The managers follow up (for sustainability)| v       | IHI | v       | RS    |
| 20  | Spreading a continual improvement culture  | v       | IHI | v       | RS    |
| 21  | Spread improvements to other areas/units   | v       | IHI | v       | RS    |
7.2.4.1. Discussing intervention & sustainability stage conditions

The items Senior expert influence, System focus and Improvement efforts well organized and Knowledge based creativity are so deeply intertwined in the theory and practice discussed in this thesis, that they will not be further discussed here.

The discussion of the other items will focus on our findings versus the findings of others regarding the patients’ role in healthcare, the handoff challenge, measurement and the use of SPC, improvement and measurement guidance, the leaders’ role in continual improvement, and the challenge of spreading successful services to other parts of healthcare.

7.2.4.1.1. THE ROLE OF THE PATIENT IN HEALTHCARE

FINDINGS ITEM 4: PATIENT AIMS

Ringerike hospital has since the mid-nineties had a strong focus on the patient perspective of the care as a process, and with a level of patient engagement that has only been seen in the Microsystem movement. Ringerike hospital designed the care by focusing on patients’ perspectives on the journey through healthcare already since the mid-nineties. This was reflected in the seamless care of the trauma patient 22 July 2011, where the same trauma team stood by the patient through the entire acute care process, preventing handover-related adverse events. The first version of the learning collaborative model was not focusing on the patient’s perspective on the care process, taking for

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**The importance of patient focused targets**

More than 90 percent of the 132 responding improvement teams answered that patient focused targets was a condition for making the professional environments engage in the improvement efforts.

This is indicating the importance of removing barriers that are making it impossible for the professionals to take pride in their work.

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granted that this was covered by the professional knowledge (see Kilo 1998). A typical consequence is shown in the “Early intervention in Psychiatric disorder”- collaborative of the NMA, where only five (29%) of the 17 improvement projects were successful (see Appendix 2). To reach their target, the participants were highly dependent on the interaction between primary care and the hospital part of the horizontal care process, but only hospitals were invited by the collaborative.
Consequently, most improvement teams did not include the entire horizontal care network (mesosystem) in all stages of the project. Those who did, however, achieved remarkable improvements. For example, by reducing the time between first time referrals of first episode psychosis by 70 percent from 18.9 to 5.6 days, and reducing the average age of first time admitted patients by 33 percent from 30 to 20 years (See Paper 2, Supplement 3, Table 1, and Figure 2 and 3, Project ID 51-54).

**FINDINGS OF OTHERS ITEM 4: PATIENT AIMS**

The *Patient focused redesign* method of Ringerike hospital was inspired by the business redesign approach of Leicester Infirmary in England (see Chapter 3.1.5. *Quality improvement history, Ringerike hospital*).\(^{214}\)

The patient’s journey through healthcare as a whole, where a poor interaction is mostly experienced by the patient only, feeling helpless when facing the consequences that are not always understood by the professionals. During the last ten years, however, there has been a fundamental shift in the patient’s role in healthcare, for example in the wake of the knowledge based Clinical microsystem movement, where the patients, their family and the healthcare personnel are defined to be part of the same system. Nelson et al. (2008), defined the horizontal patient process to be a mesosystem of interrelated clinical microsystems.

In an essay about the modified version of *The quality improvement formula*,\(^{215}\) Paul Batalden emphasizes that quality improvement must acknowledge patient coproduction. Modelling healthcare as either a product or a service neglects essential aspect of coproduction of health. Coproduction between doctors and professionals bring different expertise, knowledge and experience to their shared interactions of a healthcare service.\(^{216}\) According to his modified model, a healthcare usually is composed of a relationship and an action:

> “*When a trusted health professional explores a patient’s need, a relationship is formed. This relationship is key to agreement and to share actions that might follow, such as procedures or drugs. Patient and professional are held together by knowledge, skill, habit, and willingness to be vulnerable. (…) A willingness to be vulnerable arises from being fully present and able to fully engage another person*” (Batalden 2018).

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\(^{214}\) See also “The findings of others, item 16: Reducing the number of care handoffs”.

\(^{215}\) See Chapter 3.2.2. *The Clinical Microsystem concept*

\(^{216}\) See Chapter 4.1.2. *The Improvement formula and Patient aim*
The quote reminds me of how impressing it was to me as a researcher to observe how the communication and body language of the focus group members showed a strong relationship to each other and to the trauma patients from Utøya, their willingness to be vulnerable, and how they were in this together (with the patients).

In a recent study of the psychosocial care for hospitalized young survivors after the terror attack on Utøya Island, Bugge et al. (2018) found that talking with the hospital staff about their traumatic experiences was mostly perceived as positive and linked to various helpful outcomes. In addition to engaging in the trauma narrative, the staff needed to comprehend and address how the traumatic experiences and the hospitalization resulted in the survivors’ extended fear and changed appraisals about the world and themselves. Having the time to stay physically and mentally close to the youths and engage in everyday interaction was crucial in rebuilding their sense of safety and bringing back normalcy. The hospital staff played a significant role in strengthening the survivors’ confidence in own capabilities and trust in others. The different professionals in the hospital contributed to various aspects of psychosocial care, and both trauma-focused interventions and commonplace conversations and actions were emphasized as important and meaningful approaches.

7.2.4.1.2. THE HANDOFF CHALLENGE

FINDINGS ITEM 16: DECREASING THE NUMBER OF HANDOFFS

The importance of a seamless care continuum with as few handoffs as possible has not been focused by the IHI learning collaborative concept, nor by the collaboratives of the NMA. However, we have found examples of projects collaborating with the municipalities from day one of the project with great success (see Item 4 above “Findings item 4 Patient focused targets (engaging)”.

Ringerike hospital, however, has been working to solve the problem since the millennium shift (see Thoresen 2011, and Chapter 3.1.5. Quality improvement history, Ringerike hospital).

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**Decreasing handoff-related adverse events**

At Ringerike hospital in collaboration with the municipalities, the development of seamless, horizontal care networks has been a target since 1996

22 July 2011, the trauma teams stood by their patient during the entire acute care process, to prevent deadly, handoff-related events.
FINDINGS OF OTHERS ITEM 16: DECREASING THE NUMBER OF HANDOFFS

Dixon-Woods & Pronovost (2016) propose that one neglected reason why the safety problem has proved so stubborn is that healthcare suffers from a pathology known in the public administration literature as the problem of many hands:

“It is a problem that arises in contexts where multiple actors – organizations, individuals, groups – each contribute to effects seen at system level, but it remains difficult to hold any single actor responsible for these effects. Efforts by individual actors, including local quality improvement projects, may have the paradoxical effect of undermining system safety. Many challenges cannot be resolved by individual organisations, since they require whole-sector coordination and action. We call for recognition of the problem of many hands and for attention to be given to how it might most optimally be addressed in a healthcare”. (Dixon-Woods & Pronovost 2016)

The seamless trauma care processes provided by the trauma teams at Ringerike hospital 22. July 2011, belong to their preparedness plan, and has been recommended by The Joint Commission and others documenting mortality related to handovers in the acute trauma care process (Gruen et al. 2006, JCAH 2007, Stahl et al. 2009, Zakrison et al. 2017).²¹⁷

7.2.4.1.3. MEASUREMENT AND THE USE OF SPC

FINDINGS ITEM 5, 9-11 & 14-15: MEASUREMENTS

Interprofessional reflection on common practice

The interprofessional reflections on common practice based on the BEST concept, is a role model for how to come together and analyse displayed variation from all kinds of data produced in common practice.

PDASA

Monitoring variation and change with Statistical Process Control (control charts) is associated with success in the Project study, and in the pilot hospital report of Ringerike hospital. Small scale testing in Plan-Do-Study-Act cycles²¹⁸ however, have seldom been found in the learning collaborative projects of

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²¹⁷ See “The findings of others, Item 4. Patient focus” for more information about the findings of others.
²¹⁸ See Figure 3, The continual improvement cycle
the NMA, according to the 189 final reports. It has not been easy for the coaches to convince clinicians of the necessity to test a change before it is implemented. Small-scale change testing could have earned the benefit of “returning” to a stage where you have been before, but on a higher reflection and knowledge level for each return.

SPC

Our findings suggest successful improvement teams find Control charts easy to understand, if they have access to skilful coaching. Access to data and measurement guidance is a resource that should have been available at all clinical units.

SPC is not relevant for simultaneous data. We have seen in the final reports that some teams have plotted simultaneous data from a session (course evaluation results) on a control chart as if time was a variable. Because their data were produced at the same time, they had to create a manipulated order of data to make it look like time series, on a chart that was producing false statistical signals.

Observation is measurement. When the data are produced simultaneously as in a training session, video recording can play the role of measurement in a Plan-Do-Study-Act cycle. A video from a training process in real time, is displaying a much broader scope than a single variable on a control chart can provide. This is helping the team to assess and discuss their own performance from various perspectives, give each other feedback on things that went well, debrief if necessary, and discuss possible improvements, regarding leadership, the care, the system, technical skills, interaction and communication.

The Project study indicates that skilled SPC guidance is associated with success in the improvement projects of the Learning collaboratives of the Norwegian Medical Association (NMA). Suggesting that control charts are easy to communicate to the peers in the site, presenting measurements continually was maintaining the motivation in the improvement process. This achievement is based on the efforts of the NMA after the millennium shift, providing their coaching team with an effective SPC-education. Not all the improvement knowledge experts of the coaching team were interested in measurement. The challenge was solved by a mentorship between skilled and less skilled SPC-coaches.

Measurement is never easy, but with skilled guidance it is possible to end up with something that is easy to communicate in the professional environment. SPC belong to one of the simplest statistical techniques and control charts are easy to analyse. Without proper guidance the development of reliable measurements can be a barrier to the majority of the healthcare professionals who are not familiar with “simple measurements” or with identifying key variables to monitor variation and change.
FINDINGS OF OTHERS ITEM 5, 9-11 & 14-15: MEASUREMENTS

Strating et al. (2011) found in a multiple case study of improvement collaboratives that that creating measurability and formulating challenging and achievable targets is one of the crucial tasks for the program managers.

PDSA

The Plan-Do-Study-Act (PDSA) cycle is a commonly used improvement process in health care settings including measurement, although its documented use in pragmatic clinical research has been rare (Taylor et al. 2014), and the process has been translated into healthcare with failure to invest in a rigorous and tailored application of the approach (Reed & Card 2016). Too often improvement teams go through the motions of PDSA cycles without really embracing its spirit or applying its scientific method (Leis & Shojana 2016).

SPC

In a systematic review of healthcare improvement efforts, Thor et al. (2007) found statistical process control (SPC), to be a useful measurement method for those who mastered the technique. In a recent systematic review of the use of SPC to measure the success of pressure ulcer prevention, Clark et al. (2018) found that SPC methods have been reported in nine publications since 2010 to interpret changes in the incidence of pressure ulcers over time. While these methods offer rapid interpretation of changes in incidence than is gained from a comparison of two arbitrarily selected time points pre- and post-implementation of change, more work is required to ensure that the clinical and scientific communities adopt the most appropriate SPC methods.

I am surprised to what (small) degree the quality and safety improvement studies are presenting their improvements on control charts, and if they do, the charts are not provided with sufficient informative head titles, axis titles and subtitles, and sometimes the charts are very strange.

Hendricks (2015) has monitored the adherence with oral antiemetic agents in patients with breast cancer receiving chemotherapy, by a chart they are calling run-chart in the Abstract and p-chart in the text, that is not a run-or a p-chart, but a strange chart with non-symmetric control limits.

Even if the easiest part of SPC is to analysing the chart, proper guidance is still needed. Roberts et al. (2018) were using PDSA and SPC in the improvement of the communication of patient issues on transfer out of intensive care. Perfectly applying the PDSA cycle, they conducted six cycles of change,

\[219\] Read more of what others have found in Chapter 4.1.1.7.3. Benefits and challenges of the PDSA cycle
monitoring the process on a control chart. The problem is, however that several shifts of level in the desired direction that are “found” that are not real.220 This is a very important improvement initiative that should be followed up by involving a skilled coach on SPC, and engaging the involved professionals at both sides of the transfer in the future improvement cycles.

Papers like this are leaving an impression that recognized Journals (impact factor 1.2) lack competence regarding statistical process control.

In a study of the use of control chart for guiding decision making, Schmidke et al. found that people may have problems interpreting graphs in general. Referring to Rakow et al. (2014)221 they suggest that it is an important step to help these people to carefully construct the graph so that the axes provide the right information (e.g., mortality vs survival).

The same problem is observed in the chemical and process industry. Woodall (2000), discussing controversies and contradictions in SPC, is suggesting that useful advances in control charting methods have not had a sufficient impact in practice, citing Crowder et al. (1997), stating: “There are few areas of statistical application with a wider gap between methodological development and application that is seen in SPC”222.

Run-charts are often recommended by experts because they are easy to construct by hand. (Perla et al. 2010). I am still surprised to what degree run-charts have been recommended by experts knowing that runs charts are not capable to differ between variations caused by routine practice or variations caused by other things, which should be one of the main reasons for monitoring processes with SPC (see Chapter 4.1.1.4. Statistical process control.).

Schmidtke et al. (2017) argue that if people do not know what control lines represent, they will probably ignore them. They are referring to the research of Zikmund-Fisher’s et al.223 who found that people are largely unfamiliar with control charts and experience difficulty interpreting them. Schmidke

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220 Making breaks based on single points above the upper control limits is not right, such point are signals of something special happened that is not part of the present routine practice, and is therefore not a shift of a routine practice level. They also claim to have four special cause variations indicating a process change. They may have achieved one shift of level in the desired direction compared to baseline, if ≥7 consecutive points above baseline is enough. According to Wheeler (2003) ≥8 points are required if ≥20 datapoints (Wheeler 2003). Consequently, their have one shift of level in an undesired direction (at cycle 2). Compared to this low Cycle 2 level, Cycle 4 indicate a shift in the desired direction but not to baseline.


et al. conclude that this is not a problem with control charts, but rather the users’ ability to interpret them, and that this barrier may be overcome with educational interventions.

The emerging research on sustainability presented in a recent systematic review of Lennox et al. (2018) did not have stable and predictable processes with reduced variation on control charts among the sustainability evaluation approaches. Only qualitative criteria were found. Control charts would however (as presented in Appendix 4), have been one of the easiest and best communicable approaches to a manager in following up the sustainability of an improvement.

The findings of others indicate the international field of quality and safety improvement have not fully understood the power of the SPC method in quality and patient safety. This can, according to our findings, be improved with a combination of access to their own data, access to measurement guidance and access to control chart software.

7.2.4.1.4. IMPROVEMENT AND MEASUREMENT GUIDANCE

FINDINGS ITEM 1, 12 & 13: IMPROVEMENT KNOWLEDGE GUIDANCE

Paul Batalden was one of the IHI learning collaborative innovator, In spite of his continual improvement theory (Batalden & Stolz 1993), where he is emphasizing that an integration of professional and improvement knowledge is a condition for continual improvement, coaching was not included in the learning collaborative concept. Batalden had to take the cultural challenges at that time seriously:

“From a physician’s perspective quality improvement is another in a long string of administrative maneuvers focused on cost control; few physicians took the activities of “improvement” efforts seriously.” (Hence…) “IHI maintains a primary focus on the clinical subject matter, not quality improvement methodologies” (Kilo 1998)

In the sustainable trauma system of Ringerike hospital, coaching has been integrated in the program as effective and invisible as yeast in a bread (see Paper 3 Box 1 and 3.) This means the system has met the criteria that “change making has become an intrinsic part of everyone’s job, every day, and in every part of the system” (Batalden and Davidoff 2007).
**Improvement guidance**

In contrast to the first version of the IHI learning collaborative concept, improvement guidance was emphasised as an important investment by the learning collaborative organizers of the NMA. Already from the first collaborative, the NMA invested in a multiprofessional team of quality improvement advisors. The coaches were educated and trained in knowledge-based measurement and guidance, and followed up by an internal mentoring system.

Our findings in the qualitative and quantitative Project studies, indicates that this was a highly rewarding investment.

**FINDINGS OF OTHERS ITEM 1, 12 & 13: IMPROVEMENT KNOWLEDGE GUIDANCE**

The role of qualified improvement knowledge guidance has received surprisingly little attention in the quality improvement literature (Spencer & Walshe 2009, Kaplan et al. 2010, Glasgow et al. 2012). Øvretveit argued in 2002 that research shows collaboratives need to develop the understanding of change theories as well as specific change skills, and for analysing and managing the politics of change. Some collaboratives, however, do not give sufficient time to this, or developed knowledge but not skills. He concluded that teams need help to understand how best to achieve change within their own organisational culture. (Øvretveit et al. 2002).

In 2012, Paul Batalden participated in a cluster-randomized trial concluding that coaching was the most important and cost-effective element of improvement collaboratives (Gustafson et al. 2013). Godfrey 2013 and Godfrey & Andersson-Gare et al. 2014 have also found positive effects of clinical-level coaching (see Chapter 4.1.4. **Improvement process guidance (coaching)** and Chapter 4.3.1.4. **Improvement guidance (coaching) studies**).

**7.2.4.1.5. THE LEADERS’ ROLE IN CONTINUAL IMPROVEMENT**

**FINDINGS ITEM 17 & 19 THE MANAGER’S FOLLOW UP/SUSTAINABILITY**

Management was not found to be associated with success in the quantitative Project study. This makes it hard to believe that even successful changes in a learning collaborative period will be sustainable. A poor association between leadership actions and successful improvements are not proof of causality where the leadership has been randomly bypassed by a powerful national learning collaborative, and the target group of the guidance has been the improvement teams only, and not the healthcare managers.
Management

Our findings suggest that management by trust, knowledge and data collection,
and the development of good teams,
is promoting the interaction, and the quality of the work.

The basis is continuous learning, training and improvement,
and easy available plans with clearly defined roles & responsibilities.

According to the findings of others (see below), management is associated with success if the leaders are involved in the project from day one, and have access to improvement knowledge guidance. Some leaders were included in the Learning collaborative of the NMA as a member of the improvement team and coaching efforts with measurable, good outcomes (see example in Appendix 4), but this was not a systematic approach of the collaborative, and therefore random engaged leaders were statistically invisible.

FINDINGS OF OTHERS (17&19): THE MANAGER’S FOLLOW UP/SUSTAINABILITY

The managers role in continual improvement

In a systematic review of the research of leading improvement effectively, Øvretveit (2009) found few empirical studies of leading improvement. Associations discovered in research between leadership actions and improvement are not proof of causality. Some studies are too ready to imply this, but do not have evidence of causality.

An independent study of the Jönköping Quality program, found research reporting that Jönköping is one of the few health systems that have been able to sustain a significant program of improvement. The study, however, found limitations as lack of measurement and physician involvement, and less evidence of the costs or savings of the program or projects. The study concludes that the study illustrates how much energy, resources, dedication, and consistency are needed to achieve measurable better patient outcomes in some departments (Øvretveit & Staines 2007).

The theory of Argyris (1997) of double loop learning in organizations is a reminder of what it takes to achieve sustainability224. Hovlid et al. (2012) show how they gained a deeper understanding of the clinical system and interdependencies by applying the framework of organizational learning. The show how clinicians and leaders who were sharing information about their everyday work related to the improvement of clinical pathways, became increasingly aware of how different elements needed to

224 See Chapter 3.2.5. Organizational learning and mastery climate
interact to enhance the performance and how their own efforts could contribute. They concluded that by double loop learning, deeper system properties are changed, and more likely to be sustained.

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The managers role in successful changes

Management cannot be expected to be associated with successful changes if the leaders are not included in the improvement guidance, and are only randomly involved in the process of planning, executing and following up the quality improvements from day one.

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NHS Institute for Innovation and Improvement have designed a Sustainability Model (SM) to help healthcare managers and teams recognize determinants of improvement sustainability, and take action to embed new practice in routine care. Doyle et al. (2013) studied the effectiveness of the SM. They found the instrument to be of importance, but securing the engagements of teams with the SM was challenging. Capacity building and facilitation appears necessary for effectively deploy the SM.

In a systematic review of the role of hospital managers in quality and patient safety, Parand et al. (2014) found some evidence that managers’ time spent and work can influence quality and safety clinical outcomes, processes and performance. However, there is a dearth of empirical studies, further weakened by a lack of objective outcome measures and little examination of actual actions undertaken. When healthcare leaders have been included in the improvement efforts from day one, and have received education about improvement and access to improvement guidance, these leaders had a positive influence on the effectiveness of the improvement efforts (Gustafsen et al. 2013). Godfrey 2013 and Godfrey & Andersson-Gare et al. 2014, Kringos er al 2015).

The research of Nerstad et al. (2016), is contributing to understand the success of the local EMS in action 22 -24 July 2011. Their findings indicate that when employees perceive a mastery climate, they are more likely to feel trusted by their leaders at individual and group levels. In a mastery climate employee are encouraged to do their best, by self-referenced goals and several opportunities of improvement. A mastery climate values, supports, and rewards employees’ efforts of cooperation, learning, mastery and development of skills.

Is sustainability a subject in the abstracts of PDSA articles?

PDSA cycles should include measurements and tests of change in a never-ending process (Deming 1986, Wheeler 2003). I was curious to see to what degree PDSA-users of today are finding follow up measurements and/or barriers to sustainability so important that the subject is included in the

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225 See Chapter 3.2.5.3. Interpersonal trust and knowledge sharing, and the focus group statements presented in the result section of paper 3, and Part 4 in the Appendix to Paper 3.

A PubMed search by the term “Plan-Do-Study-Act cycles” revealed 176 papers. Most abstracts emphasized the usefulness of the cycle as a framework to evaluate current practice, test and generate new ideas, but did not mention sustainability or follow up measurements. The search terms “Plan-Do-Study-Act cycles AND follow up” revealed 17/27 abstracts reporting that follow up measurements were planned (only) or conducted earlier than six months after the intervention. The same was found in 12/17 abstracts by the term “Plan-Do-Study-Act cycles AND sustainability”.

Thirteen papers met the criteria of reporting sustainability/follow up measurements in the abstract: *Sustainability activities were reported in six abstracts* (Jobson et al. 2015, Burchett et al. 2015, Dandoy et al. 2016, Schofield et al. 2017, Kellams et al. 2017, and Irizarry-Alvarado et al. 2018). See details below.226

*Follow up measurement were presented in three abstracts:* (Andrews et al. 2014, Dorrington et al. 2015 and Goodman et al. 2018). The question is, if measurements 8-12 months after a change is enough to assure their sustainability. They are, however, an important stage in a continual improvement process.

*Barriers and facilitators to sustainability was a subject in four abstracts:* Coury et al. (2017) report the challenge of measuring the outcomes of PDSA processes with the available electronic medical record tools. Wilson J. et al. (2018) report sustainable change requires strong leadership, organizational support and teamwork. Merkel et al. (2014) suggest sustainability is critically dependent on culture changes. Calderwood et al. (2017) conclude that long-term monitoring is required.

Lennox et al. conducted the first review to consolidate available approaches for sustainability across diverse healthcare settings in 2018. The paper was published by the journal of *Implementation science*, a research field rooted in Evidence-based practice.227

Read more about sustainability in Chapter 4.3.1.5. *Research on sustainability*, Chapter 7.2.3. *When sustainability and resilience work together*, and Chapter 7.3.5. *Sustainability & spread is no quick fix.*

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226Jobson et al. (2015) report their gains were sustained for 24 months. Burchett et al. (2015) increased the number of follow-up calls to discontinue antibiotics when urine cultures were negative. Dandoy et al. (2016), created a sustainable improvement of timely antibiotic delivery. Schofield et al. (2017) Reported the changes made to the appointment booking process regarding sustainability etc.

227See Chapter 3.3.5. *Evidence-based practice and Implementation science*, Chapter 4.2.1.5. *Research on sustainability* and Chapter 7.3.1.3. *From Compliance & control to Learning & Interaction*
7.2.4.1.6. THE CHALLENGE OF SPREAD

FINDINGS ITEM 20-21: SPREAD

Spreading a golden standard like the team-training model (BEST) means every step of the improvement process has to be made excellent described by Batalden and Davidoff (2007) and the Improvement formula of Batalden (2018) (see chapter 4.1.2). As highlighted in the box, Ringerike hospital has been able to spread the trauma team program to other disciplines to be able to save lives based on other life-threatening diagnoses. It has been a creative management challenge to tailor the different programs to meet the evidence-based knowledge and the particular needs of the patient groups. Ringerike hospital however are used to include former patients in their process design/redesign efforts. It has also been a creative challenge to design a good resource distribution, when e.g. already limited resources like anaesthetists and nurse anaesthetist are needed all several different training sessions.

Spread

As typical to a hospital with a continual improvement culture,
Ringerike has been able to apply and adapt
the evidence-based team-training model to other disciplines
such as childbirth, critical ill children in the ED, and poisoning etc.

This has not been a quick fix, but a process that can be described by the Quality improvement formula of Batalden and Davidoff 2007.

THE FINDINGS OF OTHERS ITEM 20-21: SPREAD

Spread is the responsibility of innovators, quality advisors, researchers and others involved in successful innovations and changes. The process of spreading improvements from one place to another is no quick fix (Dückers et al. 2011). Even if a change appears to be highly successful in one context, the same change may not be successful in another context, even when a spread is local.

The diffusion and dissemination process has been described by Rogers E. in 1957228 and explored by Greenhalgh et al. in 2004. Batalden and Davidoff (2007) published a formula showing what knowledge should be combined when integrating a gold standard like the BEST model into a particular context.229 The formula is made complete when commenting creativity and sustainability by linking the aims of

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228 See Rogers E. 1983 and Eastbrooks et al. 2008
229 The formula was modified by Batalden in 2018, see Chapter 4.1.2. The Improvement Formula and Patient aim
better professional development, better system performance and better patient and population outcome to everyone.

Dückers et al. (2011) found that system changes affect context factors as organisational culture, policies and procedures, past experience, organisational resources, and organisational structure. Programme coordinator responses indicate that the same factors are utilised to manage spread and sustainability. They conclude that further research is needed to assess long-term effects.

7.2.5. Theoretical underpinnings with implications

Specific research question 2: What are the theoretical and historical underpinnings of the high performing clinical teams and networks?

7.2.5.1. Theoretical underpinnings of the teams and the network

A “good theory” provides a clear explanation of how and why specific relationships lead to specific events (Nilsen 2015). I have used an Abductive analysis method to reveal the theories hidden in intellectual underpinnings of the successful clinical teams & networks. As described further in the method section, abduction is to first observe a fact, and then explain how it happened by using a theory. Since there may be more theories that can explain the same fact, abduction implies an inference to find the best explanation.

To limit the magnitude of the discussion section, I have made a broader presentation of the different theories and approaches in Part II and III of the Thesis, as referred to in Table 7 below.

Theories can be organized in hierarchy on an abstraction continuum Nilsen (2015). Grand theory make generalizations that apply across many different domains, constructing a language from which to construct particular descriptions and themes. Mid-range theory explain a limited set of phenomena. A program theory is empirical, describing how an intervention process is planned to be stepwise conducted.

The conclusion drawn from my analysis of the theoretical underpinnings of this multi method study will not be explicitly stated. This, because an abduction implies there may be other theories that also could explain my findings. In addition, there are many other theories rooted in the same thinking that could have been included in this theory categorization (see Part II and III of the thesis).

After studying the present knowledge at large, I find the underlying theories displayed in Table 7, to be the best explanations to our findings, and to my Thesis statement.
Table 7. The theoretical underpinnings of the successful projects and excellent care

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grand theories</strong></td>
<td>(An almost unlimited scope)</td>
<td>A) See Chapter 4.1.3. <em>Complexity theory</em> especially 4.1.3.3. <em>The adaptive cycle</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B) See Chapter 4.1.1. <em>Continual improvement</em></td>
</tr>
<tr>
<td><strong>Mid-range theories</strong></td>
<td>(Explaining limited sets of phenomena)</td>
<td>A1) See Chapter 4.1.3.2. <em>Complex adaptive systems</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A2) See Chapter 4.1.3.3. <em>Resilience theory</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1) See Chapter 4.1.1. <em>Continual improvement</em> and Figure 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B2) See Chapter 4.1.2. <em>The Improvement Formula and Patient aim</em>, and Figure 4</td>
</tr>
<tr>
<td><strong>Programme theories</strong></td>
<td>(Empirical generalizations)</td>
<td>A) See Figure 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1.1) See Chapter 4.1.1.7. <em>Model for improvement</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>B1.2) See Chapter 4.1.1.4. <em>Statistical Process control</em>, and Appendix 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B2) See Chapter 4.2.2. <em>The Norwegian team-training concept (BEST)</em>, and Figure 5</td>
</tr>
</tbody>
</table>

Continual improvement theory is to a large degree based on the social sciences, illuminating different perspectives on the same thinking based on observable social phenomena at a workplace (see Chapter 4.1. *Theoretical underpinnings*, Chapter 3.1.3. *Shewhart, Deming, Juran and Ishikawa*, Senge’s *Learning organization* theory, and Argyris’ *Double loop learning* presented in Chapter 3.2.5.2., *Normalization process theory* (Chapter 3.2.5.6.), Chapter 3.2.5.3. *Interpersonal trust and knowledge sharing* and Chapter 3.2.6. *Innovation theories*, and Chapter 3.2.2. *The Clinical Microsystem concept*.

The theory of continual improvement alone, is covering many interrelated theories and knowledge domains. The continual improvement theory from the early nineties \(^{230}\) has been confirmed eighteen years later by an international, multidisciplinary colloquium (Batalden et al. 2011), and this PhD project is suggesting the same conclusion. There is of cause other models and theories that are more specific.

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\(^{230}\) See Chapter 4.1.1. *Continual improvement*
and useful in a particular context, and to individual patient groups, but later scientific work belonging
to the same environments\textsuperscript{231} are contributing to a richer understanding of how to operationalize the
continual improvement theories.\textsuperscript{232}

7.3. Contribution to the present knowledge

This chapter is suggesting the contribution of the thesis to the present knowledge. We have harvested
from the wisdom of high performing healthcare professionals by a positive deviance approach. I have
developed a thesis statement by an interpretive synthesis with a narrative summary approach, and
suggested a combination of six conditions for improvement and excellent care. I have defined the
complex interactions of a successful healthcare service, and discussed the relationship of continual
improvement, sustainability and resilience. I have organized present knowledge in two opposite
paradigms suggesting there is an emerging paradigm shift from a Compliance, inspection & control
culture towards the Learning, interaction & empowerment theories that are underpinning our findings.

7.3.1. What is the present knowledge?

A systematic review of the application of quality improvement methodologies published in 2012,
included 34 articles. Nine studies described continuous quality improvement, five total quality
management, five plan-do-study-act/plan-do-check-act cycles, five statistical process control (SPC) or
statistical quality control (SQC), five Six Sigma, four Lean and one Lean Six Sigma approach.
Quality improvement research has evolved under various names, including Improvement science,
Evidence-based practice, Implementation science, Knowledge translation research (KT), Research
utilization, Delivery science, and Patient safety science etc. (Speroff & O’Connor 2004, Straus et al.
2009, Wensing et al. 2012, Grol & Wensing 2013). Other academic fields, such as organizational theory
and complexity science, are also contributing to the development of a shared body of knowledge for
understanding healthcare improvement practice and science.

Based on the differences in the epistemological, ontological and methodological assumptions in the
jungle of quality managerial and improvement methods, I have found meaning in categorizing some of
the most known into two different paradigms (Table 8A).

\textsuperscript{231} Institute for Healthcare Improvement (IHI) and The Dartmouth Institute, USA
\textsuperscript{232} See Chapter 3.2. Learning, interaction & empowerment approaches, especial Chapter 3.2.2. The Clinical
Microsystem concept, and The eight domains of knowledge, Published by Batalden & Splaine (2002), and the
theoretical reference frame of the qualitative Project study (Brandrud et al. 2011).
The same pattern of two paradigms has influenced the structure of Chapter 3 *State of Knowledge*, where more than 20 different approaches and theories are presented in addition to the approaches presented in Chapter 4 *Rationale* (the theoretical underpinnings of the thesis).

**Table 8A. Two quality managerial and improvement paradigms**

<table>
<thead>
<tr>
<th>Compliance, inspection and control (The whole is the sum of its parts)</th>
<th>Learning, interaction and empowerment (The whole is the sum of its parts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scientific management (Taylor)</td>
<td>Total Quality Management (TQM)</td>
</tr>
<tr>
<td>Certification</td>
<td>The Plan-Do-Study-Act cycle (PDSA)</td>
</tr>
<tr>
<td>Accreditation</td>
<td>Statistical Process Control (SPC)</td>
</tr>
<tr>
<td>High Reliability Organizations</td>
<td>System of profound knowledge</td>
</tr>
<tr>
<td>Resilience concept</td>
<td>Learning Organizations</td>
</tr>
<tr>
<td>Evidence Based Practice</td>
<td>Continual Improvement</td>
</tr>
<tr>
<td>Implementation science</td>
<td>Model for Improvement</td>
</tr>
<tr>
<td>Six Sigma</td>
<td>Lean</td>
</tr>
<tr>
<td>Lean Six Sigma</td>
<td>IHI Breakthrough Series (Learning collab.)</td>
</tr>
<tr>
<td>New Public Management</td>
<td>Clinical Value Compass</td>
</tr>
<tr>
<td>Corporate governance</td>
<td>Clinical Microsystems</td>
</tr>
<tr>
<td>Innovation</td>
<td>The quality improvement formula</td>
</tr>
</tbody>
</table>

### 7.3.1.1. The Compliance, inspection & control paradigm

The basis of the *Compliance, inspection & control* paradigm is to motivate and change peoples’ performance to achieve successful outcomes. The underlying assumption is that the bulk of the causes of quality problems is under the control of the workforce. That means the individual worker/professional is seen as the cause of all problems and ineffectiveness.

This paradigm is characterized by traditional methods of seeing the world, comparing its working to a machine where *the whole is defined to be the sum of its parts*. However, every complex system, from human beings to stock markets to global organizations, share behavior that cannot be explained by their parts alone.

### 7.3.1.2. The Learning, interaction & empowerment paradigm

The basis of the *Learning, interaction & empowerment* paradigm is to help the workforce improve the system, e.g. by continual education, multiprofessional training and guidance. The philosophy is that people are part of the system, that quality issues arise from poor system, not individual, performance,
and that management is based on trust, and the management’s responsibility is to remove the barriers that makes it impossible for the workers to take pride in their work.

In this paradigm, the whole is defined to be more than the sum of its parts, and different from the sum of its parts (emergence). Emergence is a product of the interaction of the parts. This means, in complex systems relationships are key. As emphasized above, successful emergence involves creativity, building on what exists and is already working (Westley et al. 2007).

Table 8B. From compliance & inspection to learning & interaction

<table>
<thead>
<tr>
<th>Two quality managerial and improvement paradigms</th>
<th>Learning, interaction and empowerment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance, inspection and control</td>
<td>Learning, interaction and empowerment</td>
</tr>
<tr>
<td>(The whole is the sum of its parts)</td>
<td>(The whole is the sum of its parts)</td>
</tr>
<tr>
<td>Scientific management (Taylor)</td>
<td>Total Quality Management (TQM)</td>
</tr>
<tr>
<td>Certification</td>
<td>The Plan-Do-Study-Act cycle (PDSA)</td>
</tr>
<tr>
<td>Accreditation</td>
<td>Statistical Process Control (SPC)</td>
</tr>
<tr>
<td>High Reliability Organizations</td>
<td>System of profound knowledge</td>
</tr>
<tr>
<td>Reason 2000, Ghaferi 2016</td>
<td>Learning Organizations (Senge)</td>
</tr>
<tr>
<td>Resilience concept</td>
<td>Continual Improvement</td>
</tr>
<tr>
<td>Braithwaite 2016</td>
<td>Model for Improvement</td>
</tr>
<tr>
<td>Evidence Based Practice</td>
<td>Lean (Lean: Moraros et al 2016)</td>
</tr>
<tr>
<td>EBM: Guyatt et al.1992, P. Nilsen 2015</td>
<td>IHI Breakthrough Series (Learning collab.)</td>
</tr>
<tr>
<td>Implementation science</td>
<td>Clinical Value Compass</td>
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<td>Six Sigma</td>
<td>Clinical Microsystems</td>
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<td>Lean Six Sigma</td>
<td>The quality improvement formula</td>
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<td>New Public Management</td>
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<tr>
<td>Innovation</td>
<td></td>
</tr>
<tr>
<td>Govindarajan &amp; Trimble 2010</td>
<td></td>
</tr>
<tr>
<td>The other side of innovation (Idea + Execution)</td>
<td></td>
</tr>
</tbody>
</table>

7.3.1.3. From Compliance & control to Learning & Interaction

The Compliance, inspection & control culture, is characterized by compliance to rules, and this makes their research reliable and worth listening to. Researchers from the patient safety environment like High Reliability Organizations (Reason 2000, Ghaferi 2016), and Resilience concept (Hollinger 2015, Braithwaite 2016), Implementation science (Nilsen 2015) grown out of Evidence-based practice (Gyatt et al. 1992), and the field of Innovation (Govindarajan & Trimble 2010), are all pointing at a revolution ahead. As illustrated in Table 8B, they are all moving closer to a Learning, interaction & empowerment paradigm.

Their terms and figures illustrating their new approaches are good and mostly very useful, also to the improvement knowledge coaches of the Learning, interaction & empowerment paradigm.
Many quality and safety improvement approaches have grown out of those two paradigms, using different terms on approximately the same things. Over the years, research within both paradigms (including the present thesis) have brought more and more evidence to the learning, interaction & empowerment paradigm. In a “third wave” of patient safety innovation, research within the High reliability organisation environment has brought the approaches away from standardization and punishment towards leadership support, learning, teamwork and care coordination. In 2016, Harvard Business Review published an interesting paper of Ghaferi et al., arguing:

“High reliability organizing rest on the notion that in order to achieve high performance – especially under trying conditions – we have to pay attention to how individuals interact with another and organize their day-to-day work. (…) Indeed, pursuing a perfectly standardized system ignores the fact that each patient is different (…) over-standardizing can also increase risks. Therefore making patients safer involves standardizing when possible, but also embracing variation, instead of simplifying patients into one category, and honing practices for responding to a range of encounters” (Ghaferi et al. 2016)

As illustrated by Table 8B, researchers from related cultured are moving in the same direction: Evidence-based practice and implementation science have found it necessary to apply knowledge from other disciplines like psychology, sociology and organizational theory to achieve evidence-based practices (Nilsen 2015). Resilience concept researchers define a “Safety 2” approach focusing on how people, processes and practice come together for patient care to make things go right under both expected and unexpected conditions (Hollnagel 2015, and Braithwaite et al. 2016). Read more about the approaches displayed in the first column of Table 8B in Chapter 3.3. Compliance, Inspection & Control approaches. 233

Typical to the Compliance, inspection & control paradigm described above, Certification focus on the simple problems, while Accreditation and Evidence-based medicine focus on the simple and complicated parts. I have, however, found indications of an emerging paradigm shift within different parts of the Compliance, inspection & control environment.

A systematic literature review of Lean interventions (Moraros et al. 2016) found a negative association with financial costs and worker satisfaction, and no association with patient satisfaction. This makes me wonder if the angle to effectiveness is moving the approach away from its roots of Learning,

233 See Chapter 3.3.5. Evidence-based practice and Implementation science, and Chapter 3.3.6. Resilience Concept and High Reliability Organizations.
interaction & empowerment, towards a more Compliance, inspection & control-oriented culture (Table 8B).234

Innovation seem to be a popular term among companies, universities and politicians, compared to the quality improvement approaches. Govindarajan and Trimble (2010)235 however, describe how companies have a tendency to ignore “the other side of innovation:

When hoping to stimulate innovation, companies tend to put almost all of their energies into the thrilling hunt for the breakthrough idea”. That is unfortunate, because there are severe challenges and hidden dangers on the other side. Complicating matters, the managerial techniques that work well on this side have almost nothing to do with what works on the other side” (Govindarajan & Trimble 2010).

Their recommendations are familiar to the Learning, interaction & empowerment approaches. In other words, this evolution towards relationship makes sense if the whole is more than the sum of its parts.

7.3.1.4. The complexity of a successful healthcare service

Healthcare is complex, and need to solve both simple, complicated and complex problems to make things go right. Complexity does not mean difficult. The theory of Glouberman and Zimmerman (2004) can be used to illustrate the complexity of the successful trauma care in a simple way (see Figure 10).

The complexity model (Figure 10) is based on the theory of Aristoteles that the whole is more than the sum of its parts. This “more” is here created by the interaction of the simple, complicated and complex pars of the care. The combination is crucial when planning the care, when improving the care, and in the particular situation at the place where patients, families and professionals meet. Aristoteles’ theory can explain the many improvisations made to prevent the overloaded trauma system from “falling apart” 22 July 2011. Here are two examples: (1) Bringing severe injured trauma patients to the local hospital because it became impossible to reach the Trauma centre on time, (2) Providing patient lists by the help of the Police to the families that were desperate searching for their child.

Figure 10. Simple, complicated and Complex parts of the successful EMS236

234 See also Chapter 3.2.4. Lean methodology and Chapter 3.3.4.2. Lean Six Sigma.
235 See also Chapter
236 The figure is based on the model of the complexity science researchers Glouberman and Zimmerman (2002), as interpreted and lectured by professor Paul Batalden at The Dartmouth Institute in 2007.
<table>
<thead>
<tr>
<th>Clearly defined roles &amp; tasks</th>
<th>High levels of knowledge &amp; skills</th>
<th>Management based on trust</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recipes</strong></td>
<td><strong>Expertise</strong></td>
<td><strong>Relationship</strong></td>
</tr>
<tr>
<td>«We saw they were clinging to their action cards in a way that some cards were worn out»</td>
<td>“Knowledge is important, but we need to be trained. If anyone in the team is untrained, it helps that some have trained and can help/lead the others along”</td>
<td>“We needed each other in making the right decisions”</td>
</tr>
</tbody>
</table>

**Reminders**

<table>
<thead>
<tr>
<th>Simple</th>
<th>Complicated</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>A good recipe should produce the same outcome each time</td>
<td>High degree of certainty of outcome if formulae are followed correctly</td>
<td>Outcome is uncertain and cannot be reliably predicted beforehand</td>
</tr>
</tbody>
</table>

(Brandrud 2018, after Glouberman & Zimmerman 2004, and Batalden 2007)

**SIMPLE PROBLEMS**

...such as following a protocol may encompass some basic issues of technique and terminology, but once these are mastered, following the "recipe" carries with it a very high assurance of success. The "simple" part of the local hospital’s trauma system contain an Emergency preparedness plan, a Trauma manual with clearly defined roles and tasks described in the Appendix to Paper 3, Pages 4-7. They have laminated “action cards”, describing the standardized responsibilities of each role. The prehospital infrastructure is an important element of the simple part. The impassable road and air routes discussed in Chapter 7.2.2. *Creativity and the Swiss cheese metaphor*, is an example of how the creative ability of individuals can rescue lives and be a crucial resource, even in the simple part of the system. This also show the simple part is never simple, but the term indicates that *under ordinary conditions* it will always bring the same results.

**COMPLICATED PROBLEMS**

...contain subsets of simple problems but are not merely reducible to them. Their complicated nature is often related not only to the scale of a problem like trauma surgery, but also to issues of coordination and specialized expertise. Complicated problems, although their solutions are generalisable, are not simply an assembly of simple components. The complicated part of the local EMS, is the professional
knowledge provided and continually updated by ATLS courses (Advanced trauma life support), hemostatic emergency surgery, trauma nursing courses etc.237 There is a high degree of technical skills, complicated decisions and improvements based on experiences and data collection in daily work. 22 July 2011, the creative ability of a surgeon saved a young life in the darkness of a corridor with a chest tube, caused by the unpredictable injuries of fragmenting ammunition.238

COMPLEX PROBLEMS

...can encompass both complicated and simple subsidiary problems, but are not reducible to either, as they too have special requirements, including an understanding of unique local conditions and their historical pathways. The trauma care network produced observable patterns. Patterns in response to the non-technical parts of the team training, that are neither predictable nor generalisable, yet understanding them in retrospect can inform future possibilities of confidence, mutual empowerment and trust239.

The successful management in the complex terror situation was based on trust, by forming good teams and by being careful not to intervene into the details of the teams’ work. By collecting data continually, the tactical management got an overview of the situation, to be able to meet the overwhelming desire for information, and the many decisions tailored to the unpredictable situation.

The leaders had developed a good plan in collaboration with the professionals. The plan freed up the capacity to improvise when necessary. The plan and the trauma manual were described as simple, but good (see Appendix to Paper 3), and did not contain a lot of possibilities and details hiding the few actual parts. Others have found that a good plan cannot cover everything that may happen;240 the rest is left to the teams. Our findings indicate that creativity was empowered by clearly defined roles, tasks and responsibilities (the simple part), high levels of knowledge and skills (the complicated part) and by mutual trust and empowerment from the emergency care network management, in a network of interaction from Utøya to discharge from Ringerike hospital (the complex part). The trauma care network was including the psychosocial part of the care, and the lifesaving efforts of the police241.

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237 See Chapter 4.2.2. The Norwegian team-training concept (BEST)
238 See, Chapter 6.4.3.2. What characterizes the many improvisations? Improvisation # 11.
240 Perry & Lindell 2003
241 The police was reported to be an important Chapter of the care network contributing to prevent further human losses after arriving the island.
7.3.2. Resilience and the invisible web of interaction

One of the most important findings of this thesis belonging to the complex part of the care, is an invisible multiprofessional web of communication & interaction that, according to our informants, was crucial to the successful local medical and psychosocial response to the Utøya terror attack.

It takes many years to develop a sustainable web of interaction like this, with clearly defined (and adopted) roles, responsibilities and tasks, where professionals from different disciplines are learning and working together in teams. An invisible web of mutual respect to each other’s knowledge and skills is make them able to communicate and interact in the best way, continually reducing the gap between what they know and what they do, in an environment of mutual empowerment and a common desire to make a positive difference together with the patient and family.

The invisible web of interaction is explaining the resilience of the successful service, like the wood-wide-web under the soil is explaining the resilience of a wood (after the fire).²⁴²

It is important that politicians, policy makers and managers who are remote from the clinical environment are aware of the importance of protecting the web, also when the web is invisible to them. When the professionals argue that a certain organizationional change is making it impossible to them to make things go right, they should be carefully listened to, instead of being accused for resistance to realignment.

Resilience concept researchers have lately highlighted the difference between “Work-as imagined” and “Work as done” as a problem that has to be taken seriously in the implementation of evidence based clinical guidelines (Hollinger 2015, Clay-Williams 2015). Their findings are related to the challenge of protecting the invisible web of interaction against decisions made at the top of an organization, far away from “Work as done”.

²⁴² The term Wood Wide Web describe the complex mass of interactions between trees and their microbial counterparts underneath the soil (see Chapter 4.1.3.3. Resilience theory, and Chapter 7.2.3. When sustainability and resilience work together.)
7.3.3. The value of diversity

Diversity in the multiprofessional collaboration in combination with a shared mental model is crucial to be able to solve the complex problems of the care. In this thesis the term “interprofessional” has hardly been used. Our findings indicate the value of diversity as a condition for inter-professionality, a combination of disciplines and professionals with different knowledge and skills, and with clearly defined roles and tasks. Professionals that have been trained regularly to communicate and interact in mutual respect and empowerment, enabling them to do what the situation demands, and when possible, in collaboration with the patient and the patient’s family (see Chapter 1.6. Glossary & abbreviations for further definitions).

As commented in the BMJ Quality & Safety’s editorial on our Sustainability study (Paper 3):

“...we find the principles of empowerment and subsidiarity on a multiprofessional level. These elements obviously favored effective and legitimate leadership and active, anticipating followership. Both allowed for a robust command structure and communication, essential in any crisis management. The importance of this study is that the authors demonstrate and summarise essential elements of a conceptual framework to create a shared mental model and maintain a collective memory through empowerment and subsidiarity based on knowledge and competence” (Gauss & Cook 2017).

7.3.4. The combination of measurement & guidance

The power of professional and improvement guidance belong to the complex part of the care, and is baked into the local EMS system as yeast in a bread (see Paper 3). The power of guidance in the intervention stages of a continual improvement process has been revealed by the Project study (Paper 2). The power must be understood in relation to the fact that the process guidance provided in the Learning collaboratives of the NMA is based on a planned investment in the role of coaching, and theoretically underpinned by sound theory. 243 Our findings show the effectiveness and usefulness of control charts (Shewhart charts) to monitor improvement efforts before, during and after change, that Control charts are easy to communicate to the peers in the site, and by presenting measurements continually, the charts are contributing to maintaining the motivation among the professionals to participate in the improvement process. Since the millennium shift, the NMA has systematically invested in SPC education of their learning collaborative coaches. Our findings suggest

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243 see Chapter 4.1.  Improvements process guidance (coaching), Chapter 7.2.4.1.3. Measurement and the use of SPC, and Chapter 7.2.4.1.4. Improvement and measurement guidance.
this was a rewarding investment. As much as 78 percent of the successful projects achieved a shift of level in the desired direction on a control chart. The responses from the improvement teams explain their use of SPC by available and good measurement guidance.

Papers published in recognized medical journals indicate the international field of quality and safety improvement have not fully understood the power of SPC. This can be explained with limited access to measurement guidance and control chart software. Easily access to their own data is also crucial to the professionals and their leadership.

The successful trauma care (Paper 3) is a result of video-recorded training sessions, making it possible for the teams to study and reflect on their own performance level in real time, with access to professional and improvement guidance.

7.3.5. Sustainability and spread is no quick fix

Sustainability is a young field of science (Lennox et al. 2018). Our findings in the Sustainability study (Paper 3) and in the Multi-method study of this thesis indicates that sustainability and spread is no quick fix. The story of how the BEST program was developed, spread and made sustainable at Ringerike hospital, with a remarkable result eight years later (22. July 2011) is contributing to the present knowledge about sustainability and spread, but the science of improvement needs more examples of how sustainability can be achieved.

The many years of Patient focused redesign efforts at Ringerike hospital is a positive deviance example of how to achieve sustainable improvement based on a mastery climate, knowledge sharing and organizational learning to understand and redesign clinical pathways in all parts of the care. A typical result is the prevention of hand-overs in the acute part of the trauma care process 22. July 2011. The findings of others show that mortality or other adverse events are increasing with the number of handoffs.

The spread of the team-training model to other disciplines at Ringerike hospital after 22 July 2011 is another example of what a hospital with a learning and continual improvement culture is able to achieve in spite of the limited resource situation. This has been a huge challenge, because such

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244 See Chapter 7.2.4.1. *Discussing intervention & sustainability stage conditions*, ITEM 5, 9-11 & 14-15: MEASUREMENTS and Chapter 4.1.1.4. *Statistical process control*

245 See Chapter 3.1.5. *Quality improvement history, Ringerike hospital*, 4.3.1.5. *Research on sustainability, 7.2.1. The link between the EMS and the collaboratives*. Chapter 7.2.3. *When sustainability and resilience work together*, and Chapter 7.2.4.2. *Interesting differences*, Item 20-21 *Spread*.

246 A Cochrane review found clinical pathways to be associated with reduced in-hospital complications and improved documentation without negatively impacting on length of stay and hospital costs (Rotter et al. 2010)


248 Pedersen 2018
spread is nearly impossible because it is overloading the capacity of critical units like the anesthesia department, because anesthesiologists and nurse anesthesiologists must be a part of all kinds of emergency care teams. In addition, the spread to other disciplines is requiring a full extend process, perfectly illustrated by the modified Improvement formula of Batalden & Davidoff.249 Referring to what I have seen by the findings of others250, I am not surprised that the systematic review of studies of sustainability by Lennox et al. (2018) did not mention stable and predictable processes with reduced variation on control charts among their findings. Control charts may represent an easy communicable way of following up the sustainability of an improvement, if the indicator is easy to understand and the data are easy to record (see Appendix 4). Video-recorded training sessions, showing the performance level in real time to the professionals and their leaders is another easy communicable technique, where sustainability and resilience paradoxically work together in an effective continual improvement process.

7.3.6. Creativity as a resource

This thesis has revealed many different aspects of the creative ability as a condition for successful improvement efforts and excellent care. We have, however, found a limited focus on the issue in the quality improvement and patient safety literature. In a literature review of characteristics of medical teams operating at the disaster scene in low-resource settings, Oldenburger et al. (2017) found four interdependent characteristics; 1) adaptability, flexibility and improvisation; 2) creativity and innovation; 3) experience and training; 4) leadership and command structure. The improvisations were often related to lack of resources and constant changing circumstances.

Since the millennium shift, we have seen an increasing belief in standardization to achieve drastic improvements in patient safety, often set up with rewards and punishment systems for compliance. Our findings are illuminating the value of proper interactions to achieve a good outcome of the care. We have found that creativity is a necessary resource in unpredictable situations, where the patient safety and the mental health of family members is threatened because of communication and interaction system that is insufficient or failing. Based on trust, a good structure and high knowledge, it is possible to improvise solutions that are saving the patient and family from the adverse consequences.

249 See Chapter 4.1.2. The improvement formula and Patient aim
250 See Chapter 7.2.4.2. Discussion early and sustainable change condition, ITEM 5, 9-11 & 14-15: MEASUREMENTS and Chapter 7.3.4. The combination of measurement & guidance
7.3.7. The positive deviance approach

An increasing amount of researchers are addressing the quality and safety challenges of healthcare by learning from why things go right (Nelson et al. 2002, Govindarajan & Trimble 2010, Hollnagel et al. 2015, Ghaferi et al. 2015, Dixon-Woods & Martin 2016).

“Too little has been spent on the organizational strengthening needed to make improvement. Once the search for magic bullet intervention is abandoned, much can be learned from the characteristics, practices and behaviors that are implicated in the performance of demonstrably safe and high-quality settings. (…) The increasingly popular positive deviance approach similarly seeks to learn from exceptionally good performance. Sometimes, these approaches can help to identify processes that promote high-quality care, sometimes it will identify characteristics of context (values, behaviors, structures and so on) that need to be propagated” (Dixon-Woods & Martin 2016).

Our Sustainability study was published by BMJ Qual Saf, commissioning an editorial to go with our article (Paper 3) by Gauss & Cook (2017). The two anesthesiologists are referring to many examples in their editorial on what others can learn from our study on what went well 22 July 2011, concluding:

“The importance of this study is that the authors demonstrate and summarize essential elements of a conceptual framework to create a shared mental model and maintain a collective memory through empowerment and subsidiarity based on knowledge and competence. This enables the capacity for dealing with a crisis situation or a rare catastrophic event and to improve care in any given health facility, both in regular and exceptional circumstances, no matter the available resources. We hope that the results presented by Brandrud et al. will inspire others”.

The same positive deviance study was leading to a front-page article in the Norwegian newspaper Aftenposten 17. Oct. 2017, emphasizing the international recognition of our study in an editorial published in the BMJ of Quality and Safety concerning the emergency medical response ability of the local care network.
Chapter 8.
Strengths and weaknesses of the chosen methods

8.1. The effect of the researcher

Malterud (2001) is referring to Haraway (1991), claiming that the perspective of the observer is always limited and determines what can be seen. This notion applies even in laboratory science. Malterud is suggesting that:

“Objectivity, redefined by Haraway (1991), means to recognize that knowledge is partial and situated, and to account adequately for the effects of the positioned researcher. During all steps of the research process, the effect of the researcher should be assessed, and, later on, shared. Adequate accounts of these effects should be presented in the publication, as the frame of discussions of limitations and strengths of the study, and transferability of findings. Bias, in the sense of undesirable or hidden skewness, is thus accounted for, though not eliminated. Subjectivity arise when the effect of the researcher is ignored.

Aiming to compensate for this limitation, I have included multiple researchers in the study, not for the purpose of consensus, but to supplement and contest each other’s’ statements. Differences in perspectives and opinions have been seen as valuable sources of illuminating the complexity of the case. In relation to facts and events, however, (e.g. why the trauma victims were not brought to the nearest trauma centre) I have checked the information by different sources until I have not been able to find more information about the case.

Malterud (2001) is referring to Georgi that the investigator always enters a field of research with certain opinions about what it is all about, suggesting that:

“Reflexivity starts by identifying preconceptions brought into the project by the researcher, representing previous personal and professional experiences, prestudy beliefs about how things are and what is to be investigated, motivation and qualifications for exploration of the field, and perspectives and theoretical foundations related to education and interests” (Malterud 2001).

My presstudy perspective on coaching: I have studied and practiced coaching, continual improvement and statistics in quality improvement at Norwegian and American high schools and universities, and

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in the courses of the learning collaboratives of the NMA. Other parts of my quality improvement journey has been described in the Acknowledgement Chapter.

My prestudy perspective on the Compliance, inspection & control paradigm: My education and preconceptions belong to what I have characterized as the Learning, interaction & empowerment paradigm, and may have had a tendency to read recent research within the “Compliance-paradigm” as “the devil is reading the Bible”. However, I recognize the importance of research studies in the “Compliance-environment”, with findings that are bringing them much closer to “our” paradigm (“Safety 2” by Hollnagel 2015, and “the third wave,” by Ghaferi et al 2016). I appreciate the way they explain their new approaches, and their terms, even if some of them are new to “us”.

My prestudy perspective on trauma care: I have been working as nurse anesthetist for 15 years, and my understanding of the trauma care system (Paper 3) is of cause influenced by my own experiences in the field.254 This is both a limitation influences “my lenses” as researcher, and an advantage, because I am able to understand the information and the culture.

My preconceptions brought into the project are also presented in Chapter 2, Problem description. Other limitations of this thesis have been presented and commented in details in the different chapters of the method section. Here is a brief summary of the limitations described elsewhere.

8.2. Discussion positive deviance approach

Baxter et al. (2016) found reason to question the positive deviance approach if success is achieved through non-deviant means. Referring to the organizational theorists Suddaby & Foster (2017), Pettigrev et al. (2001) and Quattrone & Hopper (2001) they suggest that change is a universal but undefined construct, and its epistemological status is “left unexamined” in the change management scholarship. Leaving an impression of watertight bulkhead between the science areas, this suggestion does not refer to improvement knowledge, implementation science, high reliability organizations or resilience concept literature.

One area could with advantage have been examined more by all these approaches; the historical consciousness of the organization in the process of learning, innovation and change. We have to a certain degree compensated for this by exploring the historical roots of the continual improvement method, the BEST concept, and the continual improvement history of Ringerike hospital. This history indicates that the successes of the improvement teams and the success of the local EMS in action 22. July 2011 have not been achieved through non-deviant means.

254 See Chapter 4.4.2. Trauma system
8.3. Discussion mixed method approach

The definition of the multi method research method is discussed among experts. Johnson et al. (2007) asked current leaders in mixed methods research how they define mixed methods research. The study revealed that the concept of mixed methods research has been defined in a number of ways in recent years. Here are two examples:

Michael Q. Patton: “I consider mixed methods to be inquiring into a question using different data sources and design elements in such a way as to bring different perspectives to bear in the inquiry and therefore support triangulation of the findings. In this regard, using different methods to examine different questions in the same overall study is not mixed methods” (Johnson et al. 2007).

Pat Bazeley: “I tend to distinguish between mixed methods and multi method, although if I need a generic term, I used mixed methods. Multi method research is when different approaches or methods are used in parallel or sequence but are not integrated until inferences are being made. Mixed methods research involves the use of more than one approach to or method of design, data collection or data analysis within a single program of study, with integration of the different approaches or methods occurring during the program of study, and not just at its concluding point. Note that I am not limiting this to a combination of qualitative and quantitative research only, but more broadly, combinations of any different approaches/methods/data/analyses” (Johnson et al. 2007).

This thesis is perhaps most relevant to Pat Bazeley’s definition. Mixed method is to use different approaches or methods parallel or in sequences and not integrate them until inferences are being made (conclusion reached on the basis of evidence and reasoning).

8.4. Discussion Interpretive synthesis approach

The analysis method is presented in Chapter 5.3.4. Interpretive synthesis. Here we will discuss why the method was chosen.

8.4.1. Why an interpretive synthesis was chosen

This dissertation study is concerned with the experiences of people involved in particular types of role who are the target of complex interventions and crucial processes of improvement and delivery. The selected approach is inspired by the work of Dixon-Woods et al. (2005), arguing that:

“Current methods for evidence synthesis have tended to favour quantitative forms of evidence only, and systematic reviews often omit qualitative evidence. Methods of synthesis that can accommodate diversity both of questions and of evidence are needed. (...) Excluding any type of evidence on grounds of its methodology could have potentially important consequences.
Policy-makers and practitioners are increasingly aware of the limitations of regarding randomised controlled trials as the sole source of ‘evidence’. This has resulted in growing calls for more inclusive forms of review, so that better use may be made of primary data. Some questions can only be appropriately answered by examining a range of data sources; maximum value can be gained from studies able to overcome problems with access to sensitive or hard-to-reach settings; contradictions in the evidence-base can be identified and examined; and theory development or specification of operational models can be optimised (Dixon-Woods et al. 2005).

Dixon-Woods et al. (2005) discuss existing research techniques for synthesising evidence from primary reports (not for re-analysis of the original datasets). Among the eleven types of strategies for synthesising qualitative and quantitative evidence they are presenting, the narrative summary is best suited for this thesis. The same approach has been chosen by Dixon-Woods for Mixed-methods studies involving collection and triangulation of data from multiple sources, including interviews, surveys, ethnographic case studies, board minutes and publicly available datasets.

8.4.2. Limitation, interpretive synthesis approach

Dixon-Woods et al. (2005) argue the limitation of the interpretive, narrative synthesis method is informal and lacks transparency, but a planned, methodological guidance will inform future good practice in this area.

“Narrative summary can integrate qualitative and quantitative evidence through narrative juxtaposition – discussing diverse forms of evidence side by side – but, as a currently largely informal approach, is likely always to be subject to criticism of its lack of transparency”

(Dixon-Woods et al. 2005)

The interpretive, narrative synthesis approach is mostly used for a much larger number of primary studies than our four, hence a lack of transparency is less problematic here.

8.5. Discussion Qualitative study approach

8.5.1. Why the CIT method was chosen

Aiming to learn from high performers, we needed a method that was tailored to illuminate the conditions for successful improvements and work from the perspective of the clinicians.

Data collection from sampled informants in focus groups based on the critical incident technique (CIT) was found to be the best method for this purpose.

A critical incident is described as one that makes a significant contribution, either positively or negatively to an activity or phenomenon. The objective is to gain understanding of the incident from
the perspectives of the individual, taking into account cognitive, affective and behavioral elements. The researcher asks respondents to recall specific events, and tell a story about an experience they have had. The data are collected from the respondents’ perspective and in his or hers own words, allowing the respondent to determine which incidents are the most relevant to them for the phenomenon being investigated.

There is no given framework of what will be important to the informants, CIT allows for interaction and discussion among the informants, providing a synergy of the members of the group that helps informants remember things they thought they had forgotten (Gremler 2004).

Each informant statement has been quoted once on a flip chart in real time, while the informants were asked to control the accuracy of the quote.

We tried to control a source of bias by quoting each statement on a flipchart at the focus group meeting, asking the informants to control the accuracy of their statements. Although informants sometimes have made us aware of wrong quotes, we have no guarantee that the informants always did that.

Because CIT is a retrospective research method, it may be flawed by recall bias or memory lapses. As the incident has taken place more than a year before the data collection in focus groups, the subsequent description may lead the respondents to misinterpret the incident. This risk of recall bias was higher in the single interviews than in the focus groups of people working together at the same part of the network. Hence, I was always comparing the reported conditions, which were surprisingly confirmatory with their reflections. Facts and events however, had to be exact, and were controlled by different sources.

By asking for the reflections of teams that already had been evaluated as successful by other high performing teams, it is discussable if it is an advantage or a problem that the data are collected up to two years or more after the focused situation happened (the case). The responding informants of Paper 2 and 3 were still working at the same place where the focus situation happened, representing respectively 70 percent and 85 percent of the sampled population. Thus, the knowledge constructed together with the informants on how and why things went well, may have been based on a richer frame of knowledge and reflection than it would have been shortly after the situation focused. This was a kind of reflections that were used by purpose to produce knowledge in the follow up conversations with key informants (see below).

The research groups were conducting the coding process based on all the statements noted on the flip-chart during the meetings. Like others (Gremler 2004), I experienced a few times that the focus group statements were misinterpreted or misunderstood in the analysis process, by researchers who
were not present at the focus group meetings. In the beginning I sometimes had to refer to the notes I had made after the focus group meeting (on my observations of the group process) to prevent misunderstandings by the research group.

8.5.2. Limitations of the CIT method

8.5.2.1. RELIABILITY AND VALIDITY
Although the benefits of using the CIT method are considerable, the method has been criticized on issues of reliability and validity (Chell 1998). Reliability is concerned with consistency; it is a matter of whether a technique applied repeatedly to the same object would yield the same result each time. Gremler argue that reliability is assessed by investigating the reliability indices used and the magnitude of the statistics reported in the CIT studies. According to Moen and Middelthon (2015) questioning reliability and statistics are not relevant in a qualitative study. Even the term validity is discussable in qualitative research. The way I am using the CIT method, statistics has never been a relevant issue (see Chapter 5.3.1.1. Inductive analysis).

8.5.2.2. SOURCES OF BIAS
We have tried to control sources of bias by quoting each statement on a flipchart at the focus group meeting, asking the informants to confirm the accuracy of their statements. Although informants sometimes have made us aware of wrong quotes, we have no guarantee that the informants always corrected the documentation. I have conducted up to 30 focus group interviews with patients over the years. The first meetings were audio recorded, but as I have been more and more trained in this kind of data collection, I dropped audio-recording because it did not add more information. In addition, I have observed that the informants are more relaxed when they know they are not being audio recorded. It is also an advantage to have the data anonymously transcribed on flipcharts in the ethical challenge of protecting the privacy of the respondents. I have, however found no literature supporting this observation and choice of mine.

When interviewing focus groups related to an extremely horrible event as the Utøya terror attack upon children and youngsters, audio-recordings could have been helpful. Not because I think I did not catch all their statements, but “the elephant in the room” made the data collection extremely exhausting to me as a researcher. The informants had been asked to focus on the system, and not on the horror (only if necessary, to explain an important point of view). The informants were (like myself) trained professionals familiar with debriefing routines, and afterwards some of them commented they felt the focus group was working like a debriefing to them. To me as an attentive listener, the air felt thick with suppressed feelings, making it much harder than usual for me to concentrate on what was commented by the focus groups.
8.5.2.3. RECALL BIAS
Because CIT is a retrospective research method, it may also be flawed by recall bias or memory lapses.
As the incident has taken place more than a year before the data collection, the subsequent description may lead the respondents to reinterpret the incident.255
This is a problem in research, but not always. Because the retrospective study was aimed to learn from high performers about the conditions for improvement and excellent care, it was possible that the stories and assessments of the informants could be colored by reflections and later experiences regarding the conditions for excellent care in general. This did not as far as I understood not reduce the value of the knowledge constructed by their common reflections.
Facts and events however, had to be exact, and were thus controlled by other sources. For example:
- the logistic of the patient list submission to the police (checked by the tactical leadership)
- the timeline Paper 3 Table 1 (checked by the event log and external reports)
- “what did the trauma teams do” Paper 3 Box 2 (checked by the trauma coordinator)
- patient logistic and cooperation with other hospitals (checked by external reports)
- the perspectives of the ambulance commander at the scene (Larsen 2013)
- the surgical perspective on the medical response (Waage et al. 2013)
- the historical roots (reports, present & former CEO’s and quality advisors, external rewards)

Others have reported ambiguity associated with category labels and coding rules within a CIT study.256
I recognize the challenge in my roles as both data collector and a member of the external research team. I was “pregnant” with the data for more than three years by the time the others were analysing the material for the first time. I understood I had to let the team process evolve over time without revealing my own reflections, but it was not easy.
Like others (Gremler 2004), I experienced that the focus group statements could be misinterpreted or misunderstood in the analysis process. In the beginning I sometimes had to refer to the notes I had made after the focus group meeting to prevent misunderstandings. When discussing the material with the members of the internal expert team, it was revealed that some facts and events had been misunderstood either by me as a data collector, or by the informant. See examples of controlled and adjusted facts and events above.
As a conclusion to this limitation chapter, I concur with the conclusion in Gremler’s review (2004) that the critical incident technique (CIT) has been demonstrated to be a sound method since Flanagan first presented the approach more than 50 years ago (1954), and relatively few modifications have been made since then.

8.5.2.4. SINGLE INTERVIEWS

The five single interviews related to the Sustainability-study were audio-recorded. After the informant had told her/his story without interruption we had a conversation about the critical incidents highlighted by “their” focus group of colleagues (where they were not able to meet), which mostly was confirming the picture made by the “single” informant. This was made to compensate for the risk of recall bias that was higher in the single interviews than in the focus groups of people working together at the same part of the network, reminding each other of forgotten things.

It is a limitation that I have had no one to review my coding of the three audio-recorded single interviews made in 2013. It is also a limitation that I did nor transcribe verbatim, but quoted the audio-recorded interview in the same way as I was used to do in front of a focus group. This was a process I was trained to manage well after more than 30 focus group interviews over the year. But because I did not have a focus group to help me, I listened repeatedly to the record, until I was sure I was referring their statements right. I was not surprised to find that most statements derived from these three single interviews were align with the statements of “their” focus group where they had been unable to meet, because they had all been working in the same part of the trauma care network.

This part of the study was a flexible and dynamic interaction and communication where the experts I consulted by meetings, telephone calls and e-mails had the role of “co-producers” of knowledge. We were reflecting repeatedly together until better questions and answers grew out of our interaction. After the single interviews I made in 2015 and later, I always provided written reports, to where we were “co-producing” corrections and additional comment until we had a product we could go for. The Regarding facts and events however, I was always consulting other experts until we all were convinced information was correct (see examples Chapter 8.5.2.3. Recall Bias)

8.5.2.5. INDUCTIVE ANALYSIS OF CIT DATA

Gremler found in his review (2004) that CIT data can be used both qualitative and quantitative, but I do not agree with Gremler that calculating and reporting reliability statistics belong to the analysis of CIT data, at least not in a study like our, with rather complex combinations of focus group statements and researcher observations. We have always analysed CIT data qualitatively, i.e. we were not counting how often the same statement was made by our informants, but were of course recognizing a possible generalizability of items that were often repeated by the different groups and individuals.257

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257 See also Chapter 5.3.1.1. Inductive analysis, and Chapter 8.5.2. Limitations of the CIT method
8.6. Discussion Quantitative study approach

8.6.1. Discussion factor analysis
Regarding the factor analysis of the data collected by the questionnaire (instrument 2), an Obligue rotation could have been a better choice than a Varimax rotation, because there is a certain correlation between some of the items in instrument 2 as indicated by the crossloadings. Factor III (Professional environment) is crossloaded by four items, but have been retained with the assumption that it is the latent nature of the variable.

8.6.1.1. WHY A FACTOR ANALYSIS WAS CHOSEN
The analysis method is presented in Chapter 5.3.2. Factor analysis. Here we will discuss why the method was chosen.

8.6.1.1.1. INSTRUMENT 1
The factor analysis of the 13 process items of the CPO-scale (Instrument 1), was made to identify the underlying structure of the scale, mainly to check if it we had reached our goal to make an instrument in accordance with the IHI Model for improvement,258 and determine the number of factors present in the instrument (thereby reducing the number of variables).

We considered process and outcome items to be so fundamental different that we found no reason to include both in the same factor analysis. A reduction of the number of outcome variables was not an issue, because the scale has only four specific outcome items, and two global items. One of the global items is a copy of the IHI Self-Assessment Scale for improvement teams. The teams are asked by their coaches to hand in their scores to the IHI scale in connection to each of the three learning sessions, assessing and displaying the progress of their project, which is presented to the audience by the collaborative leadership from session to session.259

8.6.1.1.2. INSTRUMENT 2
The main reason for the factor analysis of the survey data, was to identify the combinations of items mutually empowering each other as conditions for making successful improvements and excellent care in a complex environment. As mentioned above, we first made a multivariate logistic regression analysis of the 25 questionnaire items from the 132 responding improvement teams, sorted in 54 successful and 78 other projects. Two single variables (Q12 and Q7260) were found in the final model, indicating the importance of measuring and studying variation in the intervention stages of continual improvement processes. This was however, not enough to answer the research question of the

258 See Model for improvement in Chapter 4.1.1.7. Model for improvement
259 See paper 1, p.118, Appendix 1
260 The questionnaire items are presented in Table 2

178
Sustainability study (Paper 3) *What combination of factors tend to produce adoptable improvement innovations?* The first analysis was to so some degree an example of what Davidoff (2009) meant when arguing that “suppressing participants’ heterogeneity may obscure an essential dimension of social and clinical knowledge”. Consequently, we decided to first make a factor analysis, and then a multivariate logistic regression analysis on the domains of interrelated variables (the identified factors).

### 8.6.1.2. LIMITATION FACTOR ANALYSIS

#### 8.6.1.2.1. LIMITATIONS RELATED TO FACTOR LOADING

All five factors found in the quantitative Project study (the survey) have items with factor loadings ≥5, except Factor I (Measurements & Guidance), where Q7 “Someone in the team enjoyed working with measurements” and Q10 “We got hold of our coach between the learning sessions” have factor loadings 0.4. Still, I have decided to retain these two variables of three reasons: 1) because their factor loading is >.32) they are related to all the other variables of the same factor showing different aspects of measurement and coaching (see Table 2), and because they are not crossloaded with other factors.

#### 8.6.1.2.2. LIMITATIONS RELATED TO CROSSLOADING

Factor III (Professional environment) is crossloaded by four items, but they are all retained. Q1 because it seem to be the latent nature of this variable to be associated to the impact of the leadership. Q5 because the organization of the improvement effort in spite of a difficult resource situation seem to be highly dependent on a creative and effective group process. Q6 because it seem to be a latent nature of this variable to be associated with Leadership engagement and the group process in the improvement team. They need to develop a good strategy, and they need the support of their leader to make a project that is well grounded in the professional environment. Q23 because it seem to be a latent nature of this variable to be associated with the two other factors as well.

#### 8.6.1.2.3. LIMITATION RELATED TO VARIMAX ROTATION

Regarding the analysis of the data collected by instrument 2, it is possible that an Obligue rotation would have been a better choice. As shown by Table 2 there is a certain correlation between some of the items in instrument 2, and as indicated by the many crossloadings presented above. Promax, which is derived from Varimax is the most frequently recommended Obligue rotation method. The most widely used alternative to Promax is Oblimin, which is a generalization of earlier procedures attempting to minimize various covariance functions.
8.6.2. Discussion Logistic regression analysis

The analysis method is presented in Chapter 5.3.3. Logistic regression analysis. Here we will discuss why the method was chosen.

8.6.2.1. WHY THE LOGISTIC REGRESSION ANALYSIS METHOD WAS CHOSEN

We have found elements of a culture of improvement as a product of collaborative learning in the qualitative part of the Project study, that was published two years ahead of the PhD-project. Our findings indicate that about 90 percent of the focus group statements reflect the need for a system of continual improvement to solve the problems that organizations experience in trying to make lasting improvements (Brandrud et al. 2011). The generalizability of the findings in the qualitative part of the Project study are discussed in Appendix 1. A combination of qualitative and quantitative analysis however, based on the same material will illuminate the complexity and the generalizability of the conditions for improvement (the findings). Haynes et al. (2006) write that regression analysis has stood the test of time as the standard approach to the problem of establishing independent predictors of an outcome of interest. In the case of a binary outcome. The technique is referred to as “logistic" regression”.

Logistic regression explores the relation between an independent variable (success) and the variables that may explain the success (here 25 questionnaire items). You can deal with the problem of covariation among the independent variables by conducting multivariable analysis in which we construct a model that simultaneously consider all the independent variables. One fundamental strategy is to avoid any restrictions or constrains on the model by a “stepwise" regression, and we decided to use a backward stepwise analysis. In a backward procedure you initially enter all the variables into the model. Then you are testing how the model behaves with each variable, and drop the variables one by one that are explaining the least variance from the model. The procedure is completed when a statistically significant decrease in the proportion of variance explain occurs when you omit the last remaining variable.

8.6.2.2. LIMITATION, LOGISTIC REGRESSION ANALYSIS

If input variables are highly correlated with one another (known as multicollinearity), then the effect of each on the regression model becomes less precise (Ranganathan et al. 2017). As shown in Table 1, some of the independent variables of the questionnaire are correlated. It has also been suggested that

\footnotesize
261 A binary outcome implies there are only two possible outcomes to a certain situation (here success years/no).
262 Logistic because the technique relies on logarithms
263 Covariation: variables may be correlated with another in a test that is treating the variables as independent.
264 Or «multiple» or «multivariate»
the data should contain at least ten items for each variable entered into a logistic regression model. As shown in Paper 2, Table 4, the number of items ranged from two to nine, and the two remaining domains in the final model are containing seven and nine items.

8.7. The generalizability of our findings

To be a science, quality improvement studies need to be both generalizable and embedded in theory (Neuhauser and Diaz 2007). Theoretical underpinnings are found, and based on Neuhauser and Diaz’s three levels of generalizability, I suggest the statement of this thesis are meeting their “high level of generalizability” criteria:

“Personal involvement, paying attention, readiness for change, just in time education, social support from small groups, and rapid feedback are constructive to change. Stated this way, the findings are generalizable to all human behavior” (Neuhauser and Diaz 2007).

The context and culture of the place where the improvements are meant to happen, will always represent a limitation to generalizability because of the complexity and the differences from place to place.

“Given that organizational context is typically fixed by resource and other constraints, it makes sense to consider adapting the intervention to the context rather than vice versa. In order to do this, we need to have a clear understanding of how work is done in the clinical setting since this will never be the same as how we imagine it is accomplished” (Clay-Williams 2015).

“Even when quality improvement methods are properly applied, the success of a project still depends on contextual factors. Context refers to aspects of the local setting in which the projects operates. Context affects resources, leadership support, data infrastructure, team motivation, and team performance. For these reasons, a project may thrive in a supportive context and fail in different contexts” (Silver et al 2016).

In other words: The same “generalizable” findings of the project study will work different at different places. There is a “a black box” connected to each of the 132 projects responding to our questionnaire. A black box full of local conditions of different kinds that have contributed to positive or negative outcomes, with unknown sustainability stage situations.

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265 See Chapter 7.1. Thesis statement
The Sustainability study is focusing at the local culture and context, and the early and sustainability stages of a trauma system development. The findings are first described in paper 3, and further described by the Multi method study of the present thesis. Examples of local conditions that are not necessarily generalizable to other local hospitals, is to have about 20 000 tourists a day and two heavy trafficked main roads crossing nearby the local hospital. A context like this is a constant reminder of the importance of a good emergency preparedness.

*The importance of reminders* is a generalizable finding (see paper 3, and “action cards” Figure 10), because people are not always doing the right things, not because they do not want to do the right things, but because they are focusing on other, more difficult tasks (Kahneman 2000). Another example of generalizability is to decrease the number of hands-offs in the patient care process as much as possible to prevent communication failures and adverse events, like the trauma teams did at Ringerike Hospital 22 July 2011.

*Conclusion:* High levels of generalizability to organizational systems and human behavior still does not mean “one size fits all”. Generalizable scientific evidence is a crucial part of the structure and knowledge, making professionals meet the challenges of unpredictability with knowledge-based practice, but an additional creative ability will always be needed to be able to make things go right in the particular situation, in collaboration with unique individuals who co-produce excellent care.
Chapter 9. Conclusion

9.1. Thesis conclusion

This PhD-project is an analysis of the conditions for improvement and excellent care among high
performing clinical teams and networks. The study aim is to contribute to the knowledge about why
things go right in healthcare.

We are learning from high performing teams about why things go right in the intervention stages of a
continual improvement process. In a survey among the 189 projects of eight learning collaborative of
The Norwegian Medical Association (NMA), the response rate was 70 percent.

54 of the 132 projects were sampled to be successful by a validated instrument (Paper 1) and
compared to the less successful projects in a multivariate regression analysis (Paper 2). Two domains
associated with success were found, (included in condition 1, 5 and 6 below).

We are learning about why things go right from a trauma care network responding successfully to a
terrorist attack at Utøya youth camp in Norway in 2011. The network was staffed by 260
professionals covering 35 different roles, from the scene at Utøya to discharge from the local
hospital. Five focus groups covering 30 of the 31 most important roles told their stories (Paper 3).
A combination of four determinants for success were found (included in condition 1-6 below).

In the multi-method part of the PhD project, additional information about the historical and
theoretical underpinnings of the high performing teams and networks has been collected. The
trauma system was found to be in the sustainability stages of a continual improvement process,
partly rooted in the continual improvement thinking provided by the Learning collaboratives of NMA.

Through an interpretive synthesis of the results of the primary and additional studies, This PhD
project found six conditions for improvement and excellent care by:

1) **Invisible web of interaction.** Professionals with defined roles & tasks are working and learning
together in multiprofessional teams, continually improving the care in an environment of mutual
empowerment and a common desire to make a positive difference together with the patient.

2) **Management by trust, knowledge and data collection.** Leading and continually improving the
system, developing common, easy available plans with clearly defined roles & responsibilities.

3) **Fostering creative ability.** No plan can cover everything that may happen. In unpredictable
situations the system can be insufficient or failing. With a good structure, knowledge and trust,
improvisations can be made, maintaining communication, collaboration and interaction among
professionals, patient and family, creating good solutions, rescue patients from the adverse consequences of an event, and allowing the team to be able to do what the situations demands.

4) **Minimizing the number of handoffs** in the care process prevents adverse events.

5) **Monitoring current practice and change.** Identifying key process and outcome variables, reflecting together on the variation, using control charts where time is a variable, and/or video-recording where the data appear simultaneous (e.g. training sessions). Make decisions based on the findings.

6) **Professional and improvement knowledge guidance.** Continual information about best practice, with easily available coaching when needed, integrated into daily work like yeast in a bread.

The informants were selected among professionals still working at the same place, representing 70 percent of the improvement teams (Paper 2) and 85 percent of the roles of the trauma network (Paper 3). Studying the historical and theoretical underpinnings of the local EMS in action 22 July 2011, I have continued to produce questions and knowledge together with clinical experts from 2015-2018, harvesting from an even richer frame of knowledge, reflection and growth. The aim has not been to bring more evidence to a success found by others, but to reveal the conditions for success, based on the reflections and wisdom of the informants. Based on this recognition, it is discussable if it is a limitation or an advantage that some of the data were collected from one to seven years after the situation focused.

By an abduction based on the state of knowledge and the theoretical and historical underpinnings of our findings, I have defined a Learning, interaction & empowerment culture of theories and approaches related to the continual improvement thinking. In this paradigm the whole is defined to be more than the sum of its parts. This more belong to the complex part of the care, characterized by interrelationship, multiprofessional interaction, knowledge sharing, empowerment and mutual trust.

I have also defined a quite opposite culture of Compliance, inspection & control, where management has been based on the philosophy that the whole is the sum of the parts. In this paradigm the complex part of the care has not been an issue. Based on the findings of others, however, I am suggesting there is an emerging paradigm shift going on within the environments of patient safety, evidence medicine and innovation research, moving away from a Compliance, inspection & control orientation, towards more complex approaches related to a Learning, interaction & empowerment culture.
9.2. Further research
Healthcare research is a young discipline. Further research is needed contribute to the knowledge about the conditions for improvement and excellent care. This thesis raise a number of questions.

1. **How can healthcare professionals defend their web of interaction?**
   Even a pattern of interaction that is crucial for the quality and safety of the care is invisible from the top of the organization, and difficult to defend. Crucial interactions can be destroyed, leaving a feeling of helplessness among the healthcare professionals (being accused for resistance to necessary changes), and provide space for extreme standardization, external inspection and (quality) control of the personnel.

2. **To what degree is healthcare promoting or inhibiting the creative ability of the clinicians?**
   Will future healthcare professionals trust their own judgment enough to be able to discover when a standard does not fit to the actual patient and situation? Our study indicates that creative ability based on structure and competence is important. There is no doubt that an evidence-based standard developed by multiprofessional teams of experienced clinicians is valuable. Nevertheless, reality is so complex that “One size fit all” standards may lead to unintentional, adverse events, if the professionals are not allowed to think themselves.

3. **How can leadership support the recommendations from the front-line clinicians?**
   Clinicians may decide what is best yet in many cases leadership does not support their recommended practices and sets rules and regulations that make no sense at the front line.

4. **What makes a shift of leadership to the sustainability of a desired change?**
   When leaders change, do the new leaders pick up the project and continue to advance it? Are the new leaders showing up doing their own work rather than recognize the current work and learn to support it?

5. **To what degree is healthcare facilitating measurement for improvement?**
   Are healthcare organizations able to give the healthcare professionals an easy access to recorded, real time data from (their own), clinical processes, so that they are able to monitor, reflect on and follow up their own practice and their common practice? Our findings indicate that SPC is a useful statistical technique when time is a variable, and that control charts that are easy to communicate. To what degree is healthcare facilitating a proper use of SPC? Does the healthcare professionals & leaders have access to measurement and improvement knowledge guidance?

6. **To what degree is the clinical management involved at every stage of healthcare improvement effort to achieve sustainability?**
   What can be of help during a manager’s journey towards sustainability Looking back from the
perspective of a sustainable and successful trauma system, the role of the leadership is crucial. We need to learn more about the leaders’ role in making things go right, and what leaders can do to facilitate sustainability.

7. **To what degree is healthcare preparing for a “Plan B” to be able to save as many lives as possible in unpredictable disaster situations?**

Well-developed air ambulance and trauma centers may not be as available as planned. To what degree is the future structure of trauma hospitals covering up for this challenge? An editorial to the Sustainability study (Paper 3) published by BMJ Quality & Safety is suggesting that....

“The answers provided by the study are very relevant to disaster preparedness and training programmes everywhere. A disaster can strike anywhere and, in any form, — natural, accidental, man-made. Any acute health facility is potentially involved, and the stakes are especially high if it is isolated and distant from referral centres like the Ringerike hospital was. Terrorists may deliberately integrate this potential vulnerability into their strategy. As such, the Ringerike example is important as it shows that a well prepared acute care facility can cope if necessary, even if it is not a tertiary centre” (Gauss & Cook 2017).
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PART VII. APPENDICES

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Appendix 1: The qualitative part of the Project study

Appendix 1.1. A part of the thesis

Brandrud et al. 2011 is briefly presented in this Appendix because it is one of the four cornerstones of the multimethod approach to the thesis. The paper is however, not included in the collection of original papers because it already was included in my Master study.

Appendix 1.2. Summary

A1.2.1. INTRODUCTION
The objectives of the Breakthrough Series Collaborative are to close the gap between what we know and what we do, and to contribute to continuous quality improvement (CQI) of health care through collaborative learning. The improvement efforts are guided by a systematic approach, combining professional and improvement knowledge.

A1.2.2. OBJECTIVES
To explore what the improvement teams have learned from participating in the collaborative and from dealing with promoting and inhibiting factors encountered.

A1.2.3. METHOD
Qualitative interviews with 19 team members were conducted in four focus groups, using the Critical Incident Technique. A critical incident is one that makes significant contributions, either positively or negatively to an activity.

A1.2.4. RESULTS
The elements of a culture of improvement are revealed by the critical incidents, and reflect the eight domains of knowledge, as a product of collaborative learning. The improvement knowledge and skills of individuals are important elements, but not enough to achieve sustainable changes. 90% of the material reflects the need for a system of CQI to solve the problems that organizations experience in trying to make lasting improvements.

A1.2.5. CONCLUSION
A pattern of three success factors for CQI emerges:

(1) Continuous and reliable Information, including measurement, about best and current practice;

(2) Engagement of everybody in all phases of the improvement work: the patient and family, the leadership, the professional environment and the staff; and
(3) An Infrastructure based on improvement knowledge, with multidisciplinary teams, available coaching, learning systems and sustainability systems.

**Appendix 1.3. Results**

The findings were 12 items, representing three success factors for continual improvement.

**Appendix 1, Table 1. Three success factors for continual improvement**

<table>
<thead>
<tr>
<th>Success factor I: INFORMATION</th>
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<tbody>
<tr>
<td>1. Provide continual and reliable information about best practice</td>
</tr>
<tr>
<td>2. Provide continual and reliable information about current practice</td>
</tr>
<tr>
<td>3. Benchmark systems and outcomes to others</td>
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</table>

<table>
<thead>
<tr>
<th>Success factor II: ENGAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Anchor the improvement work to the leadership at all stages</td>
</tr>
<tr>
<td>5. Focus on and engage the patient and family in all stages of the improvement work</td>
</tr>
<tr>
<td>6. Anchor the changes to the professional environment</td>
</tr>
<tr>
<td>7. Engage the staff in all stages of the improvement work</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Success factor III: INFRASTRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Base the infrastructure on improvement knowledge</td>
</tr>
<tr>
<td>9. Multidisciplinary improvement teams tailored to the topic</td>
</tr>
<tr>
<td>10. Develop a learning system tailored to the different target groups</td>
</tr>
<tr>
<td>11. Develop a system to facilitate the improvement work</td>
</tr>
<tr>
<td>12. Develop a follow-up system to secure sustainability</td>
</tr>
</tbody>
</table>

We also found that 90% of the conditions needed for making successful improvements were system-related, and that the focus group discussion of the informants showed that the improvement teams had gained improvement knowledge by participating in one of the learning collaboratives of the NMA.

**Appendix 1.4. Limitations**

The present study has several limitations.

**A1.4.1. Representativeness**

The representativeness of the teams was low (19%), especially among the first collaboratives. Although two of the regions did not reach the ideal focus group size of 5-8 respondents, their comments were consistent with those from the other groups (Brandrud et al. 2011, Table 2).
Qualitative studies often use small samples. In general few new perspectives emerge by extending the number of respondents beyond 15-24.\textsuperscript{268}

\textbf{A1.4.2. Sampling issues}

The findings are based on the perspectives of improvement team leaders who volunteered to participate in focus groups. The amount of positive spin-offs, and the fact that most respondents had documented improvements in their final reports, shows that we were most probably informed by winners. Their viewpoints may not fully represent the whole spectrum of participants, especially the viewpoints of the less successful efforts. Consequently, the inhibiting elements encountered by the teams may not have been fully revealed.

Second, the sampled BTSC are from the psychiatric sector of health care, and one may conclude that the results are limited to this field. However, the matching theoretical framework, and the reported facilitators in 10 other BTSC articles from the non-psychiatric settings does not support this.

\textbf{A1.4.3. Sources of bias}

It would have been better to have independent/external improvement experts to analyze the data. The same improvement experts (the research team) that were analyzing the data, had collected the data from the focus groups. In addition, the same research team belonged to the improvement advisor group (coaches) of the involved learning collaboratives.

First, our connection to the collaboratives could prompt us to glorify the outcomes. Second, the fact that we are experts on CQI may also lead us to see patterns that the respondents would question, especially about the need for a system of CQI. With this source of bias in mind, we analyzed the comments of each other’s focus groups. The result did not confirm such a bias. Third, the CIT method has been criticized as being flawed by recall bias.\textsuperscript{269} To avoid this, the notes on the flipchart were done in dialogue with the respondents during the data collection. Still we cannot know for sure that the research team were really assessing the accuracy of the recorded notes. We may also have recalled their meaning in the light of our theoretical knowledge.

\textsuperscript{269}  Gremler DD. The critical incident technique in service research. Journal of Service Research 2004;7:65–89.
Appendix 2: Response rates and success levels Project study

The purpose of presenting the CPO-evaluation result per collaborative in this appendix, was to illustrate the balanced representativeness of the responding improvement teams within the three success levels. It has not been an issue of this thesis to comment on the differences in the success rate of the eight learning collaboratives but three things are worth reflection on:

First, the measurement competence of the coaches is crucial. The success rate of the two first collaboratives was low. Then the NMA decided to educate their improvement coaches in Statistical Process Control techniques. Our findings indicate that a combination of measurement and guidance is associated with success (Paper 2), and Appendix 2, Figure 2 show that the quality level was increasing in accordance with the measurement competence of the coaches.

Second, the complexity of the targets must be reflected in the learning collaborative organization. It is of course easier to improve the effectiveness in an outpatient clinic, than to increase the number of referrals of teenagers with symptoms of first-episode-psychosis within a similar time frame. This does not mean Learning collaboratives are not meant for complex targets, but the collaborative must be organized accordingly. In the Early intervention collaborative from 2011, the success rate was low. This was a collaborative where only the hospital level only was included, followed by a lack of ownership to the project among the stakeholders of primary care. A few successful teams however, found their own solution to the challenge by including the entire mesosystem from day one, as illustrated in Paper 2, Supplement 3.

Third, the limited time frame of the collaborative made many promising projects unable to document their success before the end of the collaborative because it was impossible for them to collect enough data. The limited time frame of a learning collaborative is an American idea, aimed to increase the improvement effectiveness in healthcare organizations. In the US small volumes is seldom a challenge. In Norway, however, small volumes is typical.
Appendix 2, Table 1:

The eight hospital-related improvement collaboratives of the Norwegian Medical Association

<table>
<thead>
<tr>
<th>Year</th>
<th>Topic</th>
<th>Number of projects</th>
<th>Examples of the measurable aims of the single projects within each improvement collaborative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Cesarean Section</td>
<td>23</td>
<td>Reduce the cesarean sectio rate to para 0 by 20%.</td>
</tr>
<tr>
<td>2000</td>
<td>Intensive Care</td>
<td>15</td>
<td>Reduce the duration of mechanical ventilation by 20% by an optimization of the sedation; reduce length of ICU stay by 10%.</td>
</tr>
<tr>
<td>2001</td>
<td>The Use of Restraints</td>
<td>18</td>
<td>Reduce the use of mechanical restrains in psychiatric therapy by 25%.</td>
</tr>
<tr>
<td>2003</td>
<td>Serious Affective Disorders</td>
<td>23</td>
<td>Reduce the MADRS score by 50% and the length of stay by 50%.</td>
</tr>
<tr>
<td>2004</td>
<td>ADHD</td>
<td>33</td>
<td>Reduce the time from admission to diagnosis by 30%</td>
</tr>
<tr>
<td>2005</td>
<td>Quality &amp; Efficacy in Psychi-atic Outpatient Clinics</td>
<td>30</td>
<td>Increase the quality of the preliminary feedback to the primary care physician by 50%</td>
</tr>
<tr>
<td>2006</td>
<td>Substance Abuse</td>
<td>24</td>
<td>Increase the quality of the admission process by 50%</td>
</tr>
<tr>
<td>2011</td>
<td>Early Intervention in Psychiatric Disorders</td>
<td>23</td>
<td>Reduce the days between first time referrals by 50%, and the age of the patients by 25%.</td>
</tr>
</tbody>
</table>

Appendix 2, Figure 1. Response rate to the questionnaire per learning collaborative

<table>
<thead>
<tr>
<th>Questionnaire response rate (n132 of N189)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Interv Psych Disorder, n17</td>
</tr>
<tr>
<td>Substance Abuse, n17</td>
</tr>
<tr>
<td>Qual &amp; Effic Psych Outpat Clin, n20</td>
</tr>
<tr>
<td>ADHD, n26</td>
</tr>
<tr>
<td>Serious Affective Disorders, n16</td>
</tr>
<tr>
<td>The Use of Restraints, n13</td>
</tr>
<tr>
<td>Intensive Care, n11</td>
</tr>
<tr>
<td>Cesarean Section, n12</td>
</tr>
</tbody>
</table>

Appendix 2, Figure 2. Proportion of improvement project per success level. Evaluated by a team of improvement experts based on the CPO-scale (see Paper I)
Appendix 2, Figure 2 and 3 is commented in Chapter 2.3. Delineation of the Thesis (Point 4).

**Appendix 2, Figure 3. Proportion of responding improvement project per success level.**
Appendix 3: Reference frame of the improvement items

Table A and B is referring to the paper and page or table numbers which is documenting the reference frame of Table 6. Success items of intervention stages vs sustainability stages of improvement.

The references are:

*Kilo (1998)*, describing the IHI learning collaborative approach (Breakthrough Series) the same year as it was acquired by the Norwegian medical Association (NMA) in 1998. The purpose was to spread continual improvement theory to Norwegian healthcare organizations, to make it easier for the participants to close the gap between what they know and what they do.

*Thoresen (2011)*, describing the continual improvement system at Ringerike hospital in the final report of the National Pilot Hospital project.

*Wisborg et al. 2006, and 2008b*, describing the methodological, historical& scientific underpinnings of the BEST program which integration was facilitated at Ringerike hospital by a program innovator that had participated in the learning collaborative of the NMA with a successful improvement project.
### Appendix 3, Table A. Sources of the success items from the intervention stages of a CQI process

<table>
<thead>
<tr>
<th>Item number</th>
<th>Item</th>
<th>Sources</th>
<th>Intervention stages of a CQI process</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td>Learning collaborative method: Kilo 1998</td>
<td>Brandred 2011 Qual. Project study</td>
</tr>
<tr>
<td>1</td>
<td>Training &amp; coaching multiprofessional teams</td>
<td>P.3(4) (V)</td>
<td>T2#4,7,9,10</td>
</tr>
<tr>
<td>2</td>
<td>Senior expert influence</td>
<td>P.5</td>
<td>P.4, T2 F1</td>
</tr>
<tr>
<td>3</td>
<td>Grounded in the professional environment</td>
<td>P.4</td>
<td>T2#10</td>
</tr>
<tr>
<td>4</td>
<td>Patient focus</td>
<td>—</td>
<td>p.5</td>
</tr>
<tr>
<td>5</td>
<td>Cont’d info about best &amp; current practice</td>
<td>P.3 (3)</td>
<td>T2#1 &amp; 2</td>
</tr>
<tr>
<td>6</td>
<td>Web of (multiprofessional) interaction</td>
<td>P.3(2-5)</td>
<td>Box1, D1</td>
</tr>
<tr>
<td>7</td>
<td>System focus</td>
<td>P.3(5)</td>
<td>P.5</td>
</tr>
<tr>
<td>8</td>
<td>Improvement efforts well organized</td>
<td>P.3,7-9</td>
<td>T2#7,10-11</td>
</tr>
<tr>
<td>9</td>
<td>Monitoring innovation &amp; change</td>
<td>P.3, 8, 10</td>
<td>T2#2</td>
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<td>10</td>
<td>Small -scale testing (PDSA)</td>
<td>P.8</td>
<td>T2#2</td>
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<td>11</td>
<td>Self-assessments of teams</td>
<td>P.11</td>
<td>(T2#1)</td>
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<tr>
<td>12</td>
<td>Available measurement guidance</td>
<td>P.6-9</td>
<td>T2#8</td>
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<tr>
<td>13</td>
<td>Good guidance and help with measurement</td>
<td>(V)</td>
<td>T2#8</td>
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<tr>
<td>14</td>
<td>Learning SPC (important to succeed)</td>
<td>P.10</td>
<td>T2#8</td>
</tr>
<tr>
<td>15</td>
<td>Control charts easy to communicate</td>
<td>(V)</td>
<td>V</td>
</tr>
<tr>
<td>16</td>
<td>Decreasing the number of care handoffs</td>
<td>—</td>
<td>B1 D1 (V)</td>
</tr>
<tr>
<td>17</td>
<td>Manager engagement and empowerment</td>
<td>P.5, 9</td>
<td>T2#4</td>
</tr>
<tr>
<td>18</td>
<td>Knowledge based creativity</td>
<td>—</td>
<td>B1,D4</td>
</tr>
<tr>
<td>19</td>
<td>The managers follow up (for sustainability)</td>
<td>P11 (V)</td>
<td>T2#4, #12</td>
</tr>
<tr>
<td>20</td>
<td>Spread continual improvement culture</td>
<td>P.4</td>
<td>P.3</td>
</tr>
<tr>
<td>21</td>
<td>Spread improvements to other areas/units</td>
<td>P.6</td>
<td>P.4,5,T2#10</td>
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### Appendix 3, Table B. Sources of the success items from the sustainability stages of a CQI process

<table>
<thead>
<tr>
<th>Item no</th>
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<th>Sustainability stages of a CQI process</th>
<th>Paper 3: Sustainability study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sources</td>
<td>BEST: Wisborg 2006, Wisborg 2008a*</td>
<td>Thoresen 2011 Ringerike Hospital</td>
</tr>
<tr>
<td>1</td>
<td>Training &amp; coaching multiprofessional teams</td>
<td>P439*, 87,88</td>
<td>P.9</td>
</tr>
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<td>2</td>
<td>Senior expert influence</td>
<td>P.441*</td>
<td>P.7</td>
</tr>
<tr>
<td>3</td>
<td>Grounded in the professional environment</td>
<td>P.87</td>
<td>P.6</td>
</tr>
<tr>
<td>4</td>
<td>Patient focus</td>
<td>P.87</td>
<td>P49, Fig.11</td>
</tr>
<tr>
<td>5</td>
<td>Cont'd info about best &amp; current practice</td>
<td>P.87</td>
<td>P.9</td>
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<td>6</td>
<td>Web of (multiprofessional) interaction</td>
<td>√</td>
<td>P.3</td>
</tr>
<tr>
<td>7</td>
<td>System focus</td>
<td>P.87</td>
<td>P.4</td>
</tr>
<tr>
<td>8</td>
<td>Improvement efforts well organized</td>
<td>P.87</td>
<td>Fig. 6</td>
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### Part A: Applying & adapting generalizable evidence to particular context

<table>
<thead>
<tr>
<th>Item no</th>
<th>Items</th>
<th>P 439*, 87,88</th>
<th>P 7.7-9</th>
<th>√</th>
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<tr>
<td>9</td>
<td>Monitoring practice and change efforts</td>
<td>P.87</td>
<td>P.7-9</td>
<td>√</td>
</tr>
<tr>
<td>10</td>
<td>Small-scale testing (PDSA)</td>
<td>P.440*</td>
<td>—</td>
<td>√</td>
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<tr>
<td>11</td>
<td>Self-assessments of teams</td>
<td>P.87, 93</td>
<td>P.15-22</td>
<td>Box 1</td>
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<tr>
<td>12</td>
<td>Available measurement guidance</td>
<td>P.87</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>13</td>
<td>Good guidance &amp; help with measurements</td>
<td>—</td>
<td>√</td>
<td>Video taping</td>
</tr>
<tr>
<td>14</td>
<td>Learning SPC (important to succeed)</td>
<td>—</td>
<td>Fig.11</td>
<td>—</td>
</tr>
<tr>
<td>15</td>
<td>Control charts easy to communicate</td>
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<td></td>
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### Part B: Facilitating multiprofessional reflection and interaction

<table>
<thead>
<tr>
<th>Item no</th>
<th>Items</th>
<th>P 439*, 87,88</th>
<th>P 7.4-9</th>
<th>P 5. &amp; Box 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Decreasing the number of care handoffs</td>
<td>P439*, 87,88</td>
<td>P.4-9</td>
<td>P.5 &amp; Box 2</td>
</tr>
<tr>
<td>17</td>
<td>Manager engagement &amp; empowerment</td>
<td>P.86, 439*</td>
<td>P.7</td>
<td>P811-12 (5,6)</td>
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<tr>
<td>18</td>
<td>Knowledge based creativity</td>
<td>P.439*</td>
<td>P.15-22</td>
<td>P.811 (1)</td>
</tr>
<tr>
<td>19</td>
<td>The managers follow up (for sustainability)</td>
<td>P.440*</td>
<td>P.7,9,15-22</td>
<td>P811-12 (1,6) 13</td>
</tr>
<tr>
<td>20</td>
<td>Spreading a continual improvement culture</td>
<td>P.440*</td>
<td>P.7-8, 15-22</td>
<td>Box 3</td>
</tr>
<tr>
<td>21</td>
<td>Spread improvements to other areas/units</td>
<td>P.440*</td>
<td>√</td>
<td>√</td>
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</tbody>
</table>

**Table index:** P= Page, T= Table, √ = Normal approach, — Not relevant/not tested, Q= Questionnaire item, (V) = limited focus, P. 3(2-5) = Page 5, point 2-5, F = Factor, # = Item number
Appendix 4: Sustainability test by control charts

Assessing sustainability by the variation of the process on a control chart was not an issue in the systematic review of Lennox et al. (2018). This is an example on how this can be done in a way that is easy to understand in the professional environment.

One of the promising improvement projects of the use of restraints collaborative in 2001 achieved a reduction in the time the patients needed to stay on compulsion (§5) by 34 percent from an average of 18 to 11.9 days during the nine months of their participation in the learning collaborative.

The team had a coach with limited interest in statistical process control, hence they made a student t-test on the difference. With a p-value resulting in 0.09, they concluded the difference was not significant at p<0.05, which was the limit.

This was the reason why this promising project was not included in the successful projects.

Later, their leader asked me to make a control chart on her data because she was going to make a presentation of the project on an international conference. This is the result (Figure x and Y).

Figure X: I-chart (control chart) on the length of stay

The I-chart show a shift of level in the desired direction at the end of the project (marked with a green circle). This was a signal of a change that that came so early that a t-test would not have revealed it.
The moving range chart is bringing important information when indicating a significant reduction of the variation, which can be interpreted as signal of an agreement among the healthcare professionals on a change that probably is related to the restrain reductions.

*Figure y: Moving range chart on the difference in days from one patient to the next*

As shown six months after the end of the learning collaborative, both the shift of level in the length of stay on compulsion (§5), and the reduced variation sustained. The question is, if the changes at that point were sustainable. It is too early to say already six months after the end of the collaborative. The process is significant improved, but because it is not stable, it is unpredictable. Especially are the last 25 observations providing a weak signal of undesired instability, with as much as seven points in a row above its own center line.

It is interesting to know that at that time the leader was about to leave for another job. It may be a co-incidence, but that is anyhow the reason why I have not got further data from her, and am not able to tell the rest of the story.

I am not aware of the reason for the single point above the upper control limit on baseline (120 days). It looks like the cause has been met by a tailored change that was included in the new routines, because it never happened again. If not, we could have washed that point out of baseline. The mean baseline would then have been reduced to 16 days, and the shift of level would have been
found about six months after the end of the learning collaborative. The reduced variation however, would still have been significant in the project period, and after six months.

The control chart indicates how variation may first be influenced by the leader’s engagement, and later by the unstable situation of a predicted leaders change when you do not know if a new leader will pick up the improvement project and continue to advance it or not.

So, with a new leader engaged in following up the improvement efforts by displaying the control chart on the white board, analysing variation together with the professionals at their ordinary meetings, we have reason to believe the changes would have been as sustainable as the team-training routines at Ringerike hospital. Their key variables however, are simultaneous data, thus control charts are not relevant. Instead they are monitoring practice by video to be able to assess the sustainability of their last improvements.
Appendix 5: Delineation of the primary studies

A5.1 DELINEATION OF THE PROJECT STUDY

Five delineations were made to the project study.

1. The project study was not meant to be an evaluation of breakthrough collaboratives in an entire country. One of the reasons are the risk of bias when members of the improvement advisor group (coaches) of a learning collaborative are evaluating the projects initiated within the same collaborative. The multiprofessional research team members were experts on quality improvement, and they (we) did not evaluate the projects we had been guiding personally; however, we were all part of the same improvement advisor group (coaches). The CPO-assessment result was only used for validating and publishing the scale, and for sampling successful projects based on the result of their own (proper) measurements.

2. The CPO-scale is not made to cover the particular context of the single projects in the learning collaboratives of the NMA. The scale is designed to cover the structure of the final reports in the IHI learning collaborative concept. The final reports were predesigned by the collaborative to minimize the problem that “Organization reports are often lengthy, difficult to digest, and filled with extraneous information, virtually guaranteeing that useful learning is hidden” (Kilo 1998). Hence, the IHI report format does not ask for contextual information, but “only vital information—the organization’s name, aims, measures and sampling methods, data (in the form of an annotated run chart as a minimum standard), and details about key changes” (Kilo 1998). This is the reason for developing a second instrument, (the questionnaire) aimed to reveal the conditions for making a good start at continual improvement in a particular context, with and without the support and guidance from a Learning collaborative.

3. The data collected by the two instruments of the Project is not exploring sustainability. In the project study, success means measurable improvements. In 2008 I reported the result of a study of the first seven learning collaboratives to the Norwegian Medical Association. Only 10 percent of the 114 responding improvement teams answered that the changes were followed up by measurements after the end of the learning collaborative.

4. The data collected in the project study is limited to the first nine months of an improvement process (Paper 2), to understand how some teams are able to achieve a successful outcome to an improvement intervention that soon. To understand how to reach the sustainability stages of a continual improvement process, I included a successful trauma system from a hospital and their municipality partners with a long history of continual improvement efforts (see below).
5. To limit the scope of the Project study to a manageable amount of work, I merged the 50 promising projects with the 28 uncertain projects in the statistical analysis into a comparison group of 78 projects. This does not mean the differences between the promising and uncertain projects are out of interest; on the contrary, I am certain they are. But my dissertation study was more than comprehensive enough without this perspective on the improvement challenges.

A5.2. DELINEATION OF THE SUSTAINABILITY STUDY

Four delineations were made to the sustainability study.

1. The study of the successful local medical and psychosocial response after terror attack was limited to 22-24 July 2011 in time.

2. We considered the risk of causing emotional or psychological harm to the study participants, and decided to exclude certain members of the care network from the research that may have been vulnerable in the data collection situation.

3. The professional subject matter research on trauma care and treatment, e.g. trauma surgery and the intensive care of trauma patients is not included in this study. Professional subject matters are only involved when relevant to understand the structure (e.g. competence requirements) and the complexity of the system (e.g. inter-professional relationships). The purpose is to understand the innovation of the trauma care system, how the system changes over time, how the trauma team training model (BEST) has been adapted by the professional environment in the particular context, and to understand the different perspectives of the providers and their performance.

4. The study is especially focusing on the interrelationship between all parts of the care network from Utøya to discharge from Ringerike hospital. The prehospital part of the study is exploring some of the challenges that are poorly covered by others, but has the main focus on the hospital part. This does not mean the prehospital part is of less importance than the hospital, but the prehospital care and the conditions for making a good job at the scene was already covered by others, among whom Gaarder BI (2011), Thoresen S (2012) and Larsen & Hole (2013) are the most relevant.
PART VIII. ORIGINAL PAPERS

Original papers with supplements

Project study (quantitative part): Learning from high performing improvement teams about the conditions for success at the intervention stages of a continual improvement processes

*Paper 1. The sampling instrument:*


*Paper 2. The conditions for success at the intervention stages of a continual improvement processes:*


*Sustainability study: Learning from a high performing emergency care network about the conditions for success at the sustainability stages of a continual improvement process*

*Paper 3. The conditions for success at the sustainability stages of a continual improvement process:*

Paper 2
Domains associated with successful quality improvement in healthcare – a nationwide case study

Aleidis Skard Brandrud¹*, Bjørnar Nyen², Per Hjortdahl³, Leiv Sandvik⁴, Gro Sævil Helljesen Haldorsen⁵, Maria Bergli¹, Eugene C. Nelson⁶ and Michael Bretthauer⁷

Abstract

**Background:** There is a distinct difference between what we know and what we do in healthcare: a gap that is impairing the quality of the care and increasing the costs. Quality improvement efforts have been made worldwide by learning collaboratives, based on recognized continual improvement theory with limited scientific evidence. The present study of 132 quality improvement projects in Norway explores the conditions for improvement from the perspectives of the frontline healthcare professionals, and evaluates the effectiveness of the continual improvement method.

**Methods:** An instrument with 25 questions was developed on prior focus group interviews with improvement project members who identified features that may promote or inhibit improvement. The questionnaire was sent to 189 improvement projects initiated by the Norwegian Medical Association, and responded by 70% (132) of the improvement teams. A sub study of their final reports by a validated instrument, made us able to identify the successful projects and compare their assessments with the assessments of the other projects. A factor analysis with Varimax rotation of the 25 questions identified five domains. A multivariate regression analysis was used to evaluate the association with successful quality improvements.

**Results:** Two of the five domains were associated with success: Measurement and Guidance ($p = 0.011$), and Professional environment ($p = 0.015$). The organizational leadership domain was not associated with successful quality improvements ($p = 0.26$).

**Conclusion:** Our findings suggest that quality improvement projects with good guidance and focus on measurement for improvement have increased likelihood of success. The variables in these two domains are aligned with improvement theory and confirm the effectiveness of the continual improvement method provided by the learning collaborative. High performing professional environments successfully engaged in patient-centered quality improvement if they had access to: (a) knowledge of best practice provided by professional subject matter experts, (b) knowledge of current practice provided by simple measurement methods, assisted by (c) improvement knowledge experts who provided useful guidance on measurement, and made the team able to organize the improvement efforts well in spite of the difficult resource situation (time and personnel). Our findings may be used by healthcare organizations to develop effective infrastructure to support improvement and to create the conditions for making quality and safety improvement a part of everyone’s job.

**Keywords:** Quality improvement, Learning collaboratives, Continual improvement, Conditions for change, Context
Background
Healthcare is suffering from serious unsolved problems that are threatening lives, increasing costs, and making the care unpredictable to the patient [1–7]. Improvement of quality in health care, is probably one of the greatest challenges of modern healthcare leadership. Quality improvement strategies sometimes fail to focus the changes on clinical, patient oriented improvements, and to involve the frontline healthcare professionals at an early stage of the change process [8–10].

The role of qualified improvement guidance has received little attention in the quality improvement literature [11–15]. A recent analysis of 35 systematic reviews explored the influence of context on the effectiveness of different quality improvement strategies. Improvement guidance was not found among a broad range of associated contextual factors that contribute to successful improvement. The analysis organized the findings based on the Model for Understanding Success in Quality (MUSIQ) model [16, 17]. The MUSIQ model itself was based on a systematic review that included continual improvement interventions, but did not cover the role of improvement knowledge guidance [14, 17]. A cluster-randomized trial aimed to compare clinic-level coaching with other learning collaborative components, found coaching to be equally effective with interest circle calls (group telephone conferences) in achieving clinical outcome improvements, but coaching was more cost-effective [18]. Godfrey did also find positive effects of systematic clinic-level coaching [19, 20].

In a case study of 182 improvement teams Strating found that creating measurable targets is a crucial task in quality improvement [21]. In a systematic review of quality measurement, Thor et al. found statistical process control (SPC), to be a useful method for those who mastered the technique [22]. This underscores the importance of good measurement guidance.

Many healthcare organizations do not have a basic infrastructure to support improvement, and contextual factors generally receive scant attention in the current literature on quality improvement strategies [13, 14, 16, 22, 23]. Kringos et al. found that the availability and functionality of information technology and facilitated data collection improved the effectiveness of quality improvement intervention, as well as the involvement of multidisciplinary improvement teams [16].

Little evidence is found that leadership support is associated with successful quality improvement [24–26]. This may be typical for external initiated learning collaboratives, because we found a few studies where the frontline leaders have been directly included in the project planning and improvement guidance, with a positive leadership influence on the effectiveness of the improvement efforts [16, 18–20].

Since 1994, and in spite of a limited underpinning of scientific evidence, the continual improvement method has been spread worldwide by thousands of improvement collaboratives [13, 27–29]. Relatively little of that work is reported in the biomedical literature [30]. Systematic reviews and single studies of quality improvement efforts that are reported, indicate that a systematic and knowledge based approach is not enough to succeed without the presence of certain conditions for improvement, also described as context factors [13, 14, 16, 31]. To meet these challenges, additional improvement approaches, including instruments for evaluating the underlying conditions for improvement, have been described [12, 17, 32]. In 2004 a systematic review recommended further research on factors that tend to produce adoptable changes in healthcare organizations [33]. A recent umbrella review of 35 systematic reviews of the influence of context factors on the effectiveness of (any) quality improvement intervention recommend further research to report the context factors in a systematic way to better appreciate their relative importance [16].

The present study explores the conditions for improvement in the context of 189 Norwegian clinical improvement projects initiated by the learning collaboratives of The Norwegian Medical Association. We asked participating clinicians to identify factors that may promote or inhibit quality improvement. Referring to the studies above, two of the unanswered questions are (1) “What combination of what factors tend to produce “adoptable” improvement innovations?” [33]. (2) How is the effectiveness of the continual improvement method? (The continual improvement method is described in Additional file 1: Supplement 1). The purpose is to identify domains associated with success, as this knowledge may be used to develop an infrastructure and culture that promotes continual improvement in healthcare, without the help from a learning collaborative.

Methods
Summary
The method of the present study had four steps. First we developed a questionnaire for improvement teams. The instrument was based on a qualitative study of the conditions for change among 19 participants of the learning collaboratives of the Norwegian Medical Association (Sub study I, published in 2011) [23]. Second, we submitted the questionnaire to the 189 improvement teams of the same learning collaboratives. Third, we analyzed the data by comparing the reported conditions for improvement in the organizations of the successful projects versus the other (comparator) projects. We already knew the success level of the 189 projects from the validation of a Change Process and Outcome Scale instrument which was published in 2015 (Sub study II) [32].
The learning collaboratives

Between 1998 and 2011 The Norwegian Medical Association sponsored eight hospital related improvement collaboratives to support quality and safety improvement efforts in clinical environments (Table 1). The improvement collaboratives were based on the Breakthrough Series model of the Institute for Healthcare Improvement, aiming to accelerate improvement beyond what had been achieved by traditional educational approaches [34]. The model has two dimensions: the learning collaborative method (national level), and the systematic approach to continual improvement (organizational level) [11, 22, 35–42] (described in Additional file 1: Supplement 1). Each collaborative lasted from 6 to 9 months and engaged clinicians from 15 to 30 healthcare organizations who met to learn from each other and from recognized experts in specified topic areas (Table 1). The participating improvement teams sent 2–4 representatives from different disciplines involved in the topic (at least one physician) to three collaborative learning sessions, where the relevant subject matter experts of the collaborative (medicine, nursing, psychology, etc.) demonstrated the quality gaps within the topic to the participants. A team of 10–15 improvement knowledge experts (coaches) guided the improvement teams at, and in between the learning sessions.

Instrument development

The questionnaire was developed to identify the activities and conditions associated with successful quality improvement initiatives, and to study the effectiveness of the continual improvement method (Additional file 1: Supplement 1). The instrument and its development is described in details in Additional file 1: Supplement 2.

Sub study I

The first sub study was published in 2011 [23], and provided us with a large amount of relevant comments, and enabled us to develop a validated questionnaire reflecting the most interesting conditions for change reported by clinicians telling their improvement project stories from their own organizations, after participating in a learning collaborative of the Norwegian medical association.

Data collection

The questionnaire was submitted to former improvement team leaders between 2 and 4 years after the end of each improvement collaborative. We had access to their e-mail addresses from the improvement collaborative participant list. A link to an on-line questionnaire was e-mailed to the improvement team leaders. They were asked to think back on their improvement project and the promoting and inhibiting conditions for quality improvement that they encountered, and to show their level of agreement with the focus group comments that were included in the questionnaire.

If a Word-version of the questionnaire was preferred, the respondents returned their filled-in questionnaires by e-mail or “surface mail”. In cases of non-response from team leaders, we contacted other participants from the same team. In 36% of the teams, late responses lead to more than one response from the same team. Because the responses from team members mostly reflected different professions, and the inter-rater reliability of the same team ranged from poor to strong, we decided to let each team be represented by the average ratings of its responding members.

Project evaluation

This study is neither an experiment, nor a study of the experiments of others, aiming to bring evidence to the success of the projects in our material. This is a study of the conditions for making successful changes. The aim is to learn from healthcare professionals in the improvement teams of those projects who have been able to document improvements.

<table>
<thead>
<tr>
<th>Year</th>
<th>Topic</th>
<th>Number of projects</th>
<th>Examples of the measurable aims of the single projects within each Improvement collaborative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Cesarean Section</td>
<td>23</td>
<td>Reduce the cesarean section rate to para 0 by 20%</td>
</tr>
<tr>
<td>2000</td>
<td>Intensive Care</td>
<td>15</td>
<td>Reduce the duration of mechanical ventilation by 20% by an optimization of the sedation; reduce length of ICU stay by 10%.</td>
</tr>
<tr>
<td>2001</td>
<td>The Use of Restraints</td>
<td>18</td>
<td>Reduce the use of mechanical restrain in psychiatric therapy by 25%.</td>
</tr>
<tr>
<td>2003</td>
<td>Serious Affective Disorders</td>
<td>23</td>
<td>Reduce the MADRS score by 50% and the length of stay by 50%.</td>
</tr>
<tr>
<td>2004</td>
<td>ADHD</td>
<td>33</td>
<td>Reduce the time from admission to diagnosis by 30%</td>
</tr>
<tr>
<td>2005</td>
<td>Quality &amp; Efficacy in Psychiatric Outpatient Clinics</td>
<td>30</td>
<td>Increase the quality of the preliminary feedback to the primary care physician by 50%</td>
</tr>
<tr>
<td>2006</td>
<td>Substance Abuse</td>
<td>24</td>
<td>Increase the quality of the admission process by 50%</td>
</tr>
<tr>
<td>2011</td>
<td>Early Intervention in Psychiatric Disorders</td>
<td>23</td>
<td>Reduce the days between first time referrals by 50%; and the age of the patients by 25%</td>
</tr>
</tbody>
</table>
Sub study II
The second sub study was published in 2015 [32]. Seven improvement experts from different healthcare professions alternated in participating in a four-person review team. The reviewers were two physicians (BN and TSH), three nurses (GSH, ASB, and EA), one psychologist (LDG) and one bioengineer (AS). The improvement experts were not involved in the evaluation of projects they had participated in with coaching or other kinds of support. In this study we explored the final reports of the improvement teams. We developed a checklist to structure the study according to the recommended improvement method (Plan-Do-Study-Act-cycles) [38], to make it easier to discuss our observations an reflect on our different assessments of the project. The criterion to be classified as successful was to document significant improvements by recognized measurement methods, based on a clear linkage between vision, aims, change efforts and measurements.

We found that 72 projects (38%) were successful, ranging from 17 to 60% within each of the eight collaboratives. A majority (78%) presented their outcomes as a shift in the level in the desired direction on a control chart.

Data analysis
We analyzed the association between the assessments of the improvement teams (responses to 25 selected questions) and the success level of their projects. First, a logistic regression analysis was used to analyze the association between success and each of the 25 questions. Second, a factor analysis with Varimax rotation was used to identify the underlying structure of the 25 questionnaire items. Domains were extracted with an Eigen value greater than one. Kendall’s tau-b correlation revealed that the conditions for a principal component analysis (PCA) were present. Third, when analyzing the multivariate associations between the five domains and success. Logistic regression analyses were performed, with success as the dependent variable, and the success domains as independent variables. Only domains which were significant in a bivariate analysis (defined as \( p < 0.05 \)) were included in the multivariate regression analyses. The results from the regression analyses are presented as odds ratios with 95% confidence intervals and corresponding \( p \)-values. A significance level of 5% was used. All statistical analyses were performed using the software package IBM-SPSS version 21.

Results
Our results are based on the answers to the 25 variables of the questionnaire from the successful versus the other projects. The questionnaires were returned by 53 physicians, 56 nurses, 38 psychologists, and 51 other healthcare professionals, representing 132 (70%) of the 189 improvement teams. Of the 132 responding projects, 54 (41%) had documented improvements in their final reports by recognized measure methods, and 78 (59%) had not been able to do so within the time frame of the learning collaborative (Table 2). The results of the 54 successful projects are presented in Additional file 1: Supplement 3, not as a result of this study, but to illustrate the relationship between the changes they have made, and the conditions for change reflected in our findings.

Research question I: “What combination of what factors tend to produce “adoptable” improvement innovations?”
First, in a logistic regression analysis of the answers to the 25 questions of the questionnaire (Additional file 1: Supplement 2) we identified the variables which were significant associated with success. Two variables were found in the final model: (Q12) Good guidance & help with measurement, and (Q7) Someone in the improvement team enjoyed working with measurement (Table 3).

Second, to disentangle what combination of variables are underpinning successful improvement efforts, we performed a factor analysis of the 132 responses to the 25 questions. This analysis produced five domains: Domain I: “Measurement and Guidance” (nine variables), Domain II: “Leadership engagement” (five variables), Domain III: “Professional environment” (seven variables), Domain IV: “Group process” (two variables), and Domain V “Leadership impact” (two variables) (Table 4).

Third, we studied the quartiles of the domains in the successful projects and compared the scores from the 54 successful projects with the 78 comparator projects within the five domains. Two domains were significantly associated with success: Domain I Measurement & Guidance \( (p = 0.002) \) and Domain III Professional environment \( (p = 0.002) \), (Table 5).

Finally, we made a logistic regression analysis of the five success domains. As shown in Table 6, two domains were found in the final model: “Measurement and Guidance” and “Professional environment”, confirming the findings of the crude analyses displayed in Table 5.

Table 2 Projects, completed questionnaires and response rate per success level

<table>
<thead>
<tr>
<th></th>
<th>Projects per success level</th>
<th>Filled-in questionnaires per success level</th>
<th>Response rate per success level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful projects(^a)</td>
<td>72 (38%)</td>
<td>54 (41%)</td>
<td>75%</td>
</tr>
<tr>
<td>Other projects</td>
<td>117 (62%)</td>
<td>78 (59%)</td>
<td>67%</td>
</tr>
<tr>
<td>Total</td>
<td>189 (100%)</td>
<td>132 (100%)</td>
<td>70%</td>
</tr>
</tbody>
</table>

\(^a\)The successful projects have documented improvements by recognized measure methods in their final reports
The complexity of our findings is displayed in Table 7 presenting the combination of variables that are underpinning the two success domains, illustrated by the proportion of successful and comparator projects scoring on the positive side of the scale (4 + 5) to each variable.

The first success domain “Measurement & Guidance” cover the two success variables from the first regression analysis: Good guidance & help with measurement, and Someone in the improvement team enjoyed working with measurement. In addition the findings suggest it was easier for the successful projects to get hold on their coach when needed (Q10), an availability they assessed as important to succeed (Q11). Further, did the control charts appear to be easy to communicate to their peers in the site (Q20), assessed as important when trying to make successful improvements (Q21).

The second success domain “Professional environment” indicate the importance of presenting patient focused aims when trying to engage of the professional environment in the improvement efforts (Q16), and the importance of presenting measurement to maintain motivation.

### Table 3: Bivariate and multivariate logistic regression analysis for detection of variables significantly associated with success, (with the 25 questions as independent variables and success as dependent variable)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Bivariate analysis</th>
<th>Multivariate analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>P value</td>
</tr>
<tr>
<td>Q12: Good guidance &amp; help with measurement</td>
<td>3.17 1.82 5.52</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Q7: Enjoying to work</td>
<td>3.03 1.45 6.25</td>
<td>0.003</td>
</tr>
</tbody>
</table>

The table shows the independent variables in the final model, their odds ratio (OR) associated with one point increase on a 5 point Likert scale, 95% confidence intervals (CI) and P values

### Table 4: Rotated component matrix (Varimax with Kaisers normalization)

<table>
<thead>
<tr>
<th>Domain</th>
<th>I Measurement &amp; Guidance</th>
<th>II Leadership engagement</th>
<th>III Professional environment</th>
<th>IV Group process</th>
<th>V Leadership impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q7*</td>
<td>.438</td>
<td>-.122</td>
<td>.280</td>
<td>.092</td>
<td>.275</td>
</tr>
<tr>
<td>Q10*</td>
<td>-.430</td>
<td>-.314</td>
<td>.119</td>
<td>-.028</td>
<td>.204</td>
</tr>
<tr>
<td>Q11</td>
<td>.678</td>
<td>-.128</td>
<td>.073</td>
<td>-.031</td>
<td>-.016</td>
</tr>
<tr>
<td>Q12</td>
<td>.722</td>
<td>.235</td>
<td>-.152</td>
<td>.106</td>
<td>-.253</td>
</tr>
<tr>
<td>Q13</td>
<td>.809</td>
<td>-.036</td>
<td>.135</td>
<td>.132</td>
<td>.106</td>
</tr>
<tr>
<td>Q18</td>
<td>.538</td>
<td>-.037</td>
<td>-.081</td>
<td>.197</td>
<td>.086</td>
</tr>
<tr>
<td>Q19</td>
<td>.753</td>
<td>-.074</td>
<td>.211</td>
<td>.145</td>
<td>.273</td>
</tr>
<tr>
<td>Q20</td>
<td>.733</td>
<td>.152</td>
<td>.130</td>
<td>.017</td>
<td>.091</td>
</tr>
<tr>
<td>Q21</td>
<td>.768</td>
<td>.018</td>
<td>.257</td>
<td>.016</td>
<td>.169</td>
</tr>
<tr>
<td>Q2</td>
<td>-.061</td>
<td>.732</td>
<td>.209</td>
<td>.045</td>
<td>.121</td>
</tr>
<tr>
<td>Q3</td>
<td>-.048</td>
<td>.816</td>
<td>.049</td>
<td>.160</td>
<td>.107</td>
</tr>
<tr>
<td>Q4*</td>
<td>.142</td>
<td>.485</td>
<td>.426</td>
<td>.098</td>
<td>-.374</td>
</tr>
<tr>
<td>Q14</td>
<td>.040</td>
<td>.822</td>
<td>.096</td>
<td>.058</td>
<td>.134</td>
</tr>
<tr>
<td>Q24*</td>
<td>.009</td>
<td>-.736</td>
<td>-.138</td>
<td>.009</td>
<td>.012</td>
</tr>
<tr>
<td>Q1</td>
<td>-.120</td>
<td>-.088</td>
<td>.480</td>
<td>-.160</td>
<td>-.439</td>
</tr>
<tr>
<td>Q5</td>
<td>.234</td>
<td>.266</td>
<td>.491</td>
<td>.439</td>
<td>-.072</td>
</tr>
<tr>
<td>Q6</td>
<td>.081</td>
<td>.417</td>
<td>.498</td>
<td>.409</td>
<td>-.255</td>
</tr>
<tr>
<td>Q16</td>
<td>-.053</td>
<td>.117</td>
<td>.692</td>
<td>.007</td>
<td>-.028</td>
</tr>
<tr>
<td>Q17</td>
<td>.308</td>
<td>.133</td>
<td>.455</td>
<td>.130</td>
<td>.286</td>
</tr>
<tr>
<td>Q22</td>
<td>.208</td>
<td>.292</td>
<td>.598</td>
<td>.287</td>
<td>.081</td>
</tr>
<tr>
<td>Q23</td>
<td>.335</td>
<td>.125</td>
<td>.678</td>
<td>.109</td>
<td>.327</td>
</tr>
<tr>
<td>Q8</td>
<td>.183</td>
<td>.040</td>
<td>.018</td>
<td>.879</td>
<td>.032</td>
</tr>
<tr>
<td>Q9</td>
<td>.078</td>
<td>.113</td>
<td>.193</td>
<td>.846</td>
<td>.030</td>
</tr>
<tr>
<td>Q15</td>
<td>.176</td>
<td>.332</td>
<td>-.055</td>
<td>.081</td>
<td>.497</td>
</tr>
<tr>
<td>Q25</td>
<td>-.034</td>
<td>.048</td>
<td>.111</td>
<td>-.085</td>
<td>.709</td>
</tr>
</tbody>
</table>

*One of four negative variables that are turned to positive in the other tables
Regardless of their success level, 83% reported they had been able to organize their improvement efforts well, in spite of a limited resource situation (Q5) (Table 7).

Research question 2: How is the effectiveness of the continual improvement method?
Our findings reflect the intellectual underpinnings of the continual improvement method presented in Additional file 1: Supplement 1. High performing professional environments were successfully pursuing patient-centered quality improvement if they had access to a combination of: (a) knowledge of best practice, provided by professional subject matter experts, (b) knowledge of current practice provided by simple measurement methods, learned from (c) improvement knowledge experts who provided good guidance and help with measurement, and made the team able to organize the improvement efforts well in spite of the difficult resource situation (time and personnel).

Discussion
Our findings support improvement knowledge guidance
Our study underscores the power of good guidance and help with measurement. In contrast to most learning collaboratives abroad, The Norwegian Medical Association invested in a team of 10–15 improvement knowledge experts (coaches) to guide their improvement teams [23]. The coaching team met regularly for education and training. A system of mentoring was developed to enable experienced coaches to support the novice coaches (Additional file 1: Supplement 4).

Our findings support measurement for improvement as a cornerstone of the project
The present study highlights the importance of using measurement to understand and reflect on the variations in current practice, and to monitor the target process continually to maintain motivation for change. Learning from the final reports of the improvement projects, the sub study indicate that successful results are connected to a clear linkage between vision, aims and proper measurements, clear and understandable improvement efforts, and the ability to communicated this all to others in an understandable way [32]. Our findings support the findings of others indicating that by measuring and monitoring variation and change with control charts, it is easier to understand and manage performance from week-to-week, communicate progress, and motivate colleagues to sustain the improvements [43–48].

Our findings indicate common Interprofessional interest in the patients’ welfare
Our The glue for interprofessional collaboration is a common interest in the patient’s welfare, which has been emphasized as crucial by others [49]. We found that 92% of the 198 responding physicians, nurses, psychologists and other members of the improvement teams found patient-centered targets of “great” or “very great” importance for engaging their colleagues in quality improvement (Q16 Table 7).

Our findings call for an infrastructure for improvement in healthcare
We have found that successful quality improvement efforts depend on certain conditions for change in the participating organizations that to a certain degree have been facilitated by the national learning collaborative. However, if continual improvement efforts are to become part of everyone’s work in healthcare, an

### Table 5
The proportion of scores from the 54 successful projects in the five questionnaire domains

<table>
<thead>
<tr>
<th>Domain</th>
<th>Domain I Measurement &amp; Guidance</th>
<th>Domain II Leadership engagement</th>
<th>Domain III Professional environment</th>
<th>Domain IV Group process</th>
<th>Domain V Leadership impact</th>
<th>Number of projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartile*</td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
<td>Percent</td>
<td>n</td>
</tr>
<tr>
<td>I</td>
<td>27.3%</td>
<td>36.4%</td>
<td>25%</td>
<td>36%</td>
<td>45.8%</td>
<td>54</td>
</tr>
<tr>
<td>II</td>
<td>26.7%</td>
<td>35%</td>
<td>29.4%</td>
<td>37.5%</td>
<td>30.3%</td>
<td>54</td>
</tr>
<tr>
<td>III</td>
<td>42.9%</td>
<td>33.3%</td>
<td>57.7%</td>
<td>52.6%</td>
<td>51.2%</td>
<td>54</td>
</tr>
<tr>
<td>IV</td>
<td>64.7%</td>
<td>55%</td>
<td>52.5%</td>
<td>41.7%</td>
<td>35.5%</td>
<td>54</td>
</tr>
<tr>
<td>P value*</td>
<td>0.002</td>
<td>0.134</td>
<td>0.002</td>
<td>0.675</td>
<td>0.260</td>
<td>54 vs 78</td>
</tr>
</tbody>
</table>

*The quartiles represent the successful projects, and the p-values represent a Chi-square test of the 54 successful versus the 78 other projects.

### Table 6
Bivariate and multivariate logistic regression analysis of the five domains of the underlying questionnaire structure, (with the 5 domains as independent variables and success as dependent variable)

<table>
<thead>
<tr>
<th>Domain</th>
<th>Unadjusted analysis</th>
<th>Adjusted analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR</td>
<td>95% CI</td>
<td>P value</td>
</tr>
<tr>
<td>I: Measurement &amp; Guidance</td>
<td>3.13</td>
<td>1.51</td>
</tr>
<tr>
<td>III: Professional environment</td>
<td>3.20</td>
<td>1.55</td>
</tr>
</tbody>
</table>

The table shows the two results domains, their odds ratio (OR) associated with one point increase, 95% confidence intervals (CI) and P values.
Table 7 Variables of the two success-domains and the proportion of evaluated projects scoring on the positive side of the scale (4 & 5 on a scale from 1 to 5) to each variable

<table>
<thead>
<tr>
<th>Domain I: Measurement &amp; Guidance</th>
<th>Successful</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q7: Someone in the improvement team enjoyed working with measurement</td>
<td>87</td>
<td>56</td>
</tr>
<tr>
<td>Q10: We had good guidance and help with measurements</td>
<td>74</td>
<td>57</td>
</tr>
<tr>
<td>Q11: Is the availability of the coach between the LS of any importance to make successful improvements?</td>
<td>83</td>
<td>54</td>
</tr>
<tr>
<td>Q12: Is it of any importance for successful changes that the control-charts are easy to communicate to our peers in the site?</td>
<td>77</td>
<td>46</td>
</tr>
<tr>
<td>Q13: Is good guidance and help with measurements of any importance to succeed with the improvement work?</td>
<td>81</td>
<td>50</td>
</tr>
<tr>
<td>Q16: We based the improvement efforts on patient-focused aims</td>
<td>94</td>
<td>91</td>
</tr>
<tr>
<td>Q19: Is the measure method SPC of any importance to succeed with improvement efforts?</td>
<td>76</td>
<td>57</td>
</tr>
<tr>
<td>Q20: The control-charts were easy to communicate to our peers in the site.</td>
<td>78</td>
<td>51</td>
</tr>
<tr>
<td>Q21: Is it of any importance for successful changes that the control-charts are easy to communicate to the peers in the site?</td>
<td>67</td>
<td>53</td>
</tr>
<tr>
<td>Domain III Professional environment</td>
<td>Successful</td>
<td>Comparator</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>Q14: Are patient-focused aims of any importance to engage the healthcare professionals in the improvement efforts? (No negative scores found)</td>
<td>94</td>
<td>90</td>
</tr>
<tr>
<td>Q1: Referring to the senior expert team made our change ideas more feasible to the peers in the site</td>
<td>75</td>
<td>76</td>
</tr>
<tr>
<td>Q6: The project was well grounded in the professional environment</td>
<td>74</td>
<td>67</td>
</tr>
<tr>
<td>Q5: We organized the improvement efforts well in spite of the difficult resource situation (time and personnel)</td>
<td>83</td>
<td>83</td>
</tr>
<tr>
<td>Q22: We presented measurements continually to maintain motivation.</td>
<td>83</td>
<td>71</td>
</tr>
<tr>
<td>Q23: Is it of any importance to present measurements continually to maintain motivation?</td>
<td>74</td>
<td>72</td>
</tr>
</tbody>
</table>

infrastructure for improvement that at least is providing similar conditions for change in the local context is essential. The infrastructure should include: (a) a system that promotes leadership’s engagement at every stage of the improvement work, (b) provides easy access to clinical data needed for improvement measurement and reflection, and (c) provides qualified improvement guidance to frontline clinical improvement teams [23].

Methodological considerations
A significant part of the overall spectrum of healthcare problems constitutes matters that are not principally biological. For this reason, it is essential to know how the philosophies of the social sciences and the biological sciences differ. One does not erroneously use the criteria for one area to judge another. The social sciences differ from the biological sciences in two aspects: They entail greater elements of overt interpretation that often enter into the collection of data. In many cases, a research result is an understanding, not an explanation. The difference between explanation and understanding however, is not as distinct as many believe [50], and in this study, we are including both.

The present study is exploring the conditions for making desired changes in healthcare. We are not reporting on a scientific experiment aiming to bring evidence to the success of the services and projects in our material. This study has been developed with the prerequisite of the known outcome of the learning collaborative projects of the Norwegian Medical Association.

Learning from high performers stems from a growing number of “positive deviance” approaches to quality improvement [50–53]. The aim of the present study is to learn from healthcare professionals in the improvement teams of those projects who have been able to document improvements based on a clear linkage between vision, aims, change efforts and measurements.

Process and outcome evaluation by improvement experts and improvement teams can illuminate the strategies and processes responsible for the improvement of the target process. In so doing, the process and outcome evaluation from sub study II [32], makes a relevant and important contribution to the development of potentially successful strategies to make positive changes in patient care [12].

It is a limitation that 75% of the projects covered by our research are from the psychiatric sector and one may conclude that the results are limited to this field. (Table 1) The general theoretical framework that we have used (see Additional file 1: Supplement 1), the findings of others (see the Background section), and the matching conditions for improvement reported by the improvement teams from the non-psychiatric settings however, does not support this limitation [23].

It is a strength that the items used in the questionnaire was based on a data collection method that invites respondents to share their point of view, rather than respond to researcher-initiated questions [54]. We designed the questionnaire to be large enough to cover the most important comments, and short enough to get
a decent response rate. As described in Additional file 1: Supplement 2, this implied a step-wise reduction of the material from 233 (partly overlapping) comments to a final selection of 17. In spite of our systematic approach, we may unintentionally have excluded important comments in this process that should have been included in the study. The eight additional questions regarding the importance of the most critical incidents are meant to compensate for this limitation (Additional file 1: Supplement 2).

Conclusion
Our findings suggest that quality improvement projects with good guidance and a sharp focus on measurement for improvement, have an increased likelihood of success. The two success domains are well aligned with continual improvement theory. High performing professional environments were successfully pursuing patient-centered quality improvement if they had access to a combination of: (a) knowledge of best practice, provided by professional subject matter experts, (b) knowledge of current practice provided by simple measurement methods, learned from (c) improvement knowledge experts who provided good guidance and help with measurement, and made the team able to organize the improvement efforts well in spite of the difficult resource situation (time and personnel).

Our findings may be useful for healthcare organizations in the development of an effective infrastructure for improvement and thereby create necessary conditions for making quality and safety improvement a part of everyone’s job.

Additional file

Additional file 1: Supplement QI Success Domains. (DOCX 350 kb)

Acknowledgements
The Norwegian Medical Association Quality Assurance Fund for Quality and Safety provided partial funding for the first part of the data collection of this study (2006-2008). The authors thank Lill de Gelve (LdG), Ada Scheirer (AS), Tordis Sørensen Høifødt (TSH) and Ellen Andersen (EA) for their participation in the evaluation of the 189 projects. The authors thank H. Asbjørn Holm, Ole Tjomsland, and Lars Strauman for their help and support with this study.

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Availability of data and materials
Anonymised datasets are available from the corresponding author on request.

Authors’ contributions
All authors read and approved the final manuscript, agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. ASB was the research team leader and main responsible for planning and conducting the entire study. She has an intimate knowledge of the database and its content, and is main responsible for the data analysis and the manuscript. BNY collected data from one of the focus groups, participated in the development of the two instruments, participated in the evaluation of the improvement projects, has an intimate knowledge of the database and its content, assisted in the data analysis and participated in writing of the manuscript. PJJ supervised the planning and data collection part of the study, has an intimate knowledge of the database and its content, and participated in writing of the manuscript. LSA assisted in planning the research process, has an intimate knowledge of the database and its content, supervised the statistical analysis of the data, and participated in the writing of the manuscript. GSH collected data from one of the focus groups, participated in the development of the two instruments, participated in the evaluation of the improvement projects, and in the final preparation of the manuscript. MBE has an intimate knowledge of the database and its content, assisted in the analysis of the data and the literature review, and in the final preparation of the manuscript. ECN assisted in planning the research process, in outlining the contents of the article and in editing and reading the manuscript. MBK is the main supervisor of the study, has an intimate knowledge of the database and its content, assisted in the data analysis and participated in writing of the manuscript.

Ethics approval and consent to participate
The dissertation proposal was evaluated by the regional ethics committee of South-East Norway 4 Oct 2012 and waived from formal approval according to Norwegian law due to the fact that it did not involve patient interventions. Later, the study was approved by the Data Protection Authority of Oslo University Hospital as required by Norwegian law. Informed consent was obtained from all informants of this study before enrolment. Thus, all necessary approval has been in place.

Competing interests
The authors declare that they have no competing interests.

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Supplements

To Brandrud AS, Nyen B, Hjortdahl P, Sandvik L, Haldorsen GS, Bergli M, Nelson EC, Bretthauer M.
“Domains associated with successful quality improvement in healthcare – a nationwide case study”.

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**Supplement 1: The continual improvement method**

*The Continual improvement* method of the learning collaborative is a combination of Professional knowledge and Improvement knowledge. Improvement knowledge (Suppl.1, Figure 1) implies: (1) knowledge of the system (e.g. the particular context of the place where the patient meet the provider, and the patterns of their interactions). (2) Understanding variation (with time as a variable, e.g. on a control chart). (3) The psychology of work and change (e.g. peoples’ judgements and choices). (4) Theory of knowledge (the differences in the perspectives of the people involved and how they learn). Continual improvement also implies several improvement methods and tools [22, 23, 34, 37, 39, 41, 42, 44, 45].

**Suppl.1 Figure 1: Continual improvement**

![Continual improvement model](image)

The Model for Improvement describes the systematic approach to continual improvement. The model describes a visionary approach based on Deming’s cycle, including Deming’s three fundamental questions that lead to progress: (1) What are we trying to accomplish (vision and aims). (2) How will we know that a change is an improvement (observations and measurements)? (3) What changes can we make that will result in improvement (change ideas) carried out in a Plan-Do-Study-Act cycle. The cycle illustrates that improvement should be a continual, timely and scientifically grounded process [32, 38, 42, 45].

2
**Supplement 2: Instrument (questionnaire) development**

**Data collection in focus groups**
Prior to the present study, critical incident data were collected in focus groups conducted by a research team of four experienced improvement advisors: one physician, two nurses, and one bioengineer. The Critical Incident Technique (CIT) was used as the data collection method, and the result was published in 2011[23]. A critical incident is one that makes a significant contribution, either positively or negatively, to an activity.[50] When seated around the table, the respondents were asked: “Think about the time when you were participating in the BTSC and the time after the project ended. What did you experience as promoting and/or inhibiting elements during and after the BTSC?” The first focus group also wanted to discuss positive spin-offs from their BTSCs. The subsequent groups were thus asked to do the same. The story telling moved around the table several times with minimal interruption by the data collectors. Their task was to support the process using active listening techniques, confirming what the respondents meant without asking other questions or providing explanations.[23, 50] The data collectors summarized the critical incidents on flipcharts in dialogue with the respondents who assessed the accuracy of the recorded information. The focus groups lasted about 45 minutes, and each respondent reported from 5 to 20 critical incidents and positive spin-offs (comments) with a mean of 12 per respondent and a total of 233 comments. A Canadian-Norwegian journalist translated the comments into English.

**Instrument (questionnaire) development**
Avoiding to influence the perspectives of the participants by the opinions of the improvement experts, the questionnaire was derived from a qualitative study of promoting and inhibiting elements encountered by 19 improvement team members from 16 Norwegian hospitals. We gathered the data by focus group meetings using the Critical Incident technique (CIT). The CIT is designed to evoke the perspectives of the participants’ only, without disturbing the respondents with questions based on the reflections of the improvement experts who were gathering the data.[50]
We designed the questionnaire to be large enough to cover the most important comments, and short enough to get a decent response rate. The research team started the sampling process with workshops and e-mail discussions until we had boiled down the 262 focus group comments to a representative sample of 40 questions. The instrument was citing the most
 Supplements to Brandrud et al. “Domains associated with successful quality improvement in healthcare – a nationwide case study”.

critical comments, including some attitude questions about the importance of the most critical comments, and some additional background variables like profession and somatic or psychiatric care. 17 focus group comments/questions regarding critical conditions for improvement and eight questions about the importance of eight of the 17 conditions for change (questions) were meant for this study. A 5-point Likert response scale was tailored to each of the two kinds of questions. The instrument draft was tested on different healthcare providers with background in quality improvement efforts, and a few corrections were made.

The questionnaire
Conditions for improvement (n17)
1= Strongly disagree; 2=Somewhat disagree; 3=Neither agree nor disagree; 4=Agree; and 5=Strongly agree.

Based on your experiences as a member of the improvement team in the learning collaborative of NMA, please show your agreement/disagreement to the following focus group comments:

Q1: “Referring to the senior expert team made our change ideas more feasible to the site”
Q2: “The manager took an active part in selling in the project to the others in the site”.
Q3: “The project was followed up by the leadership in the project period”.
Q4: “The leader of the improvement team had too little recognition in the site*”.  
Q5: “We organized the improvement efforts well in spite of the difficult resource situation (time and personnel)”
Q6: “The project was well grounded in the professional environment”.
Q7: “No one in the improvement team enjoyed working with measurement*”
Q8: “We made good deals on meeting times and how we could get hold of each other between meetings”
Q9: “We had good agreements for the allocation and execution of tasks”
Q10: “We did not get hold on our coach when needed between the Learning sessions.”
Q12: “We (the measurement responsible) had good guidance and help with measurements”.
Q14: “The project was committed in the top management team”.
Q16: “We based the efforts on patient centered targets”.
Q18: “The improvement team learned Statistical process control (SPC)”
Q20: “The SPC charts were easy to communicate to our peers in the site”
Q22: “We presented measurements continually to maintain motivation,”
Q24: “The improvement efforts were not followed up by the management after the end of the project*”

The importance of eight of the critical conditions for improvement (n8)
1 = No importance; 2 = Little importance; 3 = Some importance 4 = Great importance 5 = Very great importance

Please show your agreement/disagreement regarding what importance the different activities may have had to make successful changes.

Q11: Is the availability of the coach between the Learning sessions of any importance to make successful improvements in the participating sites (ref Q10)?
Q13: Is good guidance and help with measurements of any importance to succeed with the improvement work (ref Q12)?
Supplements to Brandrud et al.
“Domains associated with successful quality improvement in healthcare – a nationwide case study”.

Q15: Is the top management commitment to the project of any importance to succeed with the improvement efforts (Ref Q14)?
Q17: Are patient centred targets of any importance to engage the providers in the improvement efforts (ref Q16)?
Q19: Is the measure method SPC of any importance to succeed with improvement efforts (ref Q18)?
Q21: "Is it of any importance for successful changes that the SPC charts are easy to communicate to the peers in the site" (ref Q20)?
Q23: "Is it of any importance to present measurements continually to maintain motivation (ref Q22)?"
Q25: "Is this of any importance to achieve sustainable improvements (ref Q24)?"

*) We have changed negative variables (in italic) to positive when presented in Tables & Figures
Supplement 3: The outcomes of the successful projects
Suppl.3, Table 1: The achievements of the 54 successful projects

<table>
<thead>
<tr>
<th>ID</th>
<th>%</th>
<th>Measurable achievements of the 54 successful projects</th>
<th>Shift of level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>Reduced total Caesarean frequency from 14.2 to 9.7%, Caesarean breech from 70 to 25%, Caesarean para 0 from 19.1 to 10.2%.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>60</td>
<td>Increased the use of a quality-based follow up of the mothers after an acute Caesarean from 57% to 91% of the cases.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>Reduced mean ventilator time from 7.4 to 5.3 by improved observation &amp; sedation. Mean stay decreased by 1 day from 9.3 to 8.3 days. <em>(Brattebo et al. published this project in BMJ 2002; 324: 1386-1389, and the follow up results in Qual Saf Health Care 2004;13:203–205)</em></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>Reduced mean ventilator time from 2.9 to 6.3 by improved observation &amp; sedation. Mean stay decreased by 2.9 days from 6.3 to 3.4 days.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>53</td>
<td>Reduced the use of mechanical restraint from 23.3 to 4.6 hours per event by changing the routines.</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>30</td>
<td>Reduced aggressive outbursts per day by 30% after involving the patient in the planning and development of their own health care.</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>35</td>
<td>Reduced the length of involuntary coerced observation in the acute psychiatric ward by 35% by changing the routines.</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>Reduced the number of involuntary admissions (coerced observation) in the acute psychiatric ward by 50% by changing the routines.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>49</td>
<td>Reduced the use of mechanical restraint by 6 hours (from 770 to 390 minutes) per event by changing the routines. Variation sign. reduced (SPC).</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>79</td>
<td>Increased the use of relevant information in the daily reports by a new checklist for observing serious affective disorder symptoms. <em>(See the control chart Figure 1 below).</em></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>33</td>
<td>Reduced the length of stay by 33% from an average of 41.6 to 27.7 days by electroconvulsive therapy (ECT) for serious (measured) depressions.</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>50</td>
<td>Increased the patients' satisfaction with the information (41%), help (31%) and the involvement of the family in the care (50%).</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>31</td>
<td>Increased the number of consultations regarding bipolar disorders by 31% by a systematic staff education and training program.</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td>136</td>
<td>Increased the quality of the diagnostic work by improving the medical record by 136% according to an average checklist score of 5.01 to 11.82.</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>54</td>
<td>Reduced the time from referral to diagnosis from 37 to 17 weeks. Variation reduced from 6 vs 80 weeks, to 6 vs 30 weeks.</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>15</td>
<td>Reduced the time from referral to diagnosis from 124 to 105 days. Variation (moving range) significant reduced.</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>42</td>
<td>Improved knowledge after attending a family education program about ADHD, social service and legal rights. VAS scale: 8.4, Control Group: 5.9.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>32</td>
<td>Increased the quality of the diagnostic work according to a new standard from 29.5 to 39 points measured by a checklist for the medical record.</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td>69</td>
<td>Reduced the time from referral to diagnosis from 236 to 74 days. Variation between neighbor observations (ref moving range chart) reduced.</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>93</td>
<td>Increased the quality of the diagnostic work according to a new standard.</td>
<td>1</td>
</tr>
</tbody>
</table>
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“Domains associated with successful quality improvement in healthcare – a nationwide case study”.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>30</td>
<td>Reduced the duration of the diagnostic work time to diagnosis from 5.7 to 4 hours, increased comparative data collection from 70.5 to 84%.</td>
</tr>
<tr>
<td>22</td>
<td>27</td>
<td>Reduced the time from referral to admission from 89 to 65.25 days.</td>
</tr>
<tr>
<td>23</td>
<td>44</td>
<td>Reduced the time from admission to diagnosis from 136 to 76 days. Variation between neighbor observations (moving range) reduced.</td>
</tr>
<tr>
<td>24</td>
<td>70</td>
<td>Increased the proportion of children and adolescents being examined and care for by their primary care physician according to the ADH guidelines.</td>
</tr>
<tr>
<td>25</td>
<td>30</td>
<td>Reduced the total time from referral to diagnosis from 90 to 63 days for children and adolescents by a better collaboration with the pediatrician</td>
</tr>
<tr>
<td>26</td>
<td>30</td>
<td>Reduced the total time from referral received to diagnosis by 30% and a shift of level on a control chart after improving the diagnostic procedures.</td>
</tr>
<tr>
<td>27</td>
<td>78</td>
<td>Reduced the time from admission to diagnosis/decision from 87 to 19 days. Variation (moving range) significant reduced.</td>
</tr>
<tr>
<td>28</td>
<td>52</td>
<td>205 of 392 patients had diagnosis set by a specialist after change. Specialist diagnoses increased from 4.21 per 20 weeks to 53.2 per 15 weeks.</td>
</tr>
<tr>
<td>29</td>
<td>26</td>
<td>Reduced the time from admission to medical treatment from 266 to 197 days, with a reduction in resource usage by 60% from 35 to 14 hours.</td>
</tr>
<tr>
<td>30</td>
<td>46</td>
<td>Reduced the time from admission to medical treatment from 116 to 63, earning good patient satisfaction scores, ranked as # 3 in the health region.</td>
</tr>
<tr>
<td>31</td>
<td>27</td>
<td>Reduced the proportion of &quot;no-shows&quot; from 10.3 to 7.5% by routine changes in cooperation with primary care physician, patient organizations.</td>
</tr>
<tr>
<td>32</td>
<td>75</td>
<td>Reduced the time from referral to admission from 20,6 to 5,2 weeks. The number of patients with this kind of rapid admission increased by 150%.</td>
</tr>
<tr>
<td>33</td>
<td>46</td>
<td>Reduced the time from referral to admission from 52 to 28 days. Variation between neighbor observations (moving range) reduced.</td>
</tr>
<tr>
<td>34</td>
<td>35</td>
<td>Reduced the time from referral to admission from 153 to 99 days, e.g. by increasing the # of 1.time admissions from 25 per 5 weeks to 78/5 weeks.</td>
</tr>
<tr>
<td>35</td>
<td>70</td>
<td>Increased the quality of the written hospital communication with primary care (measure checklist made by the recipient/primary care)</td>
</tr>
<tr>
<td>36</td>
<td>45</td>
<td>Increased the quality of the diagnostic work and improving the medical record by 45% according to an average checklist score of</td>
</tr>
<tr>
<td>37</td>
<td>108</td>
<td>Increased the checklist scores from 6.2 to 12.9 regarding a proper use of the research forms QRS &amp; SRS (referral and quality of care).</td>
</tr>
<tr>
<td>38</td>
<td>43</td>
<td>Reduced the proportion of «no-shows&quot; from 24 to 13.6 per week by improving the communication with patients, family and primary care.</td>
</tr>
<tr>
<td>39</td>
<td>58</td>
<td>Reduced the time from admission to diagnosis from 72 to30 days. Variation (moving range) significant reduced.</td>
</tr>
<tr>
<td>40</td>
<td>81</td>
<td>Increased the proportion of discharge summaries completed by discharge time from 3.7 to 81%, &amp; offered 84% of those patients a summary review.</td>
</tr>
<tr>
<td>41</td>
<td>71</td>
<td>Increased the quality of the admission process according to a new standard from 48 to 82 points measured by a checklist for the medical record.</td>
</tr>
<tr>
<td>42</td>
<td>32</td>
<td>Increased the quality of the diagnostic work according to a new standard from 25 to 33 points measured by a checklist for the medical record.</td>
</tr>
<tr>
<td>43</td>
<td>136</td>
<td>Increased the quality of the diagnostic work according to a new standard</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>No.</th>
<th>No.</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>200</td>
<td>Increased the proportion of patients with a good, care plan documented in the medical record within the fifth consultation from 28.6 to 86.6 %.</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td>71</td>
<td>Increased the quality of the individual care plan from 7 to 12 quality points measured by a checklist with quality criteria for the content.</td>
<td>1</td>
</tr>
<tr>
<td>46</td>
<td>240</td>
<td>Increased the quality of the diagnostic and therapeutic work from 5 to 17 quality points measured by a checklist of change criteria.</td>
<td>1</td>
</tr>
<tr>
<td>47</td>
<td>97</td>
<td>Reduced the time from admission to diagnosis from 72 to 2 days.</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>77</td>
<td>Increased the quality of the integrated care from 13 to 23 quality points according to a checklist of best practice.</td>
<td>1</td>
</tr>
<tr>
<td>49</td>
<td>42</td>
<td>Reduced the duration of the interprofessional diagnostic process from 29.5 to 17 days, by increasing the program compliance from 55 to 73 %.</td>
<td>1</td>
</tr>
<tr>
<td>50</td>
<td>46</td>
<td>Improved the diagnostic work from 8 to 11.37 points on a quality checklist, and reduced the time from decision to admission from 5 to 2 days.</td>
<td>1</td>
</tr>
<tr>
<td>51</td>
<td>70</td>
<td>Reduced time between first time referrals for first episode psychosis from 18.9 to 5.6 days, and the average age of those patients from 30 to 20 years. (see the control charts in figure 3 and 4 below)</td>
<td>1</td>
</tr>
<tr>
<td>52</td>
<td>64</td>
<td>Reduced time between first time referrals for first episode psychosis from 18.9 to 5.6 days, and referral to treatment-time from 12.44 to 10.14 days. (See the control charts in figure 2 below)</td>
<td>1</td>
</tr>
<tr>
<td>53</td>
<td>40</td>
<td>Reduced the time between the collaborative care efforts of BUP &amp;VOP** regarding 16-19 year old patients from 47.33 to 28.29 days.</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>31</td>
<td>Increased the quality of family information &amp; care from 12.14 to 15.94 points measured by a checklist of family care criteria.</td>
<td>1</td>
</tr>
</tbody>
</table>

*) Eight consecutive points or more on the desired side of the baseline median on a statistical process control chart (SPC).
**) VOP=Adult mental health care, BUP= Young adult/youth mental health care

Examples of control charts from the successful projects
Supplements to Brandrud et al.
“Domains associated with successful quality improvement in healthcare – a nationwide case study”.

**Supplement 3, Figure 1; Project ID 10:** The improvement team aimed to increase the use of relevant information in the daily reports by 79%. The quality of the daily reports was retrospectively evaluated and scored according to a checklist of serious affective disease symptoms. The checklist was evidence based and developed by the multiprofessional improvement team in collaboration with the professional environments. Different change efforts were made to improve the providers' ability to make relevant reports and the changes were tested step by step. The control chart is displaying a desired (significant) shift of level (>7 successive points above the previous (green) central line/average) after each change period.

![Reduced time between referral to treatment of first episode psychosis](image)

**Supplement 3, Figure 2; Project ID 52:** Figure 2: Project 8/10 (2011) Reduced time between referral to treatment of first episode psychosis from 45 to 18 days buy 64 percent. A significant shift of level achieved after change (7 successive points below the previous center line/baseline). The variation is also substantial reduced. Reduced variation is a sign of an integrated performance among the providers.

The barriers of the hospitals' ability to respond quickly to the needs of these youngsters were substantial reduced.
Supplements to Brandrud et al. “Domains associated with successful quality improvement in healthcare – a nationwide case study”.

**Supplement 3, Figure 3 and 4; Project ID 51:** Reduced the time between first time referrals for first episode psychosis from 18.9 to 5.6 days (by 70%), and the average age of those patients from 30 to 20 years (by 30%). A significant shift of level is achieved after change in both l-charts (>7 consecutive points below baseline after change). Figure 3 display a variation that is substantial reduced, as a sign of integrated performance among the providers. Figure 4 display that a previous normal age of 42 for a first time admission is displaying a special cause variation after the intervention. That means 42 years is no longer representative for patients with a identified first time episode psychosis.

Project 51 and 52 made several improvement efforts in collaboration with primary care, the school nurses and the teachers to help them gain a better understanding of this illness, and be able to identify the symptoms at an early stage. The barriers of the hospitals ability to respond quickly to the needs of these youngsters were substantial reduced.
Supplement 4: The improvement process guidance

The intellectual underpinnings

We are using the term (improvement) process guidance, which is our translation of a Norwegian term that does not exist in English. But our use of term guidance is meant to cover a combination of what Caplan defines as guidance, consultation, and teaching, and what our respondents defines as help (e.g. with measurements) [51-52]. The Norwegian approach can be viewed as a combination of Schön’s “knowing-in-action” and “reflection in action”, and Eddy’s (1988) analytic approach. Which approach is most relevant, is determined by the situation [53-54]. Process guidance is rooted in Schön’s “Reflective practitioner” [53]. Tuckman’s “Five stages of group development” [55, 56], and Clarkson’s “The-team-as-a-whole” [57]. Clarkson integrated the theories of Tuckman, Berne [57, 58], Watzlawick [59] and Minuchin [60]. According to Clarkson, the role of the coach is to play the team leader good by personal guidance, without intervening in the team in a way that could take the authority away from the team leader. If joining an improvement team meeting, the coach is sitting outside the meeting table, unless the leader is inviting the coach to sit in for a while, for teaching a certain theory, showing the use of an application, how to make a control chart etc.

Supplementary references

Appendix

Utøya island in Lake Tyri, Norway (photograph: Frode Johansen, with permission)

The Utøya area in Southern Norway. Sundvolden hotel was established as the triage and information center. Ringerike Hospital was the local emergency care center (Google Maps)
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Part 1: Trauma team

1.1. Innovation of the BEST training program

The figure below shows the dynamics of the meaning-driven innovations and continual improvement efforts behind the BEST program, developed at a national level and adapted by Ringerike hospital.\textsuperscript{10, 11, 12, 60}

![Diagram showing the dynamics of the BEST program]

**Better & Systematic Trauma Care (BEST)**

Purpose: Every acute care hospital should be able to undertake the initial treatment of trauma patients, despite well-developed air ambulance and trauma centers at university hospitals.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>Chance system: Trauma center focus:</td>
<td>Knowledge &amp; ED skills: ATLS\textsuperscript{a}</td>
<td>Multi-professional team training</td>
<td>Inter-professional communication &amp;</td>
<td>2006 BEST Training &amp; initial trauma</td>
</tr>
<tr>
<td></td>
<td>between and within hospitals Local</td>
<td>(Trauma Nurse Care Course), etc.</td>
<td>training together, training together.</td>
<td>Management training Common rules</td>
<td>hospitals</td>
</tr>
<tr>
<td></td>
<td>training</td>
<td>Local training</td>
<td>In the hospitals own ER</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.2. Roles and tasks of the trauma team

Here is a list of the roles and tasks of the trauma teams in the Trauma manual of Vestre Viken Ringerike hospital. Each role has its own tasks which are printed on a laminated “action card”. If a team member thinks it is necessary to intervene in another person’s tasks, they first must ask the team manager for permission to do so, formed as a question without blaming whoever owns the task. It is important that each member of the team always have in mind that performing their own tasks takes priority that nobody else is responsible for their tasks, and fundamental things may be forgotten if they are not focused primarily on their own tasks.
Appendix to “Local emergency medical response after a terrorist attack in Norway – a qualitative study”.

**TRAUMA MANUAL: RINGERIKE HOSPITAL**
(based on the manual of the trauma center at Oslo University, Oslo, Norway)

The acute alarm button in the ER expedition automatically calls in the trauma team.

**Trauma Team:**

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Call phone/P page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma Leader: Surgical Attending</td>
<td></td>
</tr>
<tr>
<td>Active Examiner: Surgical Resident</td>
<td></td>
</tr>
<tr>
<td>Anesthesiologist</td>
<td></td>
</tr>
<tr>
<td>Orthopedic Surgical Resident</td>
<td></td>
</tr>
<tr>
<td>Surgical Intern</td>
<td></td>
</tr>
<tr>
<td>Nurse Anesthetist</td>
<td></td>
</tr>
<tr>
<td>ER nurse x 2</td>
<td></td>
</tr>
<tr>
<td>Operating Room Nurse</td>
<td></td>
</tr>
<tr>
<td>Radiology Technician</td>
<td></td>
</tr>
<tr>
<td>Laboratory Technician</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Personnel / Responsibility</th>
<th>Acute response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coordinating Nurse</strong></td>
<td>• Selection of two ER nurses for the Trauma Team</td>
</tr>
<tr>
<td></td>
<td>• Secure proper temperature (28C) in the trauma room</td>
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<tr>
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<td>• Reception of the patient’s family members</td>
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<tr>
<td><strong>Paramedic/EMT</strong></td>
<td>• Gives the report in the trauma room</td>
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<tr>
<td>(Emergency Medical Technicians)</td>
<td>• Transition of responsibility to the trauma team</td>
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<tr>
<td>Ambulance (air and road)</td>
<td>• Released from the responsibility of patient care by the Trauma Leader</td>
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</table>
Appendix to “Local emergency medical response after a terrorist attack in Norway – a qualitative study”.

| Trauma Team / All involved | • Meet together outside of the trauma room  
|                           | • Dress in standard precaution devices: gloves, role-identifying vest; gown, face mask, and eye wear if indicated  
|                           | • Full attention during the ambulance report  
|                           | • Stay calm  
|                           | • Speak clearly, ask questions, make suggestions  
|                           | • Make sure you can execute your duties  
|                           | • Clearly relay completed tasks  
|                           | • All inquiries go directly to the Trauma Leader  
|                           | • **Prevent hypothermia** |
| **Trauma Leader: Surgical Attending** (tel/page) | • Triage when applicable  
| Primary responsibility for patient care | • Supervise the handover by EMS personnel  
| **Surgical Resident: Active Examiner** (tel/page) Can be the team leader depending upon experience | • Show clear leadership  
| | • Systematic examination (ABCDE) with continuous communication to the team  
| | • Give clear commands  
| | • Prioritise further exams and treatment  
| | • Call in extra personnel / Relieve personnel of duties  
| | • Decide further treatment and who is responsible for the patient after leaving the trauma room |
| **Orthopedic Surgical Resident** (tel/page) | • Full orientation about the accident details  
| | • Assist the Trauma Leader and Active Examiner  
| | • Reduction of fractures, cast placement  
| | • Act as proxy Trauma Leader in the case of multiple trauma patients |
| **Anesthesiologist** (tel/page) | • Secure the airway, determine the Glasgow Coma Scale  
| | • Evaluate circulation, peripheral venous access  
| | • Eventual arterial line, blood gas, CVK |
| **Nurse Anesthetist** (tel/page) | • Secure the airway, determine Glasgow Coma Scale  
| | • Placement of the SaO2-probe  
| | • Evaluate circulation  
| | • Establish venous access  
| | • Administer pain medication and relay treatment to ER nurses  
| | • Assist the anaesthesiologist |
## ER Nurse - chosen by the Coordinating Nurse

**ER Nurse 1**
- Document the Trauma Leader
- Responsibility for providing handheld ultrasound equipment
- Write the trauma journal (BEST)
- Relay relevant patient information
- Recruit more personnel when instructed
- Answer telephone calls
- Order relevant labs (Trauma lab order)

## ER Nurse - chosen by the Coordinating Nurse

**ER Nurse 2**
- Cut off and remove clothing from the patient
- Connect monitoring equipment, enter patient identity information
- Provide warmed blankets
- Bladder catheterisation when indicated
- Provide relevant equipment and medications
- Administrate medications (work with the Nurse Anaesthetist)

## Surgical Intern (tel/page)
- Write the admitting note during the primary survey
- Assist the Trauma Leader when necessary
- Order x-rays and trauma CT

## Radiology Technician (tel/page)
- Prepare the CT machine
- Transport of mobile x-ray machine
- Prepare the mobile x-ray for use
- Take the x-ray into the trauma room when instructed
- Ask the Trauma Leader about other exams (i.e. pelvic x-ray)
- Contact the radiologist when prompted

## Laboratory Technician (tel/page)
- Phlebotomy, work with the Nurse Anaesthetist
- Inform the Trauma Team when results are available

## Operating Room Nurse – (tel/page)
- Cut off and remove clothing from the patient
- Provide warmed blankets
- Assist in surgical procedures
Primary Survey

A – airway  
B – breathing  
C – circulation  
D – disability  
E – exposure

Thorax
*  
Abdomen/pelvis with bleeding
*  
Extremities with bleeding
*  
Caput – Columna
*  
Abdomen without bleeding
*  
Extremities without bleeding
( check the distal pulse in all 4 extremities)

Target:
The primary goal is to stabilise the patient for further testing and diagnostics.

The patient will be well oxygenated with Pa02 over 12kpa. Good peripheral circulation. Systolic blood pressure over 90. Adequate urine production. Prevent hypothermia.
Appendix to “Local emergency medical response after a terrorist attack in Norway – a qualitative study”.

Part 2: Method

2.1. Design

The data collection and analysis in this retrospective, descriptive, exploratory study used a mixture of methodological approaches tailored to the different parts of the research process, as described by Moen & Middelthon:

“In short, qualitative research designs have to be flexible and dynamic in the sense of that they allow – and facilitate – productive working relationships among methods, empirical fields, practicalities, research themes, and theories.”

The research cycle included various data collection approaches, such as key informant interviews, focus group discussions based on the Critical Incident Technique, observations, flip-over notes, observer notes, qualitative interviewing, audio-records, and interview transcripts.

2.2. Ethical considerations

In January 2013, the lead author was talking with the healthcare leadership of Ringerike hospital and Ringerike District Psychiatric Centre about the possibility of inviting the emergency healthcare workers to comment on their successful medical response to the shooting spree that took place at Utøya youth camp on 22 July 2011.

Study participation was voluntary, confidential, and based on informed verbal consent, as well as a written consent with freedom to terminate participation at any time without consequences. Terrorism is a traumatic event. We considered the risk of causing emotional or psychological harm to the study participants, and decided to exclude three groups from the research: (a) survivors and bereaved families; (b) providers who were personally affected by losing a sibling, family friend, or neighbor at Utøya; and (c) providers with health problems who were absent from work because of the terrorist event. Permissions were obtained from the relevant managers before individuals (rescue workers 22-24 July 2011) were approached.

The study was evaluated by the regional ethics committee of South-East Norway and waived from formal approval according to Norwegian law because it did not involve patient interventions. The study was approved by the Data Protection Authority of Oslo University Hospital, as required by Norwegian law. Thus, all necessary approval was in place. The data were stored on the research server of Vestre Viken Health Trust, and the informants’ names were separately encrypted as required by the Data Protection Office of Human Subjects. Permissions were obtained from the relevant managers before individuals were approached. Study participation was voluntary,
Appendix to “Local emergency medical response after a terrorist attack in Norway – a qualitative study”.

confidential, and based on informed verbal consent, as well as a written consent with freedom to terminate participation at any time without consequences.

Participants were also informed (in writing) that a support team by District Psychiatric Services was available in case they should need help after recalling the traumatic events. The lead researcher was unaware if informants sought psychological help after their participation in the study, because this was viewed as a confidential and private matter.

The Norwegian Ministry of Health has established a national coordinating service (provided by the Norwegian National Research Ethics Committee) to protect those affected by the 22 July event in subsequent research. The present study was presented to and discussed by the Committee, and members of our research team participated in the national sessions and seminars that were convened for 22 July researchers.

2.3. Data analysis

Gremler recommended the use of external researchers for analyzing data collected by the Critical Incident Technique.30 The external research team did not participate in the data collection, nor did they have any substantial work experience with emergency care services. Three of four had records as clinicians and they all had experience as quality improvement advisors in collaboration with diverse disciplines. According to a conventional content analysis (see below), they independently coded the 400 statements before they held a series of meetings (stages 3-9) over eight months.

Research team 1 used the method described by Hsieh & Shannon41:

Researchers avoid using preconceived categories, instead allowing the categories and names of categories to flow from the data. Researchers immerse themselves in the data to allow new insights to emerge, also described as inductive category development. Many qualitative methods share this initial approach to study design and analysis. (…)

Data analysis starts with reading all data repeatedly to achieve immersion and obtain a sense of the whole, as one would read a novel. Then, data are read word by word to derive codes by first highlighting the exact words that appear to capture key thoughts and concepts. (…)

Codes are then sorted into categories based on how different codes are related and linked. These emergent categories are used to organize and group codes into meaningful clusters. Ideally, the numbers of clusters are between 10 and 15 to keep clusters broad enough to contain a large number of codes. Depending on the relationship between subcategories, researches can combine or organize this large number of subcategories into a smaller number of categories.

The purpose of each analysis stage was to read the material repeatedly and to improve their considerations by discussing and reflecting on the patterns that were identified in the material as viewed from the members’ different perspectives. First, they reduced the number of focus group
statements from 400 to 334, because 66 statements did not address the research question. The content analysis ended with a selection of 127 statements underpinning five success domains. Stages 10-12 of the analysis process occurred in dialogue with the emergency service experts (the internal research team). They merged two of the five success domains into one, and increased the selection of statements by 23 to 150 (see Appendix part 4.2), of which 30 comprised the final selection (see Appendix part 4.1), represented by 17 statements in the Results section of the paper.

Moen indicate that the knowledge produced in a qualitative study is a common achievement.42

“(…) The question of who produces knowledge is thematized and theorized to a much lesser extent. In many scientific discourses, it may seem that the implicit idea at work is that the researcher is the (sole) producer of knowledge. In this chapter, we assert that the people we interact with during research need to be recognized both as epistemologically active subjects and as co-producers of knowledge. (…) How we understand the “who” of knowledge production has implications for the entire research process, including how a study is conceived and designed; how fieldwork is conducted; what issues are noticed, accounted for, and critically examined; and how data are analyzed”.

The main researcher has “picked the brains” of outstanding emergency healthcare professionals and leaders and has considered their statements repeatedly in dialogue with some of the leading quality improvement experts in Norwegian healthcare. It has been a rewarding journey. She often thought that the most challenging part of the research process would be to reduce the number of statements to a manageable minimum without losing the empirical support of the findings. However, when reaching this part of the research cycle, the intimate acquaintance with the material made the final selection surprisingly obvious, but still difficult, because some of the key statements had to be excluded as quotations in the Result section for reasons of space (see Appendix part 4.1).

**Part 3: Crisis management**

The tactical management team at Ringerike hospital has developed this list of challenges and key factors of the crisis management on 22-24 July 2011.

A member of the Tactical management and the internal Research team initially developed the list in 2011 in the wake of the terrorist event. The list had been used in the emergency response planning process at another hospital. The list was presented to the lead author at a research meeting. After discussing the list with other members of Tactical management, who made a few changes to bring the list into accordance with their perspectives on the situation, the “owner” approved the list. Finally, as we translated the list to English, we removed some and anonymized other parts of the sensitive information in the text in dialogue with the “first owner”. A central member of Tactical management (and the professional research team of the present study) has evaluated the triage, diagnosis, and surgical response to the causalities from Utøya.37
3.1. Competence
The hospital was well structured with an appropriate, well-known and readily available (written) emergency preparedness plan, revised by tactical management a few weeks before July 22 2011, and well known by every manager. Good crisis management requires good management skills and medical expertise. The tactical management team must be able to understand the needs of the organization during such an event. The management were confident that the staff was competent and that they were well trained by the BEST-principle. Therefore, they could concentrate entirely on managing the overarching situation.

3.2. Logistics
The logistics revolved around patients, family, personnel, and equipment.

Personnel Logistics
The emergency preparedness plan was followed regarding the composition of one team around each patient. The doctors met in reception and other personnel met at their respective departments. Personnel that were needed for transport and/or other treatment tasks were summoned from their respective departments by the disaster coordinator. Each department appointed a coordinator, usually the one that was proposed in the local plan on an action card, or the nurse who had the best knowledge of the departments’ routines. The coordinator distributed tasks within the department and was contactable via the phone number specified in the plan.

Because of the large number of patients, the hospital’s ordinary trauma team was replaced by teams tailored to the trauma of the individual patient, with at least one physician for each team. For example, teams were summoned from the surgical department to attend the most seriously injured patients. Each patient who required surgery, alternatively stabilizing treatment, was followed all the way by a team consisting of a nurse anesthetist, a surgical or an ER nurse, and a physician (when necessary) until the initial treatment was completed. As described by Waage & Poole:

When the first patients arrived, three of five surgical consultants and one of two surgical residents were available to lead the trauma teams. One of the five consultants performed triage, and one was sent to the scene. The surgical resident on-call was unable to treat any patients owing to the greatly increased organizational duties from the mass casualty incident. Incidentally, there was only one regular acute admission from 15.00 hours until noon the next day. Two orthopedic consultants and four orthopedic residents were present. Of the four anesthetists present, one was sent out to the scene. In addition, there were 11 doctors from the medical department, and gynecologists were also available. Non-surgical personnel took care of the less badly injured patients. Patients with minor injuries were sent to the outpatient department staffed by medical doctors, and moderately to severely injured patients were sent to the emergency department. Owing to a lack of general surgeons, who normally would assess all injured patients, those with apparently isolated extremity injuries were taken care of by an orthopedic surgeon, while patients with head and torso injuries were placed under the care of a general surgeon. (....) Anesthetists were prioritized to the most severely injured patients and to patients requiring immediate surgery.37
3.3. Information

The importance of information is under appreciated. Much of the outcome of a crisis management situation depends on how well the information flows, both internally and across the various external stakeholders, such as next of kin and media.

*Event log*

Documentation was related both to individual patients and to the progression of work during the disaster. The work was documented "real time". This is why the hospital had a comprehensive overview of how the disaster was handled, and find areas for improvement in retrospect. This task was initially taken care of by tactical management and then by a secretary who was fed the information.

*Emergency-web and Patient list*

Because of the high pace in the emergency entrance, the patients could not be identified at that time and many of the patients were not able to identify themselves. Therefore, patients were registered with continual numbers in the emergency-web that followed the patients through the system. This is how strategic management could monitor patient flow.

In addition, tactical management needed a detailed list of how many patients were in the hospital at any time, the seriousness of the patients’ injuries and other important information about the patient. This was not easy. A patient list was therefore created in Excel where the number from the disaster web was as quickly as possible linked with a verified identity. The list consisted of the patients’ social security number, home municipality, information about their injuries, and other relevant information that was regularly updated.

The patient list was regularly printed out and given to the police liaison and the secretary who answered the external telephone requests. Tactical management were challenged on the legality of this list in terms of confidentiality, but chose to use it in light of the extraordinary situation.

The patient list was also used at a meeting in the intensive ward at midnight, where operating staff, anesthesia staff, and disaster management gathered to plan the night's operations (e.g., who would be sent to other hospitals, etc). The list was systematically checked.

The patient list proved to be particularly useful when it came to identifying all patients with gunshot wounds, also patients who had been sent out of the hospital due to unverified information that the perpetrator may have prepared the projectiles with poison.

The next day, the patient list was used to determine which of the patients came from the same municipality and probably knew each other, so they could stay in the same room. The patients were very happy to be with friends who had been through the same experience.
Family Information

Management placed an emphasis on ensuring quick information to next of kin. None of the patients that were admitted had working cellphones. Employees were constantly reminded that establishing contact with next of kin via the hospital’s telephone was a high priority. Disaster management also established a phone line where next of kin could call for information. Tactical management continually delivered an updated patient list here. The load was much greater than expected because many of those who called were relatives of those who subsequently proved to be among the dead. The number of inquiries was therefore much higher than the number of patients.

3.4. Other success factors

Care processes monitoring

Tactical management had two staff members that circulated, monitoring different processes and giving feedback on bottlenecks which then could be addressed. This helped management feel confident that things were running smoothly and they could concentrate on other things.

Clear management

Tactical management consisted of a tactical leader and a tactical management team. Clear and visible leadership is important in general, but particularly in a crisis. The tactical leaders moved around a lot and talked to people; they encouraged them, listened to what they were concerned about, and gave information.

Psychosocial support to those who are injured

The psychosocial support for next of kin, the uninjured and lightly injured was well attended. It is easy to forget those who are more severely injured and therefore could not receive the same help. They were recently operated upon, perhaps influenced by painkillers, and staff mainly focused on the somatic injuries. Tactical leaders went around to all the patients the day after and caught up with their needs. This mainly revolved around finding out what had happened to those they knew, and establishing contact with surviving friends, and of course next of kin.

Creativity

The disaster plan is an essential tool for the organization to run smoothly and efficiently. Nevertheless, there will always be need for creative ad hoc solutions beyond what can be conveyed in the plan. When creating such solutions, it is essential that key personnel are informed so that systems do not work against each other. Information flow and clear management is therefore essential.
Part 4: Selected statements

4.1. The 30 key informant statements

The 17 statements presented in the Method section of the paper are here written in italic.

1. Major incident preparedness and competence

"What is most important about experience is that you have the knowledge and skills you get by training. It makes you able to tolerate extreme situations and make quick decisions. Ringerike hospital has activated the trauma team many times, and with valuable debriefings afterwards. This reinforces the value of experience, making you able to tolerate more".

"Then we brought out the red emergency preparedness manual and the action cards [a role & task description so that no details were missed], and I was able to repress my own feelings and concentrate on the job".

"We need a plan anyhow, and action cards to « keep on track». We saw they were clinging to their action cards in a way that some cards were worn out”.

"The same multidisciplinary team followed the same patient thorough the entire care process, from triage to the general or psychiatric ward, and did not let go of the patient before it was justifiable"

"Proximity to the mental healthcare unit and a written emergency cooperation plan was crucial.”

"Knowledge is important, but we need to be trained. If anyone in the team is un-trained, it helps that some have trained and can lead/help the others along”.

“Hole Municipality had a trained crisis team”.

“The police were an important part of the emergency service. They cleared the path for the healthcare workers, and their lifesaving efforts at Utøya were great. They were applying direct pressure to gunshot wounds to stop the bleeding”.

2. Crisis management and leadership

“I would not have been able to lead over 200 persons without good structure as foundation. Neither would I have been able to manage the major incident without enough human resources at hand”.

“We knew we could trust the competence of our trained personnel, thanks to our monthly simulation and team-training system. Knowing this, tactical management was able to concentrate on other issues”.

“Fortunately, an experienced senior manager was available to take the responsibility as ambulance commander”.

“There was progress all the way; good flow, well directed by the (hospital) medical commander, and people did what was expected from them”.

“We endeavored to bring together the right professionals, forming good, multidisciplinary teams”.

“Crisis management must understand the real time needs of the organization and what needs can be expected in the next sequences of events”.
“Tactical management went around talking with the health professionals, encouraging and listening to their concerns and stories, and provided information”.

“The information we collected was both related to each patient (patient list), and to the consecutive events (Event log). A successful outcome depended to a large degree on the quality of the information flow, internal to the healthcare leaders, coordinators, and workers and external to the attached families and to the press”.

“The interaction between the police liaison and tactical health care leadership worked perfectly”.

3. Empowerment of the multi-professional networks

“Cooperation, and that we knew each other well, helped us manage the situation. It would have been very difficult to be alone. We needed each other in making the right decisions”.

“Then we spoke to the youngsters for hours. Their stories were heart-breaking, and we knew that we must not lose each other if we [were to] be able to withstand this”.

“When the hospital was blocked by the police due to a terror threat, those who did not have patient contact were scared. We who worked with the patients were not scared”.

"Life-saving that the ambulance/prehospital expertise was that great".

"We knew you were coming, (anesthesiologist arriving at the support center) and were aware of your presence. It was very important to have someone with your expertise among us”.

“The presence of such a versatile expertise was reassuring to me. I would not be able to do my part of the job otherwise”.

4. Ability to improvise based on structure and competence

“Easier to improvise because we have regular training, both as individuals and together with the others in the team. Enough to understand each other and to know where we had to improvise.”

“The action cards freed up mental capacity to improvise. E.g., when the police closed the road to Oslo, we established a second support center in cooperation with primary care services, taking care of the families being shut out from the main support center. This was useful”.

"We regularly provided updated patient lists to the police through the entire evening. Never felt this could be wrong".

“The support center at the hotel constituted a solid and comforting environment for providing psychosocial support.”

“Structure and competence makes room for improvisation”.

"Three helicopters landed about the same time with severely injured patients, two landed on the hospital’s helipad (meant for one) and the third in front of the main entrance."

"Thanks to the updated patient list, tactical management was soon able to identify patients from the same municipality and placed them together in the same room (at the ward). They were pleased to come together with friends sharing the same experiences".
Errata list

Name of candidate: Aleidis Skard Brandrud

Title of thesis: Learning about the conditions for improvement and excellent care from high performing clinical networks.

Abbreviations for different types of corrections:
Cor – correction of language, (Cpltf – change of page layout or text format)

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</table>
Clarifying the number of informants and their roles in the local trauma care network.

The total number of roles in the psychosocial and trauma care network from Utøya to discharge from Ringerike hospital was 35, of which 31 roles were considered particularly important. Of the 30 professionals participating as informants, 26 met in 5 focus groups. Four single interviews were made with those who were not able to meet in their focus group. The 30 informants covered 29 of the 31 most important roles. The material of paper 3 was based on the statements of these 30 informants.

A fifth single interview was made with informant number 31, because he was replacing a member of the internal expert team who suddenly died from a heart attack (see Paper 3, page 814). Informant 31 is one of the architects behind the trauma system (see Figure 5 and Chapter 7.2.1.). He is an expert on role 30, and has a perspective on trauma care that is crucial to understand the cultural, historical and theoretical underpinnings of the trauma system that are focused in this thesis. Because he did not participate in the local medical response, his interview was not included in the material of Paper 3. He was, however, participating as one of the co-authors of the paper.