Patients in Norwegian Assertive Community Treatment teams: Subjective Quality of Life and Inpatient Service Use

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Acknowledgements

Summary

Assertive Community Treatment teams (ACT) were implemented in Norway to improve services for people suffering severe mental illness (schizophrenia, other psychotic disorders or bipolar disorder) who are in need of long-term and comprehensive services, but whose needs are inadequately met by standard mental health services.

The impact of ACT has been thoroughly documented since the start-up in Madison, Wisconsin (USA) in the 1970s, but discussions regarding its place in the health care systems, including who can benefit most from it and in which settings, are ongoing. The primary aims of the ACT model are to engage and keep people who suffer severe mental illness in contact with services, to provide services that aim to improve patients' outcome, including quality of life and functioning, and to reduce the extent of hospital admissions in mental health care.

The aims of this thesis were: i) to investigate subjective quality of life in an ACT population and to explore the associations with patient characteristics, in particular practical and social functioning; ii) to investigate inpatient service use amongst ACT patients in the two years before and the two years after they enrolled into ACT teams, including the pattern of inpatient service use amongst different subgroups. We also explored associations between changes in hospitalisation (admissions, total inpatient days, and involuntary inpatient days) and patient characteristics.

All patients that enrolled into 12 Norwegian ACT teams during the teams' first year of operation were asked to participate. A total of 149 participants were eligible for Paper I which reports on the first study aim, and 142 participants were eligible for Papers II and III which report on the second aim. Socio-demographic and clinical data were collected by clinician-rated and self-reported questionnaires upon enrolment (Paper I, II and III). In addition, longitudinal data regarding inpatient service use in the two years before and the two years after ACT enrolment were obtained from the Norwegian Patient Register (Paper II and III).

Participants' subjective quality of life was positively associated with age, contact with social network, and everyday practical and social functioning. Subjective quality of life was negatively associated with severity of anxiety and depressive symptoms. Furthermore, satisfaction with specific life domains was positively associated with related areas of functioning.

The participants spent significantly fewer days in hospitals in the first two years with ACT, compared to the two years before they enrolled. This was mainly due to a reduction of inpatient days amongst participants with high use of inpatient services prior to ACT. Both participants with and without problematic substance use had significantly fewer inpatient days during ACT than before. Those with problematic substance use also had fewer involuntary inpatient days during ACT. The reduction occurred despite ongoing problematic substance use.

The design of the study does not allow for interpretation of causal directions. However, the positive relationship between subjective quality of life and the level of practical and social functioning may suggest that training targeted to increase patients' practical and social skills may improve their subjective quality of life. Further, the findings may indicate that ACT contributes to a more appropriate use of inpatient care, possibly by reducing the presumably avoidable hospitalisation of high users and increasing the presumably needed inpatient care of low users. Finally, ACT teams seem to successfully support people with complex mental health problems in the community, including those with problematic substance use, and thereby contribute to a reduction in inpatient service use.

Abbreviations

ACT = Assertive Community Treatment

AO = Assertive Outreach

AUDIT = Alcohol Use Disorder Identification Scale

AUS = Alcohol Use Scale

BPRS = Brief Psychiatric Rating Scale

CI = Confidence Interval

CRT = Crisis Resolution Team

DACTS = Dartmouth Assertive Community Treatment Scale

DALY = Disability-Adjusted Life Year

DUDIT = Drug Use Disorder Identification Scale

DUS = Drug Use Scale

GAF = Global Assessment of Functioning

GAF-F = Global Assessment of Functioning – functioning scale

GAF-S = Global Assessment of Functioning – symptom scale

HEAS = Homeless Engagement and Acceptance Scale

ICC = Intra-class Correlation Coefficient

LQOLP = Lancaster Quality of Life Profile

MANSA = Manchester Short Assessment of Quality of Life

NPR = Norwegian Patient Register

OECD = Organisation for Economic Co-operation and Development

PACT = Program of Assertive Community Treatment

PSF = Practical and Social Functioning

SAS = Statistical Analysis System

SD = Standard Deviation

SPSS = Statistical Package for Social Science

TLC = Training in Community Living

TMACT = Tool for Measurement of Assertive Community Treatment

TP = Time Period

UK = United Kingdom

US = United States (of America)

WHO = World Health Organization

List of papers

Paper I:

Clausen, H., Landheim, A., Odden, S., Heiervang, K. S., Stuen, H. K., Killaspy, H., Šaltytė Benth, J. Ruud, T. (2015). Associations Between Quality of Life and Functioning in an Assertive Community Treatment Population. *Psychiatric Services, 66*(11), 1249-1252, doi 10.1176/appi.ps.201400376

Paper II:

Clausen H., Landheim A., Odden S., Šaltytė Benth, J., Heiervang K.S., Stuen H.K., Killaspy, H., Ruud, T. (2016). Hospitalization of high and low inpatient service users before and after enrollment into Assertive Community Treatment teams: a naturalistic observational study. *International Journal of Mental Health Systems*, (2016) 10:14, doi 10.1186/s13033-016-0052-z

Paper III:

Clausen H., Ruud, T., Odden S., Šaltytė Benth, J., Heiervang K.S., Stuen H.K., Killaspy, H., Drake R.E., Landheim A. (2016). Hospitalisation of severely mentally ill patients with and without problematic substance use before and during Assertive Community Treatment: an observational cohort study. *BMC Psychiatry*, (2016) 16:125, doi 10.1186/s12888-016-0826-5

1. Background

Two of the main aims of the Assertive Community Treatment (ACT) model are to improve patients' subjective quality of life and to reduce their time spent in hospitals. Therefore, this thesis attempted to increase the understanding of the relationship between subjective quality of life and patient characteristics, in particular practical and social functioning. Inpatient service use amongst ACT patients in the two years before and after enrolment into the teams was also investigated, including associations between changes in hospitalisation and patient characteristics.

1.1 The ACT model

In the mid-20th Century, a process of downsizing and closing of psychiatric asylums started throughout the industrialized Western world. The main focus shifted from asylum-based to community-based care and patients with severe mental illness (schizophrenia, other psychotic disorders, or bipolar disorders) moved back to their communities (Fakhoury and Priebe 2007). The aims of community-based care were to promote rehabilitation and integration (Turner 2004). However, despite an increase in community-based services, communities were often not adequately prepared or equipped to provide services to meet the patients' needs. As a consequence, many patients were poorly integrated in their community, resulting in frequent or long-term hospitalisations (Stein and Test 1980). There was an evident need for improved services and different community programs were established. In the 1970s a conceptual model on community-based service delivery was developed to meet these short-comings and to provide an alternative to mental hospital treatment, the Training in Community Living (TLC) program, later called Assertive Community Treatment (Stein and Test 1980).

The therapeutic interventions and the outcome measures of the TLC program were based on the following values: 1. It is better to be outside hospital rather than inside; 2. It is better to work productively than to be dependent on others; 3. It is important to be effectively interdependent; 4. It is a good thing to be happy (Stein and Test 1980).

The model emphasized the need for the community services to meet certain requirements if they should be able to improve patients' community tenure and thus reduce inpatient service use amongst the "chronically disabled psychiatric patients". This included (Stein and Test 1980):

- helping patients acquire material resources (food, shelter, clothing, medical care)
- providing support to increase patients' coping skills to meet the demands of community living (e.g. using public transportation, preparing simple but nutritious meals, budgeting)
- motivating patients to persevere and remain involved with life

- supporting patients in gaining freedom from pathologically dependent relationships (e.g. dependence on families or hospitalisation)

- providing support and education of community members who were involved with the patients to improve relationships between them

- helping develop supportive systems that assertively help patients with the previous five requirements

By providing this support in the community it was thought that the patients would learn the necessary skills for community living in the context where they would need them, and therefore would find it easier to apply them (Stein and Test 1980).

1.1.1 Characteristics of the target group

Originally, the ACT program targeted people suffering "chronic disabling psychiatric illness" associated with poor community functioning, who did not engage with community-based services and were frequently admitted to mental hospitals (Allness and Knoedler 2003, Rosen, Mueser et al. 2007). Many of these patients spent years in mental hospitals (Stein and Test 1980).

Although the ACT teams initially included patients that had "any diagnosis other than severe organic brain syndrome or primary alcoholism" (Stein and Test 1980), the current consensus is to reserve ACT for people with the most severe and persistent symptoms. This includes patients with schizophrenia or other psychotic disorders, or patients with bipolar disorder (Allness and Knoedler 2003), who do not benefit from standard treatments, or who are difficult to engage by traditional services, and who are often referred to as the "clients in greatest need" (Allness and Knoedler 2003, Rosen, Mueser et al. 2007).

The availability of specific admission criteria has been judged as a critical ingredient for ACT by an expert panel (McGrew and Bond 1995), and the 2003 Manual for ACT lists eligibility criteria that can be used as guidelines to identify patients in greatest need (Allness and Knoedler 2003). The patients must have:

- severe and persistent illness (priority given to patients with schizophrenia, other psychotic disorders, or bipolar disorder).

- significant functional impairments, including an inability to perform a range of practical daily living tasks required for basic functioning in the community without significant support from others.

- a history of poor engagement with traditional office-based services

Priority should be given to those who:

- are high users of inpatient services (two or more admissions per year) or psychiatric emergency services

- may be residing in substandard housing, are homeless or at risk of becoming homeless, and those residing in inpatient units or supported community residence, but who have been assessed as able to live more independent if intensive services are provided.

A European survey estimated the annual prevalence of severe mental illness in two European catchment areas found that approximately 2 in 1000 persons suffered severe mental illness (Ruggeri, Leese et al. 2000). The majority of people with severe mental illness have schizophrenia and many experience severely impaired functional disability. According to the World Health Organization's (WHO) World Health Report "New understanding, new hope" from 2001, schizophrenia is the eighth leading cause of disability-adjusted life years (DALYs) worldwide for people between 15-44 years. DALY is a measure of overall disease burden describing the impact of a health problem as measured by financial cost, mortality, morbidity, or other indicator. DALYs are the number of years lost due to ill health, disability or early death.

Many people with severe mental illness also suffer co-occurring substance use problems. The lifetime prevalence of alcohol abuse or dependence in the general adult population ranges from 13.5% to 22.7% (Regier, Farmer et al. 1990, Kringlen, Torgersen et al. 2001) while 3.4% to 6.1% of the adult population has a lifetime prevalence of drug abuse or dependence (Regier, Farmer et al. 1990, Kringlen, Torgersen et al. 2001). Amongst persons with schizophrenia, the reported lifetime prevalence of any substance abuse or dependence, ranges from 47% to 60% (Regier, Farmer et al. 1990, Fioritti, Ferri et al. 1997, Fowler, Carr et al. 1998). Current prevalence ranges from 27% to 41% (Fowler, Carr et al. 1998, Ecker, Aubry et al. 2012).

1.1.2   The key characteristics of the ACT model

The ACT approach provides more flexible and intensive support than generic mental health services. The key characteristics of the model include a multidisciplinary team approach with a psychiatrist, psychiatric nurses, social workers, and specialist in substance use disorders; low user to staff ratio (10:1); shared caseload instead of working as individual case managers; and the teams provide their services in the community instead of in the office. The services are individually tailored and evidence-based (McGrew and Bond 1995, Marshall and Lockwood 2000, Allness and Knoedler 2003, Dixon, Dickerson et al. 2010, Kuipers, Kendall et al. 2010).

To ensure that the model is replicated in its original form, it is necessary to have clear and validated criteria. In 1998 Teague and colleagues published the "Dartmouth Assertive Community Treatment Scale" (DACTS), a measurement of program fidelity in Assertive Community Treatment (Teague, Bond et al. 1998). Twenty-eight program-specific items were divided in three categories, evaluating the team's human resources (structure and organisation), organisational boundaries and

nature of the services. However, with the growing focus on recovery for patients with severe mental illness and the development of new evidence-based treatments, the fidelity tool needed to be updated to capture the implementation of these services in the Assertive Community Treatment model. In 2011, Monroe-DeVita and colleagues presented a new fidelity measure: the "Tool for measurement of Assertive Community Treatment" (TMACT), which in part is based on the DACTS. The TMACT comprises 47 items, giving six subscales;

- Structure and organisation
- Core team (including team leader, nursing staff and psychiatric care provider)
- Specialist team (including substance abuse specialist, vocational specialist, and peer specialist)
- Core practices (including practices considered fundamental to the ACT model [e.g. providing services in the community rather than the office, intensive services including frequency and duration of contacts, responsibility for psychopharmacological treatment including monitoring effects and side effects], and meeting consumers' basic needs [e.g. social and communication skills training, functional skills to enhance independent living such as activities of daily living, meals, safety, planning, housekeeping, transportation planning/navigation skill building, and money management])
- Evidence-based practices (practices (including integrated dual disorder treatment, supported employment, wellness management [e.g. Illness Management and Recovery], supportive housing, cognitive–behavioural therapies, and family psycho-education and support)
- Person-centred planning and practices.

Each item is rated on a 5-point scale from 1 (not implemented) to 5 (fully implemented). (Monroe-DeVita, Teague et al. 2011). The mean scores are categorized in five levels; <2.5 (not ACT), 2.5-3.1 (low fidelity), 3.2-3.7 (moderate fidelity), 3.8-4.3 (high fidelity), and 4.4-5.0 (exemplary fidelity) (personal communication Maria Monroe-DeVita).

1.2 The implementation of ACT teams in Norway

The ACT model was introduced to Norway through a pilot project in a region in the South-Eastern part of the country in 2007. The evaluation of this project was promising and in 2009 the ACT model was included in a Government white paper (Helsedepartementet 2008-2009). From 2009 the Directorate of Health initiated funding of the implementation of ACT teams throughout Norway.

Altogether 12 teams were established between December 2009 and February 2011. Teams were established in all four health regions, covering small and large cities, and rural areas. The Directorate of Health funded an evaluation of these teams alongside this investment.

1.3 Mental health services in Norway

Norway has a population of approximately five million people. The country has a few larger cites (Oslo is the largest, with approximately 600,000 inhabitants) and vast rural areas with low population density. The mental health service system for the adult population is divided into two organisational levels. The first level comprises general practitioners, emergency medical centres and mental health services in the communities. The second level comprises; (1) *community mental health centres* (in Norway called District Psychiatric Centres - DPS) that offer specialised mental health care and that are divided into different units, typically; general outpatient clinics, psychosis/rehabilitation/ambulatory teams, substance abuse clinics, day/group clinics and crisis resolution teams; and (2) *psychiatric hospitals* including acute, semi-acute and long-term wards. Mental health services in primary care and in the community mental health centres may also offer inpatient services but with a lower level of specialised care.

The services are often fragmented, and the division between the service levels and between the units may present impediments to accessing appropriate treatment and follow-up, particularly for people suffering severe mental illness. Inadequate or inappropriate care may increase the risk of dropping out of treatment.

In 1996-1997, a white paper concluded that the quantity and the quality of mental health services in Norway were inadequate; it was difficult to access appropriate services; the follow-up after discharge from inpatient care was poor; and quality control of services was lacking (Helsedepartementet 1996-97). Subsequently, the Government enacted a national program for mental health to improve services (Helsedepartementet 1996-97).

In 2006 the Norwegian Directorate of Health was commissioned to reassess primary and specialized mental health services for adults with severe mental illnesses who were in need of long-term and comprehensive services. They found that the services were lacking continuity, they were fragmented, and that approximately 4000 people were not well engaged with services despite their need for treatment and follow-up. (Huus, Storm-Olsen et al. 2008). This is approximately one in every 1000 adult inhabitants of Norway. In 2009 the Health Authorities decided to fund the implementation of the ACT model as one of several actions taken to further improve services to this population (Huus, Storm-Olsen et al. 2008). The recommendation was based on the international documentation of the effect of the ACT model since the 1970s, and on the assessment of needs for ACT in a region in South-Eastern Norway (Huus, Storm-Olsen et al. 2008).

1.4 Status of knowledge in relation to the aims of the ACT model

According to national clinical guideline number 82 (from the National Institute for Health and Clinical Excellence), *Schizophrenia – The NICE guideline on core interventions in the treatment and management of schizophrenia in adults in primary and secondary care* (updated edition), the three main aims of ACT are; i) to keep people with serious mental health problems in contact with services (avoid drop-out), ii) to reduce the extent (and cost) of hospital admissions, and iii) to improve outcomes, particularly quality of life and social functioning (Kuipers, Kendall et al. 2010).

The status of knowledge regarding these aims will be discussed in the following sections.

1.4.1   Drop-out

People with severe mental illness and comprehensive co-morbidity may be in great need of services but some do not want to be involved with or are difficult to engage by traditional mental health services. A recent Cochrane review found that intensive case management, which includes ACT, is more successful in reducing rate of loss to follow-up than non-intensive case management and standard care (Dieterich, Irving et al. 2010). The controlled studies that were included in this review followed the participants from six months up to four years. Additionally, an observational study followed 165 ACT patients and found that 130 patients (79%) were still in contact with local services after a mean follow-up of six years and eight months (Rana and Commander 2010). Data from the research-based evaluation of Norwegian ACT teams show that the teams remain in contact with approximately 90% of their patients over a 12-month period (Landheim, Ruud et al. 2014). The evidence of ACT being more successful than other services in engaging people is strong. However, findings regarding the other two main aims of ACT, improvement in quality of life and reduced inpatient service use, are equivocal (Dieterich, Irving et al. 2010).

1.4.2   Subjective quality of life

People with schizophrenia report lower subjective quality of life than the general population (Tempier, Caron et al. 1998, Evans, Banerjee et al. 2007), and to improve patients' quality of life is an important aim for health services (Saxena and Orley 1997).

The patients in Stein and Test's TCL project were significantly more satisfied with their life situation after 12 months in the program than were patients in the control group (Stein and Test 1980). This difference had disappeared 14 months after the TLC patients were transferred back to traditional mental services (Stein and Test 1980). Later randomised studies on ACT have not been able to replicate these findings (Dieterich, Irving et al. 2010).

Associations between subjective quality of life and patient characteristics in patients with severe mental illness have been investigated in several studies. Gender appears not to be significantly related to subjective quality of life (Roder-Wanner, Oliver et al. 1997, Priebe,

Reininghaus et al. 2010), but positive associations have been found with older age (Priebe et al 2010), being employed (Priebe, Reininghaus et al. 2010), having a good social network (Bjorkman and Svensson 2005), and adequate social support (Caron, Lecomte et al. 2005). Psychiatric symptoms are negatively associated with quality of life (Gaite, Vázquez-Barquero et al. 2002, Bjorkman and Svensson 2005, Priebe, Reininghaus et al. 2010), but this association appears to concern particularly community patients (Eack and Newhill 2007). However, reducing symptoms does not necessarily improve subjective quality of life. Patients that achieve better functioning have also reported better subjective quality of life (Kortrijk, Mulder et al. 2012), and recent studies report positive correlations between patients' functioning and their quality of life (Galuppi, Turola et al. 2010, Edmondson, Pahwa et al. 2012). Additionally, changes in life satisfaction and functioning have been found to vary according to specific domains (Edmondson, Pahwa et al. 2012). ACT has shown to be superior over standard care in increasing patients' social functioning and improving their living situation (Stein and Test 1980, Dieterich, Irving et al. 2010).

1.4.3 Inpatient service use

Inpatient service use has been one of the primary outcomes in ACT studies since the first paper was published in 1980 (Stein and Test 1980). Before the TLC program was conducted, the authors found that people with "chronically disabling psychiatric illnesses" were prone to frequent or long-term hospital admissions if the community services did not assertively support them in obtaining basic requirements (see section 1.1. The ACT model) (Stein and Test 1980). In the TLC program, a trained hospital-ward staff was transferred into the community to provide these services. During the 14 months of the trial no TLC patients were admitted to hospital while most patients in the control group were (Stein and Test 1980). The authors also concluded that the "*community tenure (…) was not gained at the experience of their quality of life, level of adjustment, self-esteem, or personal satisfaction with life*" (Stein and Test 1980). However, 14 months after the end of the trial, the differences between the groups had disappeared. The inpatient service use amongst the TLC patients increased after they were transferred back to standard care (Stein and Test 1980).

The promising results of the ACT model (Stein and Test 1980) evoked interest both in the United States (US) and internationally. Subsequently, ACT teams were established in several countries; i.e. the US, Canada, Australia, the United Kingdom (UK) and the Netherlands (Morrissey, Domino et al. 2013) as part of their services for people with severe mental illness. The promising results of ACT in reducing hospitalisation in the first two decades of its implementation (Hoult 1986, Hambridge and Rosen 1994) have not been confirmed in the more recent years, particularly in European trials (Killaspy, Bebbington et al. 2006, Sytema, Wunderink et al. 2007). This has led to a discussion about the ACT model's relevance within current mental health systems and what

population it should target (Burns, Catty et al. 2002, Rosen, Mueser et al. 2007). Factors that contribute to the lack of success may include; differences in health care and welfare systems between countries, overlap in key components between the ACT model and control services, and trials investigating ACT in areas where the inpatient service use is already low (Marshall, Bond et al. 1999, Burns, Catty et al. 2002, Burns, Catty et al. 2007). However, the ACT model has strong evidence for keeping patients who have been difficult to engage with traditional services, in contact with the health care system (*see chapter 1.5.1*). Thus, the lack of success in reducing inpatient service use in some countries, should not overshadow the success of ACT over other services in keeping marginalised people who have been difficult to engage, in contact with the health care system (Killaspy 2007).

Identification of differences between high users and low users of inpatient care and factors associated with changes in hospitalisation can increase understanding of the impact that ACT may have on these subgroups. In general, patients with high inpatient service use are more likely to have a diagnosis of schizophrenia or bipolar disorder compared to patients with low inpatient service use (Pedersen, Sitter et al. 2009, Graca, Klut et al. 2013). Compared to patients that are low users of inpatient care, the high users are younger (Morlino, Calento et al. 2011, Graca, Klut et al. 2013), they are more often compulsory admitted (Graca, Klut et al. 2013), and they have a higher number of previous admissions (Roick, Heider et al. 2004, Morlino, Calento et al. 2011). However, there is no clear definition of high frequency use of inpatient services, and most definitions are either based on the number of admissions (Bonsack, Adam et al. 2005, Morlino, Calento et al. 2011, Graca, Klut et al. 2013) or the duration of hospitalisation (Domino, Morrissey et al. 2013, Morrissey, Domino et al. 2013). Definitions that use either frequency or duration exclude patients with few but long admissions or with frequent but short admissions. The REACT study from the UK is the only ACT trial that applied criteria accounting for both frequency and duration, defining recent high use of inpatient care *as at least 100 consecutive inpatient days or at least five admissions within the past two years or at least 50 consecutive inpatient days or at least three admissions within the past year* (Killaspy, Bebbington et al. 2006).

The strongest predictor for recurring hospital admissions seems to be high number of previous admissions, but use of inpatient services is closely linked to the availability of these services within each country or community. With the growing focus on recovery-oriented practices in ACT (Monroe-DeVita, Teague et al. 2011), these teams may offer improved services to patients suffering severe mental illness who have great needs. This may include patients with severe mental illness and poor community functioning who may have had little to no contact with services or hospital admissions. ACT is intended to primarily target persons with mental illness who have the most severe symptoms and disabilities, and who are prone to frequent or long periods in hospital. This includes patients with

poor community functioning who are not successfully reached and engaged by less intensive and less assertive services (Allness and Knoedler 2003, Rosen, Mueser et al. 2007). Some patients may therefore have little contact with services (Allness and Knoedler 2003) and few or no admissions in hospitals before ACT. Hospitalisation in this situation may contribute to stabilizing a difficult situation that could easily be overlooked by traditional, office-based mental health services. This could suggest that ACT is appropriate for people with a range of needs, not only those who are high users of inpatient services.

It is not only a history of high inpatient service use that increases the risk of hospitalisation amongst people suffering severe mental illness. Patients who in addition to a severe mental illness also struggle with co-occurring substance misuse, have higher risk of being admitted to hospital (Drake, Osher et al. 1989, Haywood, Kravitz et al. 1995), also involuntary (Hustoft, Larsen et al. 2013), and spend more time as inpatients (Menezes, Johnson et al. 1996).

Although ACT is generally more successful in reducing inpatient service use than standard mental health services, the impact of ACT on inpatient service use amongst patients with co-occurring substance misuse problems is equivocal (Drake, McHugo et al. 1998, Essock, Mueser et al. 2006, Hunt, Siegfried et al. 2013). However, there are only few trials that have investigated the impact of ACT on hospitalisation amongst these patients (Hunt, Siegfried et al. 2013). One possible explanation for the limited effect on this groups' inpatient service use, may be the lack of success in reducing substance use (Fries and Rosen 2011).

1.5 Unanswered questions

One of the overarching aims of the ACT teams is to improve patients' outcome, with particular focus on quality of life and functioning. Traditionally, specialized mental health services in Norway have targeted symptomatology with less focus on functioning. However, a decrease in symptoms is not necessarily associated with improved subjective quality of life, but there is a positive relationship between subjective quality of life and level of practical and social functioning. A more detailed understanding of the associations between satisfaction with specific life domains and the level of functioning in related areas is required.

A second overarching aim of the ACT teams is to reduce the number of admissions and inpatient days. Despite the focus that has been directed towards hospitalisation as an outcome in ACT trials, there is still an ongoing debate regarding where ACT services should be targeted. With the recent development and implementation of more recovery-oriented and evidence-based services in the ACT model, perhaps these services also have a place in the treatment and follow-up of patients without a history of high inpatient service use but who nevertheless suffer severe disabilities and are difficult

to engage by more traditional, office-based services. Furthermore, the impact of ACT on hospitalisation of patients with severe mental illness and co-occurring substance misuse is equivocal. More detailed knowledge on patterns of inpatient service use amongst different subgroups is therefore needed.

2. Aims and research questions

Two of the main aims of ACT teams are to improve patients' quality of life and to reduce the extent of inpatient service use. The present theses therefore investigated subjective quality of life amongst patients that enrolled into 12 Norwegian ACT teams and explored associations with patient characteristics, in particular practical and social functioning. Additionally, we investigated inpatient service use (admissions, total inpatient days, and involuntary inpatient days) amongst patients in Norwegian ACT teams, including amongst different subgroups. Furthermore, we explored associations between changes in hospitalisation and patient characteristics.

2.1 Paper I

The aims of the first paper were to investigate the subjective quality of life of patients who had recently enrolled into 12 Norwegian ACT teams, and to explore associations between subjective quality of life and patient characteristics. Associations between different areas of functioning and satisfaction with various life domains were of particular focus. Our research questions were:

1. What is the quality of life of our study population when they enrolled into the ACT teams?

2. What socio-demographic and clinical characteristics are associated with subjective quality of life of this group?

3. What is the association between different areas of practical and social functioning and satisfaction with various life domains in our study population?

2.2 Paper II

The second paper aimed to investigate inpatient service use (admissions, total and involuntary inpatient days) amongst high and low inpatient service users in the two years before and the two years after they enrolled into ACT. This paper also explored associations between changes in hospitalisation and patient characteristics, including high use of inpatient services. Our research questions were:

1. Are there significant socio-demographic or clinical differences between high users and low users of inpatient care upon ACT enrolment?

2. Are there differences in inpatient service use in the two years before ACT compared to the two years during ACT in the two groups?

3. Are changes in inpatient service use in the two years before ACT compared to the two years after enrolment associated with patient characteristics upon enrolment?

2.3 Paper III

The third paper aimed to compare inpatient service use (admissions, total inpatient days, and involuntary inpatient days) amongst patients with and without problematic substance use in the two years before and after they enrolled into ACT and to explore if problematic substance use is associated with change in inpatient service use[1]. Our research questions were:

1. Are there differences in inpatient service use amongst patients with and without problematic substance use in the two years before and the two years after ACT enrolment?

2. Is problematic substance use associated with changes in hospitalisation when adjusted for patient characteristics?

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[1] In the published paper the last aim of the study is described as *"…to explore associations between changes in inpatient service use and patient characteristics, including problematic substance use"* The correct aim is: *…to explore if problematic substance use is associated with changes in inpatient service use, adjusting for patient characteristics"*, in line with the 2nd research question in the paper.

3. Methods

3.1 Design

The present study had a naturalistic, observational design and included cross-sectional socio-demographic and clinical data from patients upon enrolment into 12 Norwegian ACT teams and longitudinal data on inpatient service use from the two years before and the two years after ACT enrolment.

The first paper of this thesis used socio-demographic and clinical data that were obtained when the participants enrolled into one of the 12 ACT teams. The second and third paper used socio-demographic and clinical data from when the participants enrolled into the teams and data on inpatient service use from the two years before and the two years after ACT enrolment.

The implementation of the ACT model in Norway occurred according to local interest. Therefore, it was not possible to conduct a randomised controlled trial and subsequently the design of the study did not allow for causal interference.

3.2 Setting

This thesis is part of the national evaluation of ACT teams in Norway. The research-based evaluation is a collaboration between the Norwegian National Advisory Unit on Concurrent Substance Abuse and Mental Health Disorders and the Department of Research & Development in Mental Health Services at Akershus University Hospital.

The evaluation was funded by the Directorate of Health. When designing the evaluation, two factors were important. Firstly, ACT is one of the most studied service delivery models targeting people with severe mental illness and the evidence of its' efficacy is strong, as is its' effectiveness in real-world settings because many trials were conducted in routine clinical settings (Rosen, Mueser et al. 2007). Rosen and colleagues argued in 2007 that the important issues in the discussion concerning ACT revolved around changes in mental health care since the deinstitutionalisation and the development of ACT and not in the efficacy/effectiveness debate (Rosen, Mueser et al. 2007). This was supported by the authors of the most recent Cochrane-review who concluded that trials comparing the current form of intensive case management with standard care or non-intensive case management are no longer justified because the evidence from the studies included are consistent across a large number of studies (Dieterich, Irving et al. 2010). Secondly, the implementation process of ACT in Norway was voluntary and many catchment areas were too small to allow for a comparison of ACT participants and controls.

3.2.1   Model fidelity

The Norwegian teams' fidelity to the ACT model was assessed by the research group using the TMACT (Monroe-DeVita, Teague et al. 2011). The research group was divided into three fidelity assessment teams that conducted the fidelity assessments at 12 and 30 months after establishment. Each team consisted of two researchers that visited four ACT teams for two to three consecutive days. The fidelity scores were based on different sources; including interviews with individual team members and patients, group interview with the team, observation of various team meetings and their meetings with the patients, and reading electronic medical records. The teams also filled in questionnaires regarding their services and the patients' use of these services prior to the fidelity visit.

The research group was trained by the developers (Professor Maria Monroe-DeVita and Professor Gregory Teague) in a weeklong training before starting the fidelity reviews. Ongoing feedback and supervision by the developers were performed throughout the fidelity review process. The fidelity of the Norwegian teams was measured at 12 and 30 months after establishment. The mean TMACT scores after 12 months ranged from 2.7 to 3.7, indicating low to moderate fidelity. At 30 months they ranged from 3.1 to 4.1, indicating moderate to high fidelity (Landheim, Ruud et al. 2014).

The 30-month fidelity evaluation took place halfway through the two year-follow-up of the participants in this study. Therefore, these fidelity scores were found to best represent the follow-up period. Additionally, the 12-month fidelity scores might have been influenced by the establishment phase causing lower scores due to organisational challenges outside the teams (i.e. inappropriate offices, not recruited all required personnel, no organized training of personnel in working according to the ACT model).

At 30 months the Norwegian teams had high fidelity on the subscales organisation and structure (mean score 4.1) and core team (mean score 3.9), moderate fidelity on the subscales core practices (mean score 3.6), evidence-based practices (mean score 3.4), and person-centred planning and practices (mean score 3.5), and low fidelity on the subscale specialist team (mean score 2.5). The teams had exemplary fidelity on 15 of the 47 items at 30 months. These included the following subscales and items:

- Structure and organisation: low ratio of consumer to staff (4.9), quality of daily team meeting (4.7), priority service population (4.7), and gradual admission rate (4.8)
- Core team: psychiatric care provider on team (4.5), nurses on team (5.0), and role of nurses (4.5)

- Core practices: community-based services (5.0), active engagement (4.9), full responsibility for psychiatric services (4.7), and full responsibility for psychiatric rehabilitation services (4.5)
- Evidence-based practices: engagement and psycho-education with natural supports (4.5)
- Person-Centred Planning: consumer self-determination and independence (4.8)

Several of these items represent the greatest differences in service delivery compared to the more traditional office-based Norwegian mental health services.

3.3 Recruitment and samples

The recruitment period for this study was limited to the teams' first year of operation, from December 2009 to February 2012. Potential patients were referred to the ACT teams by common referral agencies, e.g. community health and social services, general practitioners, community mental health centres or inpatient wards in mental health hospitals. The teams accepted patients that met the following criteria:

- being 18 years or older
- having a severe mental illness (schizophrenia, schizoaffective, other psychotic disorder, bipolar disorder)
- having an impaired level of everyday functioning (with regard to activities of daily living, work, social networks etc.)
- being in need of long-term and comprehensive follow-up by mental health and social welfare services
- not being successfully engaged by standard mental health services.

Patients with an unclear diagnosis were also accepted for clarification of diagnosis and assessment of needs for treatment. Patients with substance misuse were included in the teams if this was not the primary diagnosis.

During the recruitment period, a total of 338 patients[2] were enrolled with the 12 ACT teams and were asked to participate in the national evaluation program. After the teams had fully explained the procedure, 202 patients (60%) gave written informed consent to participate, of whom 178 participants (53%) were assessed by the teams and their data shared with the research group.

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[2] In all three papers the total number of patients that enrolled into the ACT teams is reported to be 337. This was a typing error. The correct number is 338. All analyses that explored differences between participants and non-participants in all three papers included 338 patients.

Figure 3.1: Flow-chart illustrating the participation rate in the three studies:

```
┌─────────────────────────────────────────────────────────────┐
│ Patients referred to  12 ACT teams during the first year of  │
│ operation                                                     │
│                          N=338                                │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│              Patients consenting to participate               │
│                          N=202                                │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│       Patients assessed by the 12 ACT teams upon enrolment    │
│                          N=178                                │
└─────────────────────────────────────────────────────────────┘
         │
         │        ┌──────────────────────────────────────────────┐
         │        │                   Paper I                     │
         ├────────│   Participants completed MANSA upon enrolment │
         │        │     (subjective quality of life questionnaire)│
         │        │                 N=149(44%)                    │
         │        └──────────────────────────────────────────────┘
         │
         │        ┌──────────────────────────────────────────────┐
         │        │                Paper II and III               │
         └────────│  Participants receiving ACT for at least two  │
                  │  years                                        │
                  │                 N=142 (42%)                   │
                  └──────────────────────────────────────────────┘
```
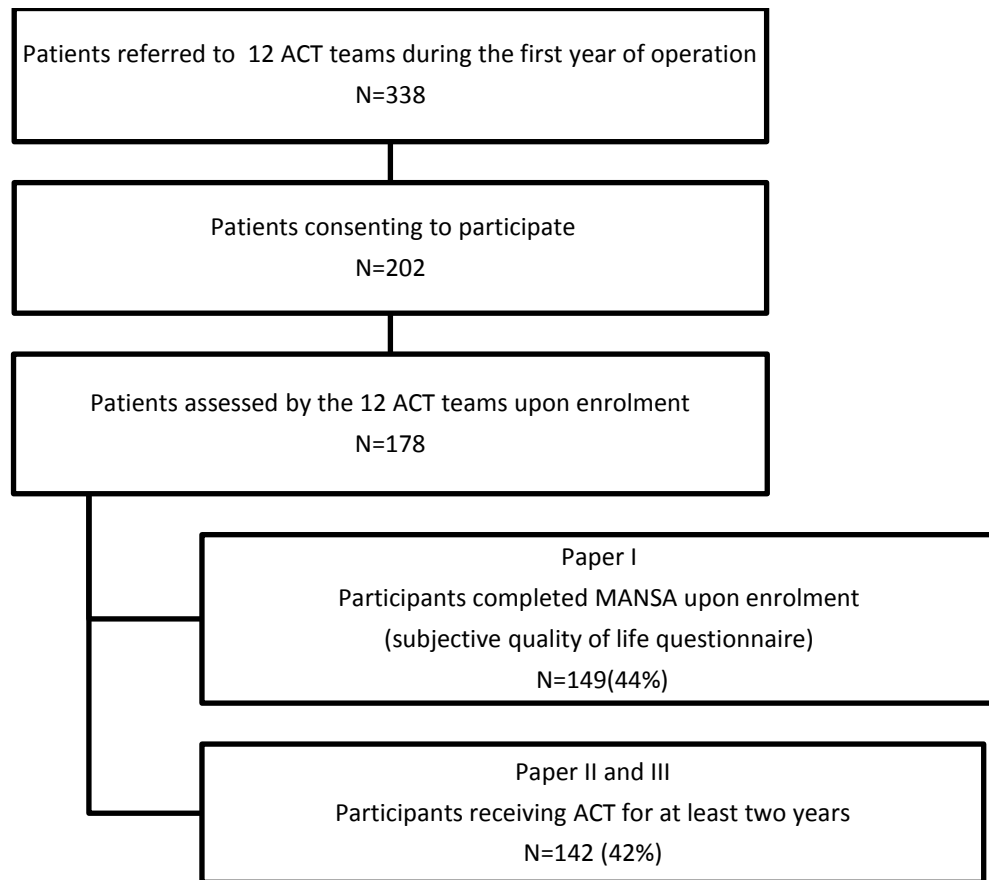
3.3.1   Participants and non-participants Paper I

The dependent variable in Paper I was patients' subjective quality of life assessed upon enrolment into the ACT teams. A total of 149 participants (44%) provided complete data on their quality of life and were considered eligible for this study.

There were no differences between participants and non-participants (n=189, 56%) in terms of gender (male n=101 versus 119, 68% vs 65%, p=0.639), age (40.3±10.6 versus 41.3±10.3, p=0.414), or diagnosis of severe mental illness (n=125 versus 163, 91% versus 92%, p=0.843). However, the participants had better functioning (mean±standard deviation (SD) Global Assessment of Functioning [GAF] score of 38.2±9.1 versus 35.6±8.4 out of 100, p=0.008), fewer were under involuntary outpatient treatment (n=44 versus 90, 30% versus 49%, p<0.001)[3], or had problematic substance use (n=87 versus 124, 58% versus 71%, p=0.020). There were some missing data amongst the non-

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[3] In Paper I the number of participants versus non-participants being subject to involuntary outpatient treatment was reported to be n=41 versus 87, 28% versus 47%, p<0.001. The correct numbers are n=44 versus 90, 30% versus 49%, p<0.001.

participants regarding global functioning (n=18, 9.5%) and problematic substance use (n=14, 7.4%) that may have influenced the results.

The majority of the participants in Paper I, were male (n=101, 68%) and of Norwegian origin (n=125, 86%). They had low educational level (completed primary school: n=83, 58%, higher education/university: n=14, 10%). Most were unemployed (n=123, 83%), while a few participants had competitive jobs or were studying (n=9, 6%). The mean±SD age was 38±10.5 years. Most of the participants were unmarried (n=116, 78%), more than half lived alone (N=91, 61%), but the majority had weekly contact with family or friends (n=125, 91%). They mostly had a diagnosis of schizophrenia (n=110, 80%), a few had bipolar disorder (n=14, 10%) and 58% had co-occurring problematic substance use (n=87). The participants had serious global psychiatric symptoms and major functional impairments (GAF score 38.2±9.1).

3.3.2 Participants and non-participants Paper II and Paper III

The dependent variables in Paper II and Paper III were changes in hospitalisation (admissions, total inpatient days, and involuntary inpatient days) from two years before to two years after enrolling into the ACT teams.

A total of 142 participants (42%) were included in the ACT teams for at least two years. Compared to the non-participants (n=196, 58%), fewer participants had problematic substance use (n=83, 58.5% versus n=128, 70%, p=0.034). The participants also had less severe symptoms (mean±SD Global Assessment of Functioning – Symptom Scale [GAF-S], 41±10.3 vs. 39±10.0, p=0.026) and better functioning (Global Assessment of Functioning – Function Scale [GAF-F], 40±8.3 vs. 38±, p=0.036). There were no differences in age (42±10.6 years vs. 40±13.3 years, p=0.269), gender (male: n=94 versus 126, 66.7% versus 66.7%, p=1.00), diagnosis of severe mental illness (n=124 versus 164, 94% versus 89%, p=0.163), or people being subject to involuntary outpatient treatment (n=51 versus 83, 36% versus 44%, p=0.213) between participants and non-participants in Paper II and Paper III. There were some missing data amongst the non-participants regarding global functioning (n=18, 9.1%) and problematic substance use (n=14, 7.1%) that may have influenced the results.

Characteristics of subgroups in Paper II

In Paper II we investigated hospitalisation in the two years before and after the patients enrolled into the ACT teams and compared the use of inpatient services amongst patients with and without a history of high use of inpatient services. Additionally, we explored the association between patient characteristics and change in hospitalisation.

The participants in Paper II were classified as high users according to the inclusion criteria applied in the REACT study (Killaspy, Bebbington et al. 2006): five or more psychiatric admissions in mental health hospitals *or* at least 100 consecutive inpatient days during the last two years, **or** three or more admissions *or* at least 50 consecutive inpatient days during the last year (Killaspy, Bebbington et al. 2006).

Seventy-four participants (52%) fulfilled the criteria for high use of inpatient services and 68 (48%) did not. At the time of ACT enrolment, the high users were younger (38±9.7 years versus 42±10.8 years, p=0.015), more likely to be subject to involuntary outpatient treatment (n=37 versus 14, 50% versus 21%, p<0.001), more likely to live in supported accommodation/be in prison or homeless, and less likely to live alone (n=15 versus 4, 21% versus 6% and n=42 versus 49, 57% versus 72% respectively, p=0.034) compared to the low users of inpatient services. There were no significant differences in scores on clinical rating assessments between the two groups.

Characteristics of subgroups in Paper III

In Paper III we investigated hospitalisation (admissions, total inpatient days, and involuntary inpatient days) amongst patients with and without problematic substance use in the two years before and after ACT enrolment. In addition, we explored associations between changes in hospitalisation and the participants' socio-demographic and clinical characteristics.

The classification of problematic substance use was primarily based on the scores on the Alcohol Use Disorder Identification Test (AUDIT) (Babor, Higgins-Biddle et al. 2001) and the Drug Use Disorder Identification Test (DUDIT) (Berman, Bergman et al. 2005). Seventy-two patients (51%) had a score above cut-off on one or both scales. Their mean total scores±SD on AUDIT (17.1±7.6) and DUDIT (21.0±10.3) indicated severe problematic substance use at the time of enrolment.

For participants who had not completed the AUDIT and/or DUDIT (n=18, 12.7%), or who had a score below cut-off on both scales (n=52, 36.6%), the clinician-rated Alcohol Use Scale (AUS) and Drug Use Scale (DUS) were consulted (n=70, 49%) (Mueser, Drake et al. 1995). If the clinician had given a score of 3 or higher on at least one of the two questionnaires, the participant was classified as having problematic substance use. Seven of the 70 participants (10%) for whom the AUS and DUS were consulted, were identified as having problematic substance use based on these scales (three participants had missing AUDIT/DUDIT while four participants had scores below cut-off on AUDIT/DUDIT).

A total of 84 (59%) participants were classified as having problematic substance use while 58 (41%) did not. The most commonly used substances were alcohol (n=54, 74%), amphetamine (n=34, 54%) and cannabis (n=30, 52%).

After two years of follow-up by the ACT teams, 78 patients (93%) still had problematic substance use. Four participants (7%) in the non-substance group scored above cut-off on AUDIT and/or DUDIT after two years. At two years follow-up, the mean scores±SD on AUDIT (16.2±7.7) and DUDIT (22.8±10.0) still indicated severe problematic substance use.

Assessments of patients' characteristics upon enrolment into the teams showed that participants in the problematic substance use group were more likely to be of Norwegian origin (n=76 versus 38, 92.7% versus 70.4%, p=0.001), to be under involuntary outpatient treatment (n=38 versus 13, 45.8% versus 22.4%, p=0.005) and had lower level of education (completed primary school: n=47 versus 29, 58.8% versus 55.8%, completed upper secondary school: n=31 versus 13, 38.8% versus 25.0%, completed higher education: n=2 versus 10, 2.5% versus 19.2%, p=0.003) than participants without problematic substance use. The problematic substance use group also had more severe psychiatric symptoms (Brief Psychiatric Rating Scale [BPRS] mean score: 2.60±0.86 versus 2.24±0.66, p=0.015), in particular manic/agitated symptoms (BPRS agitation mania: 2.42±1.19 versus 1.78±0.77, p=0.001), and a lower level of everyday functioning (Practical and Social Functioning [PSF] scale: 4.05±1.50 versus 4.63±1.62, p=0.033) than those without problematic substance use.

3.3.3   Characteristics of participants

All three papers included participants that enrolled into the ACT teams during the teams' first year of operation and gave written informed consent to participate. The characteristics of the participants in all three papers are similar to populations in other ACT studies (REACT, Sytema, Dietrich etc.) and in line with inclusion criteria stated in the ACT start-up manual (Allness and Knoedler 2003).

3.4 Measurements

This study used cross-sectional data from both clinician-rated and self-reported questionnaires and longitudinal data on hospitalisation from a public register.

Table 3.1: Overview of questionnaires used in the present study:

Domain	Instrument	Completed by:
Socio-demographic characteristics, psychiatric diagnosis, substance use, involuntary outpatient treatment, social network, somatic health, medication management	Life Situation and Health Questionnaire	Clinician-rated
Symptoms – severity and frequency	Global Assessment of Functioning – Symptom scale (GAF-S)	Clinician-rated
	Brief Psychiatric Rating Scale – 24 items (BPRS)	Clinician-rated
Level of functioning	Global Assessment of Functioning – Functioning scale (GAF-F)	Clinician-rated
	Practical and Social Functioning Scale (PSF)	Clinician-rated
Subjective quality of life	Manchester Short Assessment of Quality of Life (MANSA)	Self-report
Substance use	Alcohol Use Scale (AUS)	Clinician-rated
	Drug Use Scale (DUS)	Clinician-rated
	Alcohol Use Disorder Identification Scale (AUDIT)	Self-report
	Drug Use Disorder Identification Scale (DUDIT)	Self-report
Engagement with services	Homeless Engagement and Acceptance Scale (HEAS)	Clinician-rated

3.4.1 Clinician-rated questionnaires

Life Situation and Health Questionnaire

Socio-demographic data were collected using a questionnaire developed by the research team. Data on the participants' general life situation (including age, gender, ethnicity, education, employment status, living situation and contact with relatives and friends), and health (including psychiatric

diagnosis, age of onset psychiatric illness, legal status [in-/voluntary outpatient treatment], physical health, pharmacological treatment and side effects) were assessed upon enrolment into the teams.

Severity of symptoms and level of functioning: Global Assessment of Functioning Scale (GAF)

A global score for level of functioning and psychiatric symptoms was measured using the Global Assessment of Functioning scale (Goldman, Skodol et al. 1992). GAF is a clinician-rated scale ranging from 0 to 100 with higher score indicating less symptoms and better functioning. In Paper III, the split version was used (symptom scale [GAF-S] and function scale [GAF-F]) (Pedersen, Hagtvet et al. 2007).

The GAF scale is the only routine outcome measure that is used in psychiatric specialised care in Norway. Although the reliability of the GAF scale is questionable (Intra-class Correlation Coefficients' [ICC] varying from 0.49 for interrater reliability, 0.69 for test-retest evaluations and 0.80 in joint interviews) (Goldman, Skodol et al. 1992), the reliability of the split version, which is the version used in Norway, has shown to be acceptable (Pedersen, Hagtvet et al. 2007). The reliability increases if GAF is rated by 2 or more professionals that collaborate (Pedersen, Hagtvet et al. 2007). This was generally the case in the Norwegian ACT teams.

Psychiatric symptoms: Brief Psychiatric Rating Scale – 24 items (BPRS)

A more detailed information regarding frequency and severity of psychiatric symptoms was obtained using the expanded 24-item version of the Brief Psychiatric Rating Scale (BPRS) (Ventura, Green et al. 1993a, Ventura, Lukoff et al. 1993b) We also calculated mean scores on four symptom-dimensions from the BPRS (Kopelowicz, Ventura et al. 2008);

- positive symptoms (including grandiosity, suspiciousness, hallucinations, unusual thought content, bizarre behaviour, disorientation, conceptual disorganisation)
- negative symptoms (including blunted affect, emotional withdrawal and motor retardation)
- manic excitement (including tension, uncooperativeness, excitement, distractibility, motor hyperactivity and mannerism and posturing)
- anxiety/depressive symptoms (anxiety, depression, suicidality and guilt)

Psychometric testing of 24-item version with anchor scales showed good interrater reliability (median ICC 0.81-0.86) when tested amongst professionals with and without long clinical experience (Ventura, Green et al. 1993a). The four-factor structure has also been found to be consistent over time and across a range of patients (Kopelowicz, Ventura et al. 2008).

Everyday functioning: Practical and Social Functioning scale (PSF)

Everyday functioning was measured using the revised version of the Practical and Social Functioning Scale (PSF) (Rishovd Rund and Ruud 1994) which consists of 32 items, providing eight subscales (personal hygiene, communication, managing economy, housekeeping, contact with social network, personal health care, transportation, and work and activities). Every subscale comprises four items with scores ranging from 0 to 8. Higher scores indicating better functioning. Each subscale is also a separate factor with good internal consistency (Cronbach's Alpha between 0.735 and 0.903) and acceptable face validity (Personal communication, Torleif Ruud, 2014).

Substance use - Alcohol Use Scale (AUS) and Drug Use Scale (DUS):

Clinician assessed substance use amongst their patients with the Alcohol Drug Scale (AUS) (Drake, Osher et al. 1990) and the Drug Use Scale (DUS) (Mueser, Drake et al. 1995). The AUS and the DUS are 5-point scales with scores from 1 (no use) to 5 (severe dependence). The scores are based on information regarding substance use in the past six months.

The AUS and DUS were used by the clinicians to evaluate the participants' substance use. Previous studies have reported high interrater reliability (Kappa coefficient 0.80 for AUS and 0.95 for DUS) (Drake, Osher et al. 1989).

Engagement with services – Homeless Engagement and Acceptance Scale (HEAS):

The ACT teams assessed the participants' engagement with services using the Homeless Engagement and Acceptance Scale (HEAS) (Park, Tyrer et al. 2002). The HEAS comprises four items, three items are rated from 0 to 4 and one item from 0 to 3, with higher score indicating better quality of engagement and acceptance of contact with services.

3.4.2   Self-reported questionnaires

Substance use: Alcohol Use Disorder Identification Scale (AUDIT) and Drug Use Identification Scale (DUDIT)

Problematic use of substances was assessed using the Alcohol Use Disorder Identification Test (AUDIT) (Babor, Higgins-Biddle et al. 2001) and Drug Use Disorder Identification Test (DUDIT) (Berman, Bergman et al. 2005). They are both self-report questionnaires and assess the use of alcohol (AUDIT) or other substances such as drugs or illegal substances (DUDIT) during the past 12 months. The AUDIT comprises 10 items with total score from 0 to 40 and the DUDIT comprises 11 items with total score from 0 to 44. Score above cut-off (AUDIT: men: 8, women 6; DUDIT: men: 6, women: 2) indicates problematic use and higher scores indicate more problematic use of alcohol or other substances.

Reinert and Allen reviewed studies investigating the reliability of the AUDIT and found that the median reliability coefficient was 0.83, ranging between 0.75 and 0.97 (Reinert and Allen 2007). The reliability of the DUDIT was also found to be high with a Cronbach's alpha of 0.80 (Berman, Bergman et al. 2005).

Manchester short assessment of quality of life (MANSA)

Participants' subjective quality of life was the primary outcome of the first study (Paper I), and was measured using the Manchester Short Assessment of Quality of Life (MANSA) (Priebe, Huxley et al. 1999). The MANSA is a self-report questionnaire that assesses a person's satisfaction with different life domains (life as a whole, job (or sheltered employment, training/education, unemployment/retirement), financial situation, number and quality of friendships, leisure activities, accommodation, people that the person lives with (or living alone), personal safety, sex-life, relationship with family, physical health, mental health). Satisfaction is rated on a 7-point scale where 1 = couldn't be worse and 7 = couldn't be better. The MANSA is developed from and validated against the Lancashire Quality of Life Profile (LQOLP) (Oliver, Huxley et al. 1996) (Priebe, Huxley et al. 1999). There are high correlations between MANSA and LQOLP subscales (Pearson's r 0.83-0.99) and good internal consistency (Priebe, Huxley et al. 1999). A Swedish study found satisfactory reliability (internal construction, Cronbach's Alpha 0.81) and construct validity (positive correlations with social network, empowerment and psychosocial functioning and negative correlations with number of needs for care, personal experience of rejection) of the Swedish MANSA version (Bjorkman and Svensson 2005).

3.4.3   Register data

Norwegian Patient Register (NPR)

The NPR is a national health register comprising information on all patients who have been referred to or received treatment from specialized health care in Norway. The database consists of encrypted, identifiable data. The patients gave written informed consent for the research group to obtain data on their use of specialized metal health care in the two years before and the two years after they enrolled into the ACT teams. These data were obtained for 142 participants that received services from the teams for at least two years. The data were used in Paper II and III.

3.5 Data-collection

Socio-demographic and clinical data were collected by the ACT teams when the participants enrolled into the teams. The life-situation and health, the BPRS, both GAF scales (GAF-S and GAF-F), the AUS, the DUS, the PSF, and the HEAS were filled in by the clinical staff based on information available to

them from interviews with patients, carers, personnel from collaborating services, and electronic medical records. The AUDIT, the DUDIT, and the MANSA were filled in by the patients alone or together with team members. Additionally, the AUDIT, the DUDIT, the AUS, and the DUS were repeated after two years for those participants that were included in the ACT teams for at least two years.

Data on inpatient service use in the two years before and after enrolment into ACT were obtained from the Norwegian Patient Register for 142 patients who gave written informed consent and were engaged with the teams for at least two years.

3.6 Data used in the papers

Paper I: This paper used cross-sectional data from the MANSA, the PSF, the Life Situation and Health Questionnaire (socio-demographic data), the GAF, the BPRS, the AUDIT, and the DUDIT that were obtained when the participants enrolled into the ACT teams.

Paper II: This paper used longitudinal data on inpatient service use during the two years before and the two years after ACT enrolment from the NPR, and cross-sectional data from the Life Situation and Health Questionnaire, the AUDIT, the DUDIT, the BPRS, the GAF, the PSF, and the HEAS that were obtained when the participants enrolled into the ACT teams.

Paper III: This paper used longitudinal data on inpatient service use from the NPR and cross-sectional data from the Life Situation and Health Questionnaire, the AUDIT, the DUDIT, the AUS, the DUS, the GAF (split version), the BPRS, and the PSF obtained when the participants enrolled into the ACT teams. Data from the AUDIT, the DUDIT, the AUS, and the DUS that were obtained at two years' follow-up were also used in this paper.

3.7 Statistical analysis

Statistical analyses were performed with the Statistical Package for Social Science versions 22 (SPSS, Chicago, IL USA) and the Statistical Analysis System version 9.3 (SAS Institute, Cary, NC USA). Linear mixed models in Papers II and III were estimated by SAS while all other statistical analyses were performed with the SPSS. All tests were two-sided. Results with p-values below 0.05 were considered statistically significant.

Imputation of missing data

Missing values were imputed for the AUDIT, the DUDIT, the GAF scales, the PSF, the HEAS, and the MANSA. The imputation was performed for cases with fewer than 50% missing values on each scale in the following way: the empirical distribution for each item was generated for the AUDIT, the DUDIT, the PSF, the HEAS, and the MANSA. A random number was drawn from that distribution and used to replace the missing value. The process was repeated until all imputable values were imputed. Because of the different definition of cut-off for men and for women on the AUDIT and the DUDIT scales, the same imputation algorithm was performed within each stratum, defined by gender and the corresponding dichotomized versions of these scores. Such imputation algorithm mimics the bootstrap (Efron and Tibishirani 1993). The GAF scores were both normally distributed. Missing values on these scores were therefore imputed by drawing a random number from the corresponding normal distribution.

In Paper I, missing values were imputed for the AUDIT (n=8, 5.3% of cases), the DUDIT (n=16, 10.7%), the MANSA (n=4, 0.2%), and the PSF (n= 6, 0.1%)[4]. The GAF and the BPRS were completed for all participants included in this study.

In Paper II and III, missing values were imputed for the AUDIT (n=14, 9.9%), the DUDIT (n=18, 12.7%), the GAF (n=4, 2.8%), the PSF (n=14, 0.3%). The BPRS was completed for 98.6% of the participants and thus no scores were imputed for the BPRS. In Paper II missing values for the HEAS were also imputed (n=2, 0.4%), while in Paper III missing values were imputed for the AUDIT (n=8, 5,6%), and the DUDIT (n=10, 7%) from the data collection at two years' follow-up.

Descriptive analyses

In all three papers, dichotomous and categorical variables were presented as frequencies and percentages. Means and standard deviations (SD) were used to describe continuous variables. The MANSA scores and the PSF scores at two years' follow-up that were added in this thesis are presented as means and SD. The normality of continuous variables was assessed by inspecting the histograms.

Bivariate analyses

In Papers II and III, differences in socio-demographic and clinical characteristics between groups (high and low users in Paper II, participants with and without problematic substance use in Paper III) were assessed by Fisher's exact test for dichotomous variables, X^2-test for categorical variables, Student's

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[4] In Paper I the percentages of imputed values for AUDIT and PSF were reported to be 6% and 0.3% respectively but the correct percentages are 5.3% and 0.1% respectively.

T-test for symmetrically distributed continuous variables, and Mann-Whitney U-test for skewed continuous variables.

Multivariate analyses

In Paper I, a linear regression model was fitted to assess the associations between the mean MANSA score and selected socio-demographic and clinical characteristics. First, the bivariate associations were explored. Then a multivariate model, containing all variables potentially associated with quality of life (mean MANSA score), was estimated. We also explored the associations between the mean MANSA score and the eight PSF subscales, and finally between the MANSA subscales and the PSF subscales using bivariate and multivariate regression analyses.

In Papers II and III, three dependent variables were chosen to assess change in hospitalisation; *change in admissions, change in total inpatient days,* and *change in involuntary inpatient days*. The change in these three variables was defined as the difference between the number of admissions, of total inpatient days, and of involuntary inpatient days in the two years before and the two years after enrolment into ACT.

The difference in change in hospitalisation between the groups (high and low users in Paper II and participants with and without problematic substance use in Paper III) was analysed by linear mixed models with random effects at the ACT level, correctly adjusting the estimates for possible intra-ACT correlations. Prior to performing the linear mixed model analyses, the level of clustering within the team was assessed by an intra-class correlation coefficient (ICC). According to the ICC, the cluster effect was small indicating that the teams were quite similar. Nevertheless, we included random effects at the ACT level into the regression models correctly adjusting the estimates for changes over time.

In Paper II, we also reported on inpatient service use for four periods. Inpatient service use in each period was presented as means and 95% confidence intervals (CI).

- TP1 (Time period): 24-12 months pre-ACT enrolment
- TP2: 12-0 months pre-ACT enrolment
- TP3: 0-12 months post-ACT enrolment
- TP4: 12-24 months post-ACT enrolment

In Paper II, a multivariate linear mixed model to assess possible predictors for change in hospitalisation was built with clinical variables (involuntary outpatient treatment [Yes/No], the four BPRS subscales, the GAF, the PSF, the AUDIT, the DUDIT, the HEAS, and high inpatient service use

[Yes/No]) as fixed effects. The final model was adjusted for age, gender, and the 30 months TMACT (fidelity) score.

In Paper III, exploratory multivariate linear mixed models were built to assess the associations between substance use and the three dependent variables (admissions, total inpatient days and involuntary inpatient days). The associations between problematic substance use and these dependent variables were adjusted for demographic (age, gender) and clinical factors (involuntary outpatient treatment [Yes/No], the four BPRS subscales, the GAF-S, the GAF-F, the PSF, and problematic substance use [Yes/No]). We also assessed interactions between the problematic substance use variable and demographic and clinical characteristics in these exploratory analyses.

Akaike's Information Criteria (Akaike 1974) was applied in model reduction in all three papers. The smallest value of AIC means best model.

No correction for multiple hypothesis testing was performed in Paper II and III as the studies were of exploratory nature.

3.8 Ethical considerations

The study is part of a national research-based evaluation of 12 Assertive Community Treatment teams in Norway. The evaluation has been approved by the Norwegian Regional Committee for Medical and Health Research Ethics (ID: 2010/1196a). All patients that enrolled into the teams during their first year of operation were asked to participate in the evaluation. Patients who agreed to participate gave written informed consent after the procedure had been fully explained by the teams. The patients were informed that they could withdraw their consent at any time and that that would not interfere with their treatment and follow-up.

All patients received ACT services according to the ACT model's standards whether they agreed to participate in the evaluation or not. The assessment instruments used in the national evaluation were considered clinically useful tools that the teams could use as a part of their routine practice. All but three short instruments were completed by the team members. The burden to participate in the study was sought to be minimized as much as possible for the patients. However, we cannot exclude the possibility that some patients may have found the quantity of the questionnaires or the nature of the questions to have been too personal, too excessive, or too exhausting.

4. Results

4.1 Summary of Paper I: Associations between quality of life and functioning in an Assertive Community Treatment population

Background: Better functioning in people with severe mental illness is associated with a higher subjective quality of life, but the relationship between functioning and satisfaction with specific life domains is largely unknown. This study examines subjective quality of life in an ACT population and associations between quality of life and patients' characteristics, particularly focussing on the level of functioning within different areas. Our research questions were: 1. What is the quality of life of our study population when they enrolled into the ACT teams? 2. What socio-demographic and clinical characteristics are associated with subjective quality of life in this group? 3. What is the association between satisfaction with various life domains and different areas of practical and social functioning in our study population?

Methods: Socio-demographic and clinical data were obtained from 149 patients in 12 Norwegian ACT teams upon enrolment into the teams, including their subjective quality of life (satisfaction with life domains; Manchester Short Assessment of Quality of Life). Multivariate regression analyses were used to investigate associations between subjective quality of life and socio-demographic and clinical characteristics, and between life satisfaction with different domains and various areas of functioning.

Results: The mean overall MANSA score was 4.26 (range 1.42–6.67) upon enrolment into the ACT teams, indicating being mixed satisfied and dissatisfied with their quality of life. Participants had greatest satisfaction with their personal safety, their relationship with their family, and their accommodation. They were least satisfied with their employment status, financial situation, and sexual life. The mean overall MANSA score was positively associated with older age, fewer anxiety/depressive symptoms, and better functioning. Weekly contact with both family and friends was associated with higher subjective quality of life than weekly contact with first-degree family members only. There were no associations between the different practical and social functioning subscales and the mean overall MANSA score. However, positive associations between satisfaction with specific life domains and several areas of functioning were found. Maintaining personal hygiene, housekeeping, managing economy, and maintaining work and activity skills were related to satisfaction with mental and physical health, financial situation, and accommodation. Transportation skills were related to satisfaction with leisure time. Skills related to contact with social network were associated with satisfaction with friendships and accommodation.

Conclusion: The design of the study does not allow for interpretation of causal directions of the associations between functioning and life satisfaction. However, the positive findings might suggest that training targeted to increase patients' practical and social skills may improve their quality of life.

Table not included in Paper I:

Table 4.1.1 Mean MANSA score and life domain scores (N=149)

MANSA subscales	Mean[1]	SD
Personal safety	4.65	1.72
Family relations	4.65	1.74
Accommodation	4.65	1.93
People you live with/living alone	4.58	1.64
Social relations (number and quality of friendship)[2]	4.43	1.31
Physical health	4.26	1.62
Leisure activities	4.23	1.70
Life as a whole	4.05	1.70
Mental health	4.05	1.77
Employment status/daily activities	3.84	1.77
Sexual life[3]	3.82	1.71
Financial situation[2]	3.79	1.87
Mean MANSA score	**4.26**	**1.08**

[1]Score ranges 1-7, higher score indicates higher satisfaction

[2]N = 148

[3]N = 126

4.2 Summary of Paper II: Hospitalisation of high and low inpatient service users before and after enrolment into Assertive Community Treatment teams: a naturalistic observational study

Background: ACT is more successful in reducing hospitalisation when baseline use is high. However, with a growing recovery-focus, ACT may also be useful for people with severe mental illness who are difficult to engage, but who are not high users of inpatient services. This study investigated hospitalisation two years before and two years after ACT enrolment amongst patients with and without high inpatient services use before ACT. Our research questions were: 1. Are there significant socio-demographic or clinical differences between high and low users of inpatient services on enrolment to the ACT teams? 2. Is there a significant change in hospitalisation within each group in the two years after ACT enrolment compared to the two years before? 3. Are any patient characteristics associated with changes in hospitalisation?

Methods: This naturalistic, observational study included 142 patients from 12 different ACT teams throughout Norway. Of these, 74 (52%) were high users of inpatient services before ACT. The teams assessed the patients upon enrolment using clinician-rated and self-reported questionnaires. Hospitalisation data from two years before and two years after enrolment into ACT were obtained

from the Norwegian Patient Register. Linear mixed models were used to assess changes in hospitalisation and to explore associations between these changes and patient characteristics.

Results: When the participants enrolled into the ACT teams, high users of inpatient care were younger, less[5] often living alone and more often living in supported/staffed housing, in institutions or being homeless. They were also more often subject to involuntary outpatient treatment than low users. The participants spent significantly fewer days in hospital in the two years with ACT compared to the two years before enrolment. This was mainly due to the strong reduction amongst the high users in the two years with ACT compared to the two years before enrolment. The low users had an initial increase in inpatient days in the first year of ACT compared to the pre-ACT period, but then a subsequent decrease in the second year of ACT. There were few differences between the 12 ACT teams regarding patients' inpatient service use before ACT (total inpatient days [ICC = 7.4 %], involuntary inpatient days [ICC = 6.2 %]). There were also only small differences between the teams regarding change in total inpatient days (ICC = 2.8 %) and involuntary days (ICC = 1.1 %).

More severe negative symptoms and previous high use of inpatient care were associated with a reduction in both total and involuntary inpatient days. Additionally, being subject to involuntary outpatient treatment upon enrolment into ACT was associated with a reduction in involuntary inpatient days.

Conclusion: The findings in this study may suggest that ACT contributes to a more appropriate use of inpatient care, possibly by reducing the presumably avoidable hospitalisation of high users and increasing the presumably needed inpatient care of low users.

4.3 Summary of Paper III: Hospitalisation of severely mentally ill patients with and without problematic substance use before and during Assertive Community Treatment: an observational cohort study

Background: Co-occurring substance use increases the risk of hospitalisation in people with severe mental illness, whereas ACT generally reduces hospitalisation in patients with severe mental illness and high inpatient service use. Because the superiority of ACT over standard services amongst patients with problematic substance use is uncertain, the present study examined inpatient service use amongst patients with and without problematic substance use in the two years before and the two years after they enrolled into ACT teams. Our research questions were: 1. Are there differences in hospitalisation amongst patients with and without problematic substance use in the two years

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[5] In the Abstract of Paper II – Result section the following sentence "…, high users of inpatient care were younger, **more** often living alone and…" is faulty. The correct wording is written in the result section of the paper and in the present section of the thesis "…, high users of inpatient care were younger, **less** often living alone and…".

before and the two years after ACT enrolment? 2. Is problematic substance use associated with changes in hospitalisation when adjusted for patient characteristics?

Methods: This naturalistic, observational study included 142 patients of 12 different ACT teams throughout Norway. A total of 84 (59%) participants had problematic substance use upon enrolment into the ACT teams. The teams assessed the patients upon enrolment into ACT using clinician-rated and self-reported questionnaires. We obtained hospitalisation data from the Norwegian Patient Register for the two years before and the two years after the participants enrolled into ACT. We used linear mixed models to assess changes in hospitalisation and to explore associations between problematic substance use and changes in hospitalisation, controlling for socio-demographic and clinical characteristics.

Results: Participants with problematic substance use were more often of Norwegian origin, they had a lower level of education, and they were more often subject to involuntary outpatient treatment upon enrolment into the ACT than those without problematic substance use. Participants with problematic substance use also had more severe psychiatric symptoms, in particular manic symptoms and they had lower level of functioning than participants without problematic substance use. The most commonly used substances were alcohol, amphetamine, and cannabis.

In the two years after ACT enrolment both participants with and without problematic substance use experienced a reduction in total inpatient days. Those with problematic substance use also had fewer involuntary inpatient days. Exploratory analyses suggested that symptom severity and functioning level interacted with problematic substance use to influence change in total inpatient days.

Conclusion: These findings may suggest that ACT teams successfully support people with complex mental health problems in the community, including those with problematic substance use, and thereby contribute to a reduction in inpatient service use.

5. Discussion

The aims of this thesis were: i) to investigate subjective quality of life in an ACT population and to explore the associations with patient characteristics, in particular practical and social functioning; ii) to contribute to an increased understanding of inpatient service use amongst ACT patients by investigating hospitalisation in the two years before and after enrolling into ACT teams, including inpatient service use amongst different subgroups. Our main findings are discussed in light of previous research (5.1) and important methodological issues (5.2). Main strengths and limitations are also discussed (5.3).

5.1 Main findings

5.1.1 Summary of main findings

Our first study showed that the participants had variable satisfaction in terms of their quality of life upon enrolment into ACT. They were most satisfied with their personal safety, their relationship with their family, and their accommodation. They were least satisfied with their employment status, their financial situation, and their sexual life. We found that subjective quality of life was associated with anxiety and depressive symptoms but not with psychotic symptoms (positive, negative or manic and agitated symptoms). We also found that participants who had weekly contact with family and friends reported higher subjective quality of life than participants who had weekly contact with their family only. Additionally, there was a strong association between the subjective quality of life and the participants' everyday level of practical and social functioning. The satisfaction with specific life domains was positively related to the level of functioning in some, but not all, areas.

In our second study, we found that 74 participants (52%) had a history of high inpatient service use before ACT while 68 participants (48%) did not. The high users of inpatient services were younger, more often subject to involuntary outpatient treatment upon enrolment into ACT, and they were more often living in staffed or supported housing or had unstable living situations than participants with low inpatient service use. There were no differences in diagnosis, severity of symptoms, co-occurring substance use, or level of functioning between the two groups upon enrolment into the ACT teams. We found that the participants had fewer inpatient days in the two years after enrolment into the ACT teams compared to the two years before. This was mainly achieved amongst participants with a history of high inpatient service use before ACT. The low users of inpatient services had an initial increase in the first year of ACT followed by a small, but not significant, decrease to the pre-ACT level in the second year of ACT. There were few differences between the 12 teams regarding inpatient service use before ACT and regarding change in inpatient

days (both total and involuntary inpatient days). A history of high inpatient service use and more severe negative symptoms were associated with reductions in total and involuntary inpatient days in the two years of ACT. Being subject to involuntary outpatient treatment upon enrolment was also related to a reduction in involuntary inpatient days after ACT enrolment.

In our third study, we explored problematic substance use amongst the participants upon enrolment into ACT. Fifty-nine percent had co-occurring problematic substance use (n=84). They most commonly used alcohol, amphetamine, and cannabis. Participants with problematic substance use were more often of Norwegian origin, they had a lower level of education, and they were more often subject to involuntary outpatient treatment upon enrolment into ACT than those without problematic substance use. Participants with problematic substance use also had more severe psychiatric symptoms, in particular manic symptoms, and they had lower level of functioning than participants without problematic substance use. Both groups experienced fewer inpatient days in the two years with ACT compared to the two years before. The participants with problematic substance use also experienced a reduction in involuntary inpatient days. This occurred despite ongoing severe problematic substance use. Finally, exploratory analyses suggested that symptom severity and functioning level interacted with problematic substance use to influence change in total inpatient days.

5.1.2   Subjective quality of life

Upon ACT enrolment, participants had mixed overall satisfaction with their life, as indicated by the total MANSA mean score (4.26± 1.08). This is slightly lower than reported in other ACT studies (Killaspy, Bebbington et al. 2006, Sytema, Wunderink et al. 2007), and lower than the general population (Evans, Banerjee et al. 2007). Our participants were most satisfied with the relationship with their families (4.65±1.74), their accommodation (4.65±1.93), and their personal safety (4.65±1.72). They were least satisfied with their sexual life (3.82±1.71), employment status (3.84±1.77), and financial situation (3.79±1.87). These findings are in line with a previous study investigating subjective quality of life in an outpatient population with schizophrenia (Bengtsson-Tops and Hansson 1999).

The low scores on both the employment status and financial situation scales are likely to be related. Despite the well-organised health and social welfare systems in Norway, accommodation and living expenses are significant, and many people with severe mental illness are unemployed (OECD 2013). In 2013 the Organisation for Economic Co-operation and Development (OECD) voiced a concern regarding the high unemployment rate amongst persons with mental illness in Norway (2013). They found that Norway had the highest sickness absence incidence and disability benefit caseload in the OECD. Furthermore, mental health-related inequalities in Norway seemed very high,

"creating significant costs for people, employers and the economy at large" (OECD 2013). However, being out of competitive work does not only have financial consequences. It could also result in few meaningful daily activities, and persons suffering severe mental illness with competitive jobs report higher subjective quality of life than those who are unemployed (Nordt, Müller et al. 2007). In the early 1980s Lehman and colleagues found the same pattern of low satisfaction with financial situation and with employment status among residents with mental illness living in board-and-care homes (Lehman, Ward et al. 1982). The authors commented that these areas are mainly the responsibility of the social welfare services and therefore mental health services would not have a significant impact on their patients' satisfaction with these areas (Lehman, Ward et al. 1982). This argument is valid for the Norwegian system today. However, although the responsibility for finances and employment belongs to the social services, the ACT teams are expected to provide support related to both finances and employment to stimulate rehabilitation and recovery among their patients (Allness and Knoedler 2003, Monroe-DeVita, Teague et al. 2011). An outreaching and multidisciplinary team with focus on both health- and social services, like the ACT teams, may provide advantages over the traditional and fragmented health and social welfare services.

Factors associated with subjective quality of life
Several studies have reported significant associations between socio-demographic characteristics and subjective quality of life (Evans, Huxley et al. 2000, Huxley, Evans et al. 2001, Bjorkman and Svensson 2005, Hansson and Bjorkman 2007, Priebe, Reininghaus et al. 2010), but a meta-analysis could not confirm any stable relationships (Vatne and Bjorkly 2008). Nevertheless, our study found that older participants reported better subjective quality of life, which is in line with previous studies (Mercier, Peladeau et al. 1998, Priebe, Reininghaus et al. 2010). Mercier and colleagues found that older people with severe mental illness who were more satisfied with their quality of life also expressed less worries, had less desire for change, and had fewer plans for their short-term future. They hypothesized that older people had adapted their expectations to fit the limitations of having a severe mental illness, or that younger people had higher expectations of their possibilities in life (Mercier, Peladeau et al. 1998).

The participants in our study who had weekly contact with both family (both first degree relatives and other family members) and friends reported higher subjective quality of life than did those who had weekly contact with their first-degree relatives only (including parents, children, and siblings). Having a good social network is important for improvement in subjective quality of life (Hansson 2006), and loneliness is reported to be strongly associated with lower subjective quality of life (Borge, Martinsen et al. 1999). In the original ACT paper, Stein and Test proposed several requirements for community services to help improve patients' possibilities to cope with community

life, and thereby avoiding hospitalisation; including freedom from pathological relationships and conflictual family situations and improving how community members (including family and neighbours) relate to patients by providing them with support and education (Stein and Test 1980). Our findings emphasize the importance of services targeting people with severe mental illness to help their patients build and maintain a supportive social network comprising both family and friends.

Although psychiatric symptoms have been associated with worse subjective quality of life (Gaite, Vázquez-Barquero et al. 2002, Bjorkman and Svensson 2005, Priebe, Reininghaus et al. 2010), a recent study found that improvements in symptoms was not associated with improved subjective quality of life. However, the latter study investigated mainly psychotic symptoms. In our study, we found no associations between psychotic symptoms and subjective quality of life but more severe anxiety and depressive symptoms were significantly related to worse subjective quality of life. This finding underscores the importance of services to target anxiety and depressive symptoms as well as psychotic symptoms.

Associations between subjective quality of life and level of functioning
Our study confirmed previous findings of a positive relationship between the participants' subjective quality of life and their level of functioning (Lehman, Ward et al. 1982). Although the clinical effect may be moderate, as indicated by the regression coefficients, these findings may support previous reports of positive associations between improved functioning and better subjective quality of life (Kortrijk, Mulder et al. 2012). However, because the data in our study were cross-sectional a causal direction of the associations cannot be determined.

The areas of functioning can be divided into different skills categories; basic life skills (personal hygiene, housekeeping, managing economy, personal health care), skills for participating in the community (transportation and work & activities), and social skills (contact with social network and communication).

Basic life skills: Practical skills, such as simple maintaining personal hygiene, housekeeping, and managing one's economy, are basic skills necessary to maintain an independent life in the community (Gunnmo and Bergman 2011). Our data showed a positive relationship between level of functioning in these areas and satisfaction with physical health, mental health, accommodation, and financial situation. When the original ACT model was published, Stein and Test described the absence of basic skills as a factor that could lead to poor adjustment to community living and thus increase the risk of recurring hospitalisation (Stein and Test 1980). Improving patients' practical skills is considered one of the core services of the ACT model (Monroe-DeVita, Teague et al. 2011).

Skills for participating in the community: The ability to get around and to use public transportation is important for meeting demands of community life, as is working concentrated over time and participating in leisure activities. In our study, these skills were positively related to satisfaction with several life domains. Stein and Test emphasized that services aiming to build these skills should do so in the community. That way the patients would practice in their natural environment where they would need and use the skills (Stein and Test 1980). High-fidelity ACT teams spend more than 90 per cent of their time with the patients in the community, providing rehabilitative services, including transportation planning and navigation skill building (Monroe-DeVita, Teague et al. 2011).

Social skills: Stein and Test pointed out the need to support and provide education to patients' natural support system, and to help patients create a supportive system that will contribute to independently living in the community (Stein and Test 1980). Our study showed that contact with a social network, including both family and friends, is important to the subjective quality of life. Additionally, we found a significant relationship between keeping in contact with the social network, and satisfaction with relationship with friends as well as satisfaction with accommodation. The revised and expanded ACT fidelity scale (the TMACT) has included evidence-based methods to engage and provide psycho-education for patients' social network (Monroe-DeVita, Teague et al. 2011). High-fidelity teams spend most of their time with the patients in the community enabling them to help effectively the patients build, maintain, and interact with their social network.

5.1.3   Inpatient service use

The participants in our study were admitted to mental hospitals on average three times in the two years before they enrolled into ACT and three times in the two years after enrolment. They were admitted on average 121 days before ACT and 60 days after enrolment. Fewer days in hospital has been related to higher subjective quality of life (Browne, Roe et al. 1996, Nordt, Müller et al. 2007). In particular, dissatisfaction with family relationships has been shown to predict rehospitalisation (Postrado and Lehman 1995) and to correlate with more inpatient days (Horiuchi, Nisihio et al. 2006). A supportive social network is important for persons with severe mental illness to strengthen their community tenure and thereby avoid hospital admissions (Stein and Test 1980). Therefore, some of the core tasks of the ACT teams are to engage and to have frequent contact with patients' natural support system, and to provide evidence-based psychoeducation to them (Monroe-DeVita, Teague et al. 2011). According to the ACT model, the teams are expected to have contact with one or more person in the social network for 90% or more of their patients. Thirty months after establishment, the Norwegian ACT teams had contact with persons in the patients' natural support network (including family and friends) for approximately half of their patients. This gave a mean

TMACT score of 2.3, indicating that the teams had not implemented this item. However, the teams showed exemplary fidelity on engagement and psychoeducation with natural support (mean TMACT score 4.5). This indicates that the teams were able to engage patients' social network and to provide psychoeducation, but only for very few patients. Furthermore, frequent or long-term hospital admissions may present an impediment to obtain and keep competitive jobs. The number of admissions to mental hospitals has been shown to predict vocational status, suggesting that persons who are frequently admitted have lower vocational status (Nordt, Müller et al. 2007).

In our study, the number of admissions was the same in the two years before and the two years after ACT enrolment, but most of the participants experienced significantly fewer inpatient days during ACT compared to before. These findings confirms previous reports (Dieterich, Irving et al. 2010).

When investigating inpatient service use amongst different subgroups, we found that three of four subgroups (high inpatient service users, problematic and non-problematic substance use groups) had significantly fewer total inpatient days in the two years with ACT compared to the two years before. They had on average more than 100 inpatient days in the two years before ACT and a reduction was not unexpected when the level of inpatient service use is high prior to ACT (Burns, Catty et al. 2007, Dieterich, Irving et al. 2010). Participants with a history of high inpatient service use and participants with problematic substance use also had significantly fewer involuntary inpatient days in the two years with ACT compared to the two years before.

In contrast to the other three groups, the low users of inpatient services experienced an increase in inpatient days in the two years with ACT. This increase was most evident in the first year. The level of inpatient service use in the two years with ACT in this group was similar to inpatient service use amongst those with a history of high inpatient service use. Our findings corroborate previous findings that low users of inpatient services experience an increase in inpatient service use in the first year with ACT (Bonsack, Adam et al. 2005, Morrissey, Domino et al. 2013). This could be a negative influence of ACT involvement or maybe because the patients' need for inpatient care had not been detected by more traditional, office-based services (Mortimer, Shepherd et al. 2012, Morrissey, Domino et al. 2013). For some patients an admission is not always a bad outcome as it may help stabilise a difficult situation that would not improve with community services only and can prevent further deterioration. It is important to emphasize that the high and low user groups were not very different, in terms of socio-demographic or clinical characteristics, upon enrolment into ACT. The only differences being that the high users were younger, they were more often living in supported housing or institutions, and more often subject to involuntary outpatient treatment.

In contrast to the groups in Paper II, the clinical differences between participants with and without problematic substance use were greater upon enrolment into ACT. Those with problematic

substance use had more severe psychiatric symptoms, in particular manic and agitated symptoms, they had significantly lower everyday practical and social functioning, and their level of inpatient days before ACT was higher than that of participants without problematic substance use. Despite these differences, both groups experienced a strong reduction in total inpatient days during ACT.

It is important to mention that the reduction in total and involuntary inpatient days amongst participants with problematic substance use occurred despite ongoing problematic substance use. This is contrary to earlier suggestions (Fries and Rosen 2011). Perhaps the significant reduction in our study partly can be explained by the high level of inpatient service use before ACT (Dieterich, Irving et al. 2010). It may also indicate that the intensive, holistic and flexible ACT teams provide services that more successfully help stabilizing the participants' situation than traditional, office-based services and thereby contribute to a reduction in inpatient services use. However, we cannot exclude the possibility that the change in total and involuntary inpatient days in our study was not caused by regression to the mean. This will be further discussed in section 5.2.1.

The exploratory linear mixed models in Paper II showed that changes in total and involuntary inpatient days were positively associated with the level of negative symptoms and being high user of inpatient services upon ACT enrolment. In Paper III, we found that the associations between problematic substance use and changes in total inpatient days were influenced by the severity of symptoms and the level of functioning. However, it is important to bear in mind that the exploratory analyses in both papers were performed in small samples. There is a risk that this aspect is underpowered and replication is needed before we can draw conclusions.

5.2 Methodological considerations

Our findings are dependent on several methodological issues. In this section the study design, the representativity and generalisability of the study population, as well as the assessment measures will be discussed.

5.2.1   Study design

Our study is observational, based on cross-sectional (socio-demographic and clinical data in all three papers) and pre-post data (inpatient service use in Paper II and Paper III), and not a randomised controlled trial. It is therefore subject to potential confounders and the data allow us to only report on associations between variables and not to draw conclusions on causalities.

The ACT model was not implemented in Norway as a research project but as a strategy to improve services for persons with severe mental illness who did not benefit from the existing service. This led to the establishment of ACT teams in catchment areas where there was local interest from

both the municipalities and the hospitals. However, we chose the best possible design to study patient characteristics and outcome in a real-world setting, using naturalistic, observational design.

When using pre-post data, it is important to consider the possibility that the reduction we found in our study may be caused by regression to the mean, indicating that the participants spent less time in psychiatric hospitals during ACT because they had a natural improvement in their condition and not because they received better treatment during ACT. However, looking at national data again, patients with schizophrenia (F20-29) account for 21% of the admissions and 38% of the inpatient days in Norwegian psychiatric hospitals in 2013 (Helsedirektoratet 2014) (page 233, table 16.15 and page 234, table 16.16 respectively), showing that each patient with schizophrenia spent on average 76 days in psychiatric hospitals in 2013. Equal figures were also found in 2009 (Pedersen, Sitter et al. 2009) and they are in line with the average number of inpatient days our participants spent in psychiatric hospitals per year in the two years before enrolling into ACT. Although the design does not allow us to draw conclusions on inpatient services use, this may suggest that the reduction we found is not merely caused by a regression to the mean.

5.2.2 Study population - Representativity and generalisability

Our study was a naturalistic, observational study, not introducing any intervention, but investigating a natural clinical setting. We did not apply any exclusion criteria, and thus aimed to include a representative sample of the ACT population. The ACT teams included patients with (suspected) severe mental illness such as schizophrenia, schizoaffective disorder or bipolar disorder, who were 18 years or older, had impaired everyday functioning, and were in need of long-term and comprehensive follow-up by mental health and social welfare services. Co-occurring substance use was not an exclusion criterion as long as it was not the primary diagnosis.

All patients that were enrolled into the ACT teams during the first year of operation were asked to participate in our study. That gave a total of 338 potential participants. In Paper I we had a response rate of 44% (N=149), while Paper II and Paper III included 42% (N=142) of patients that enrolled into the ACT teams' first year of operation. The response rates were lower than expected, and lower than response rates in randomised ACT trials (Drake, McHugo et al. 1998, Essock, Mueser et al. 2006, Killaspy, Bebbington et al. 2006, Sytema, Wunderink et al. 2007).

Comparing the participants in Paper I to those who declined to participate showed that the participants had higher levels of functioning, they were less likely to have problematic substance use, and they were less often subject to involuntary outpatient treatment than those who did not participate. There were no differences in gender, age or diagnosis of severe mental illness. The participants in Paper II and Paper III had less severe symptoms, better functioning, and fewer had problematic substance use compared to patients who declined to participate in our study. There

were no differences in age, gender, diagnosis of severe mental illness or number of persons being subject to involuntary outpatient treatment.

Summing up these results, patients with problematic substance use, more severe symptoms and lower functioning were under-represented in all three papers. These differences may have led to an overestimation of the associations between satisfaction with various life domains and areas of practical and social functioning (Paper I), as well as the reduction in total and involuntary inpatient days in Paper II and Paper III.

It is important to recognize that the differences in symptom and function score on the GAF scale between participants and non-participants were statistically significant (Paper I: participants 38.2 ± 9.1 versus non-participants 35.6 ± 8.4, Paper II and III: GAF-S participants 41.4 ± 10.2 versus non-participants 38.8 ± 10.0 and GAF-F participants 39.7 ± 8.3 versus non-participants 37.6 ± 8.9) and therefore the results may not be generalizable to patients with more complex problems and poorer functioning. On the other hand, the mean GAF scores indicate that both participants and non-participants had severe symptoms and major impairments in several areas of functioning with slightly lower mean score amongst the non-participants. It is uncertain if there is a clear clinical difference when the scores are so close (Pedersen, Hagtvet et al. 2007), which could suggest that the clinical difference between the groups was not significant.

Patients with co-occurring problematic substance use were under-represented in our sample, and because substance abuse has been found to increase the risk of readmissions and inpatient days (Drake, Osher et al. 1989, Haywood, Kravitz et al. 1995, Menezes, Johnson et al. 1996), the reduction of total and involuntary inpatient days in Paper II could be overestimated. We therefore investigated inpatient service use amongst participants with problematic substance use and compared to those without (Paper III). We then found that also in this sample the reduction in both total and involuntary inpatient days was significantly lower during ACT follow-up than in the two years before enrolment. This occurred despite ongoing severe problematic substance use during ACT follow-up. However, the multivariate exploratory linear mixed models in Paper III showed that better functioning was associated with greater reduction in total inpatient days amongst participants with problematic substance use and low functioning (GAF-F score ≤ 50). Although the analyses were performed on a small sample and therefore may be underpowered, these findings support the suggestion that the reduction in total inpatient days may not be generalizable to ACT patients with problematic substance use and severely impaired functioning.

5.2.3   Measurements - Reliability and validity

We used standardised and validated instruments with acceptable to good psychometric properties in this study. Some instruments were rated by the clinicians while others were self-report

questionnaires. Despite the fact that these are well-known and validated instruments, some issues need to be discussed.

Clinician-rated questionnaires

The clinician-rated questionnaires were completed by the ACT team members; alone or in team meetings. The interrater reliability may have been affected due to the large number of raters. The inter-rater reliability for BPRS was tested in our study by providing the teams with 16 anonymised patient cases from the teams, therefore also being representative for our participants. All teams were instructed to complete the BPRS for all 16 cases. Statistical analyses showed excellent reliability for anxiety/depressive symptoms (ICC 0.78), good reliability for positive symptoms (ICC 0.71) and manic excitement (ICC 0.72), and fair reliability for BPRS total score (ICC 0.54) and for negative symptoms (ICC 0.44). The ICCs indicate that the BPRS scores in our study are reliable.

Ventura and colleagues commented on several factors that they found to affect the reliability of the BPRS 24-items version (Ventura, Green et al. 1993a). These factors may be valid for other instruments in our study as well. They found that the reliability was influenced if the raters used "inappropriate" reference groups, i.e. if the clinicians had been working with persons with severe mental illness for a long time they used this population as a reference instead of the general population. This led to an underestimation of the patients' situation. The same happened if the clinicians worked with the patients over time. They became used to the patients' symptoms and subsequently they underestimated the severity. The possibility of underestimating the participants' severity of symptoms and level of functioning is present in our study and may have influenced our results. Our research group aimed to address these issues by training the team members to use the assessment battery prior to the baseline assessments (training by project leaders: professor Torleif Ruud and dr. Anne Landheim). Additionally, regular meetings with team staff were held throughout the study period to discuss the use of the scales and the ratings. The research group also developed and distributed a guideline for the use of the assessment forms to all teams for ongoing reference.

Self-report questionnaires

The validity of self-report questionnaires has repeatedly been discussed because of their perceived inaccuracy in detecting substance use. The under reporting of substance use can be explained by several factors, such as patients denying substance use, or underestimating the problematic consequences of their use (Secades-Villa and Fernandez-Hermida 2003), or if patients believe there may be negative consequences of reporting their actual use (such as stopping treatment or legal action). They may also fear the social stigma related to substance use, or there can be misreporting caused by imperfect memory about substance use over time (Darke 1998). However, studies have

shown that self-reports on substance use can be reliable (Secades-Villa and Fernandez-Hermida 2003), and that active treatment may improve validity (Weiss, Najavits et al. 1998).

Standardised measures were used to classify problematic substance use, but there may have been some under- or over reporting on these measures that may have led to misclassification. The participants were classified as having problematic substance use based on their AUDIT and DUDIT scores. However, if the AUDIT and/or the DUDIT scores were missing (3 of 142 participants, 2%) or below cut-off (4 of 142 participants, 3%), the AUS and the DUS were consulted. We did not do any laboratory assessments such as blood samples and urine drug screening in our study, but there were no negative consequences of reporting substance use such as legal actions or stop in treatment. Additionally, problematic substance use was classified using information from both self-report questionnaires and clinician-rated instrument. However, we cannot exclude the possibility that some patients were wrongly classified as having problematic substance use when they in fact did not, and vice versa. It is also possible that some patients with problematic substance use under-reported on the AUDIT/DUDIT, and were not identified by the clinicians on the AUS/DUS, and subsequently they were misclassified as not having problematic substance use when they in fact did. This could have altered our results.

The validity and reliability of self-reported quality of life have also been questioned. However, Lehman found that patients with severe mental illness provide reliable responses regarding their subjective quality of life, and that their responses explain a large proportion of the variance in their global quality of life (Lehman 1983).

5.2.4 Register data

Inpatient service use: The data from the NPR are based on reports from each hospital trust, and the accuracy of the data relies on the correctness of reporting by each hospital. If the registration of inpatient service use contains errors, the number of admissions, the total and involuntary inpatient days may be over- or under-reported. We applied standard guidelines from the NPR to deal with the more common missing data, and we therefore chose to carry the admission forward as an internal transfer if one admission ended the same day as the next started. This may have caused the number of admissions to be lower than the actual number, but it is in line with current practice. We also interpreted the admission as involuntary throughout the period if no end-date was provided, and this may have caused an overestimation of the number of involuntary inpatient days, but also this is according to the guidelines.

5.2.5 Possible confounders

Setting: Previous studies have suggested that ACT has most impact on inpatient service use where there is less overlap with standard care services and more availability of inpatient services (7). In

Norway, there is generally little overlap between standard care services and ACT, with standard care mostly comprising outpatient service mainly offering office-based contact and marginal integration of health and social care staff. On the other hand, Norway has implemented Crisis Resolution Teams (CRTs) throughout the country. The CRT model shares some organisational similarities with ACT such as team approach, outreaching services, and the CRTs and ACT are intended to target the same population. In England, where the implementation of CRTs and ACT occurred simultaneously as a part of a national strategy, the subsequent reduction in inpatient service use was attributed to the CRTs more than ACT (Glover, Arts et al. 2006). However, in Norway, the CRTs were established before ACT, they lack some of the key characteristics found in British teams, and they serve a population with less severe symptoms (Hasselberg, Grawe et al. 2011). Additionally, the finding that the reduction in inpatient service use mainly was due to the CRTs, not ACT, has later been questioned (Jacobs and Barrenho 2011). This suggests that the presence of CRTs and ACT in the same catchment area is an unlikely explanation for the reduction in inpatient service use found in our study.

National policies on inpatient bed availability are likely to influence hospital use and internationally there has been a strategy over years to reduce hospitalisation and beds in psychiatric care. This is also the trend in Norway. In the period 2009-2013 the number of inpatient beds in Norway was reduced with 13% (N beds 2009 = 4433, N beds 2013 = 3857) (Helsedirektoratet 2014) (page 17). In the same period, there was a 15.3% reduction in total inpatient days (N inpatient days 2009: 1.350.348, N inpatient days 2013: 1.143.279, page 16) (Helsedirektoratet 2014), and minor fluctuations in the use of involuntary inpatient treatment (Helsedirektoratet 2014). Although these figures include all patients, not only those with severe mental illness, they do not suggest that changes in inpatient services nationally explain the much larger reduction in inpatient service use found in our study.

Fidelity of the Norwegian ACT teams: One of the major criticisms against European ACT studies have been that the teams are not working according to the traditional ACT model (Rosen, Stein et al. 2013). The Norwegian ACT teams' fidelity to the model was assessed using the TMACT (Monroe-DeVita, Teague et al. 2011) at 12 and 30 months after establishment. The scores are based on information from interviews with team members and patients, observations of team meetings and encounters with patients, and data from electronic medical records. The mean TMACT scores at 12 months ranged from 2.7 to 3.7, indicating low to moderate fidelity, and at 30 months the scores ranged from 3.1 to 4.1, indicating moderate to high fidelity. The key principles of ACT, mainly measured on the subscales organization & structure, core team members, and core practices, represent the greatest differences with Norwegian standard mental health services. The ratings on these items showed moderate to high fidelity at both 12 and 30 months.

The implementation of ACT was based on local interest. Working with a new, well-defined and documented model may have led to increased motivation and enthusiasm amongst the team members and the local systems. As a consequence,, this may have positively influenced our findings. However, all teams were in the start-up phase, many did not have the required professionals, adequate facilities, and for some teams it was difficult to find their place within the existing system. These are factors that could have negatively influenced the results in our study.

5.3 Strengths and limitations

Strengths and limitations have already been discussed, but the main issues will be highlighted here. The major strength of this study is that we have data from participants of 12 different ACT teams localized throughout Norway, representing both urban and rural areas. In addition, the cross-sectional data were obtained using standardised instruments with good psychometric properties and we used four years of longitudinal data on inpatient service use, from the two years before and the two years after the participants enrolled in the teams. The data on everyday functioning were based on detailed information from the observation of the participants functioning in their natural environment.

As already mentioned, our study has some limitations. First, this is a naturalistic, observational study, not a randomised trial. It is therefore subject to potential confounders, and causal interpretations cannot be made. The cross-sectional data thus only allow for investigation of associations.

In addition, ACT may not cause the reduction in inpatient days found in our study, although the reduction was similar amongst all teams, and much larger than the national reduction in inpatient service use. Furthermore, fewer than half of the ACT population (44% in Paper I and 42% in Paper II and Paper III) was included. The significant differences in characteristics between the participants and non-participants may have led to selection bias and subsequently the results may not be generalizable to all ACT patients. However, the different percentage of people with co-occurring problematic substance use between participants and non-participants are unlikely to affect the reduction found in Paper II because participants with problematic substance use also had significant reductions in inpatient days that we found in Paper III. The differences in global level of symptoms (GAF-S) and functioning (GAF-F) were statistically significant but the scores indicate only small clinical differences.

The data on inpatient service use from the Norwegian Patient Register derive from local electronic medical records, and depend on correctness of registration. Registration-errors may therefore have caused an under- or over estimation of admissions, and total and involuntary

inpatient days. Finally, the ACT teams conducted the assessments of the participants, and due to the large number of raters involved in the assessments, the inter-rater reliability may have been affected. The validity of weekly contact with social network (Paper I) and the accuracy of the classification of problematic substance use (Paper III) may be uncertain.

6. Conclusions and implications

This thesis investigated subjective quality of life amongst persons with severe mental illness who enrolled into 12 Norwegian ACT teams and inpatient service use in the two years before and after ACT enrolment. Associations with patient characteristics were also explored.

We found no significant relationship between subjective quality of life and psychotic symptoms, but a negative association with anxiety and depressive symptoms. This underscores the importance for services to target anxiety/depressive symptoms as well as psychotic symptoms amongst persons suffering severe mental illness.

Although perhaps moderate in clinical effect, our study showed positive relationships between satisfaction with various life domains and level of practical and social functioning in related areas. This could suggest that targeted interventions aiming to improve patient functioning may have a positive impact on patients' subjective quality of life. Furthermore, the positive relationship between subjective quality of life and contact with family and friends emphasizes the need for mental health services to help patients build and maintain a supportive social network. Higher satisfaction with family relations has been related to fewer hospital readmissions, and having a supporting social network may therefore increase community tenure and decrease inpatient service use.

The changes in total and involuntary inpatient days that we found may suggest that the ACT teams contribute to a more appropriate use of inpatient care. This may be because the presumably avoidable hospitalisation of high users was reduced, and the presumably needed inpatient care of low users was increased. Perhaps people without a history of high inpatient service use benefit from ACT services because these teams could detect needs that may not have been discovered by traditional services. The reduction that we found amongst persons both with and without problematic substance use could indicate that ACT teams successfully support people with complex mental health problems in the community, and thereby contribute to reduce inpatient service use, including amongst those with co-occurring problematic substance use despite ongoing, severe substance use.

In conclusion, these findings may indicate that services organised according to the ACT model successfully reach and provide adequate services to persons with severe mental illness that have been hard to reach and engage by more traditional services, regardless of their history of inpatient service use or ongoing problematic substance use.

The ACT model represents a different way of providing services to persons suffering severe mental illness who need long-term and comprehensive services, in particular compared to specialised mental health care that generally has more traditional, office-based services. The Norwegian mental

health care is fragmented, often making it difficult for patients to keep in contact with mental health care and social welfare services. Establishing teams that include professionals from both primary and specialised health care and social welfare services that target persons in the community may decrease the impediments in achieving appropriate treatment and follow-up for this population. However, these organisational adjustments require policy changes.

Further research could provide more detailed understanding of how functioning and subjective quality of life interact, and whether the organisation of services according to the ACT model would significantly and sustainably improve patients' functioning and their subjective quality of life. It is also important to investigate which factors are important for providing adequate services without unnecessary admissions in mental health hospitals. This warrant further research on subgroups of ACT patients, including long-term outcomes for persons without a history of high inpatient service use or those suffering co-occurring problematic substance use, in addition to outcomes related to recovery, such as functioning, quality of life, community tenure, and inpatient service use.

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RESEARCH

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Hospitalization of high and low inpatient service users before and after enrollment into Assertive Community Treatment teams: a naturalistic observational study

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Abstract

Background: Assertive Community Treatment (ACT) is more successful in reducing hospitalization when baseline use is high. However, with a growing recovery-focus, ACT may be useful for people with severe mental illness who are difficult to engage but not high users of inpatient services. This study investigated hospitalization 2 years before and 2 years after ACT enrollment amongst patients both with and without high inpatient services use before enrollment into ACT.

Methods: This naturalistic observational study included 142 patients from 12 different ACT teams throughout Norway. Of these, 74 (52 %) were high users of inpatient services before ACT. The teams assessed the patients upon enrollment using clinician-rated and self-reported questionnaires. Hospitalization data from 2 years before and 2 years after enrollment into ACT were obtained from the Norwegian Patient Registry. Linear mixed models were used to assess changes in hospitalization and to explore associations between these changes and patient characteristics.

Results: When the participants enrolled into the ACT teams, high users of inpatient care were younger, more often living alone and more often subject to involuntary outpatient treatment than low users. The participants spent significantly fewer days in hospital during the 2 years of ACT follow-up compared to the 2 years before enrollment. The reduction was more evident amongst high users, whereas low users had an initial increase in inpatient days in the first year of ACT and a subsequent decrease in the second year. More severe negative symptoms and previous high use of inpatient care were associated with a reduction in both total and involuntary inpatient days. Additionally, a reduction in involuntary inpatient days was associated with being subject to involuntary outpatient treatment upon enrollment into ACT.

Conclusion: The findings in this study may suggest that ACT contributes to more appropriate use of inpatient care, possibly by reducing the presumably avoidable hospitalization of high users and increasing the presumably needed inpatient care of low users.

Keywords: Assertive community treatment, Hospitalization, High inpatient service use, Appropriate services

Background

Hospitalization is considered a proxy for symptom relapse in schizophrenia and is a frequently used measure of treatment effectiveness in studies investigating services that target this population [1, 2]. Assertive Community Treatment (ACT) is a well-documented model of community based care that provides outreach services to people with severe mental illness (schizophrenia, other psychotic disorders or severe bipolar disorder), co-morbidities and poor functioning [3–5]. ACT has been found to successfully reduce hospitalization amongst people

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with severe mental illness such as schizophrenia and bipolar affective disorder, who have difficulties engaging with standard care and experience recurrent cycles of relapse and readmission to mental hospitals [6, 7]. The ACT approach provides more flexible and intensive support, including evidence-based and individually tailored services in the community, than generic mental health services [7, 8].

One of the primary aims of ACT is to reduce the extent and associated cost of inpatient service use [3] but the setting in which ACT is more appropriate for implementation and effective is debatable [9, 10]. ACT has a superior effect on hospitalization over standard mental health services where there is less overlap between the support delivered by services [11, 12] and when it is focused on high users of inpatient care [6, 12]. Conversely, patients with low inpatient service use prior to ACT may experience an increase in hospitalization once under the care of ACT [13, 14]. Indeed, Mortimer and colleagues concluded that ACT is appropriate for patients with a range of needs, not only those who are high users of inpatient services [15].

ACT is intended for persons with mental illness with the most severe symptoms and disabilities who are prone to frequent or long admissions. This includes patients with poor community functioning who are not successfully engaged by less intensive and assertive services [7, 10]. Some of these patients may have limited contact with services [7] with few or no hospital admissions. In this scenario, hospitalization may help stabilize a difficult situation that might easily be overlooked by traditional, office-based mental health services. With the growing focus on recovery-oriented practices in ACT [8], these teams may offer benefits for patients with severe mental illness and high needs, even if their problems have not led to high use of inpatient services.

Identification of differences between high users and low users of inpatient care and factors associated with changes in hospitalization is therefore important to increase the understanding of the impact that ACT may have on these subgroups. However, different criteria have been used to define high use of inpatient care, either based on the number of admissions [13, 16, 17] or total inpatient days over a fixed time period [14, 18]. Definitions using only frequency exclude patients with few but long admissions while those using only duration exclude patients with frequent but short admissions. To our knowledge, the REACT study from the UK is the only ACT trial that applied criteria that accounted for both frequency and duration [19].

The ACT model was recently introduced to Norway to improve services to patients with severe mental illness (schizophrenia, other psychotic disorders or severe bipolar disorder) who were difficult to reach and engage by existing services. The Norwegian mental health service system is divided into two organizational levels, with primary health and social care provided at the municipal level and specialized mental health services provided by state-owned health authorities. The primary mental health care comprises general practitioners, individual or group therapy, self-help groups, day centers, and supported housing with full or partial supervision. The specialized mental health services comprise community mental health centers (CMHCs) and psychiatric departments in hospitals. The CMHCs comprise outpatient clinics, psychosis rehabilitation teams, substance abuse clinics day units, crisis resolution teams, and local inpatient facilities.

The key principles of ACT, including outreach, delivery of services in the community, holistic and integrated services, and continuity of care [20] may have been incorporated in standard mental health care internationally but this is not the case in many mental health care settings in Norway. The services are often fragmented and office-based, and the complexity of the service configuration may present impediments to access appropriate treatment for people with severe mental illness.

Estimates from 2008 suggested that more than 4000 persons with severe mental illness in Norway (approximately 1/1000 inhabitants) did not receive appropriate mental health services [21]. In 2009, the National Health Authorities decided to fund implementation of ACT teams across Norway to improve services for this population. Between December 2009 and February 2011, 12 ACT teams were established throughout the country. A history of high inpatient service use was not an inclusion criterion, and this provided an opportunity to investigate possible differences between high users and low users of hospitalization, applying the criteria used in the REACT study. Based on the existing ACT literature, we expect that high users would experience a decrease in hospitalization during ACT follow-up while hospitalization would increase among the low users.

Aims and research questions

This study aimed to investigate hospitalization (new admissions, total inpatient days, involuntary inpatient days) amongst high and low inpatient service users in the 2 years before and 2 years after enrollment into Norwegian ACT teams, and to explore factors associated with change in hospitalization. Our specific research questions were: are there significant socio-demographic or clinical differences between high users and low users of inpatient care upon ACT enrollment? Are there differences in hospitalization in the 2 years before ACT compared to the 2 years during ACT in the two groups? Are

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changes in hospitalization in the 2 years before ACT compared to the 2 years after enrollment associated with patient characteristics upon enrollment?

Methods

Design

This paper is based on data from the naturalistic observational study on ACT teams in Norway. Cross-sectional socio-demographic and clinical data from 142 patients of 12 ACT teams upon enrollment and longitudinal hospitalization data in the 2 years before and 2 years after ACT enrollment were used in this paper. Due to the nature of the funding and the implementation of the ACT model in Norway, it was not possible to conduct a randomized trial. However, a naturalistic observational study was designed to investigate patient outcomes in a real-life, clinical world.

Recruitment and sample

The ACT teams used inclusion criteria defined by the National Health Authorities which are similar to criteria used in international ACT studies: 18 years or older; severe mental illness (schizophrenia, schizoaffective, other psychotic disorder, bipolar affective disorder); impaired level of functioning; in need of long-term and comprehensive follow-up by mental health and social welfare services.

Patients with co-occurring substance misuse were included if this was not the primary diagnosis.

During the ACT teams' first year of operation 337 patients enrolled in the 12 teams and they were all invited to participate in the study. A total of 202 patients (60 %) gave written informed consent to participate after the procedure was fully explained. Of these, 142 (42 %) received ACT services for at least 2 years, and were considered eligible for this study (participants n = 142). Data on inpatient service use was not available for the non-participants (n = 195).

Compared to the non-participants, fewer participants had problematic substance misuse (n = 83 versus 128, 59 % versus 70 %, p = 0.034). Participants had less severe symptoms (mean score ± standard deviation (SD) Global Assessment of Functioning-Symptom Scale (GAF-S), 41.4 ± 10.2 versus 38.8 ± 10.0, p = 0.028) and better functioning (mean score ± SD Global Assessment of Functioning-Function Scale (GAF-F), 39.7 ± 8.3 versus 37.6 ± 8.9, p = 0.036). There were no differences in age, gender, diagnosis of severe mental illness, or number of people subject to involuntary outpatient treatment.

The classification of high use of inpatient services prior to ACT were based on the inclusion criteria applied in the REACT study [19]: five or more psychiatric admissions in mental health hospitals or at least 100 consecutive inpatient days during the last 2 years, or three or more admissions or at least 50 consecutive inpatient days during the last year [19]. Of the 142 participants, 74 (52 %) were high users of inpatient services prior to ACT and 68 (48 %) were not.

Measures

Clinician-rated instruments

Socio-demographic data were collected using a form developed by the research group. Global level of functioning was assessed with the Global Assessment of Functioning (GAF) scale [22]. Psychiatric symptoms were assessed with the expanded version of the Brief Psychiatric Rating Scale (BPRS, version 4) [23, 24]. The BPRS-4 comprises 24 items, giving four subscales (i.e., positive symptoms, negative symptoms, agitation mania, and anxiety/depressive symptoms) [25]. Each item is given a score from 1 (not present) to 7 (extremely severe). Everyday functioning was measured with the revised version of the Practical and Social Functioning Scale (PSF) [26], consisting of 32 items. The mean total score ranges from 0 to 8, where higher scores indicate better functioning. An adapted version of the Homeless Engagement and Acceptance Scale (HEAS) [27] measured participants' quality of engagement with services. The HEAS consists of four items, three rated from 0 to 4 and one from 0 to 3, giving a total score between 0 and 15. Higher scores indicate better service engagement.

Self-reported questionnaires

The alcohol use disorder identification test (AUDIT) [28] and the drug use disorder identification test (DUDIT) [29] are self-report instruments that screen for problematic substance use in the last 12 months. The AUDIT comprises ten and the DUDIT comprises eleven items, with total scores ranging from 0 to 40 (AUDIT) and 0 to 44 (DUDIT). Scores above specific cut-offs (AUDIT: men 8, women 6; DUDIT: men 6, women 2) indicate problematic substance use and higher score indicates greater severity.

Data-collection

Data on number of new admissions, total and involuntary inpatient days in mental health hospitals for the 142 participants in the 2 years before and the 2 years after enrollment into ACT was obtained from the Norwegian Patient Registry. Socio-demographic and clinical data were collected by the ACT teams when the participants enrolled into the teams. Both clinician-rated and self-reported questionnaires were used. Information was obtained through interviews with patients, care givers, and professionals, from direct observations and case-note reviews. The self-reported questionnaires were

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filled in by the participants alone or together with a team member.

Fidelity of Norwegian ACT teams

The Norwegian teams' fidelity to the ACT model was assessed using the Tool for Measurement of Assertive Community Treatment (TMACT) [8]. The TMACT comprises 47 items, giving six subscales; organization and structure (OS), core team (CT, including team leader, nursing staff and psychiatric care provider), specialist team (ST, including substance abuse specialist, vocational specialist, and peer specialist), core practices (CP), evidence-based practices (EP) and person-centered planning and practices (PP). Each of the 47 items is rated on a 5-point scale from 1 (not implemented) to 5 (fully implemented). The fidelity was measured at 12 and 30 months after the teams were established. The mean TMACT scores at 12 months ranged from 2.7 to 3.7, indicating low to moderate fidelity and at 30 months the scores ranged from 3.1 to 4.1, indicating moderate to high fidelity. At 30 months, the mean scores on the different subscales showed low implementation on ST, moderate fidelity on CP, EP and PP, and high implementation on OS and CT.

Statistical analysis

Differences in socio-demographic and clinical characteristics between high and low users were assessed with Fisher's exact test for dichotomous variables, Chi square test for categorical variables, Student's *T* test for symmetrically distributed continuous variables, and Mann-Whitney U test for skewed continuous variables.

Total and involuntary inpatient days for four periods [time period (TP) 1: 24–12 months pre-ACT enrollment and TP2: 12–0 months pre-enrollment, TP3: 0–12 months post-enrollment and TP4: 12–24 months post-enrollment] were presented as means and 95 % confidence intervals (CI).

To assess changes in hospitalization the difference between the number of *new admissions, total inpatient days* and *involuntary inpatient days* in the 2 years before and the 2 years after ACT enrollment were defined as dependent variables.

The level of clustering within the team was assessed by an intra-class coefficient (ICC). Only a weak cluster effect was present but nevertheless, the difference in hospitalization between high and low users was analyzed by a linear mixed model with random effects at the ACT level, to correctly adjust the estimates for possible intra-ACT correlations. Fixed effect for variable identifying high and low users was entered into the model.

A multivariate linear mixed model was built with clinical variables [involuntary outpatient treatment (Y/N), the four BPRS subscales, AUDIT, DUDIT, HEAS, PSF,

and high inpatient service use (Y/N)] as fixed effects to assess possible predictors for change in hospitalization. Random effects at the ACT level were included. The Akaike's information criteria (AIC) (the smaller the better) [30] was applied for model reduction, but according to the AIC, none of the predictors could be eliminated. The final model was adjusted for age, gender and fidelity score (TMACT mean score at 30 months as this score was thought to best represent the 2 year follow-up period of the participants).

We imputed missing values on PSF items (n = 14, 0.3 % of cases), HEAS items (n = 2, 0.4 %), AUDIT (n = 14, 9.9 %) and DUDIT (n = 18, 12.7 %) by generating the empirical distribution for each variable and drawing a random number from that distribution to replace the missing value. The process was repeated until all missing values were imputed. The GAF scores were close to normally distributed, and missing values (n = 4, 2.8 % of cases) were imputed by drawing a random number from the corresponding normal distribution. The BPRS was completed for 98.6 % of the participants and thus we imputed no scores.

Linear mixed models were estimated by Statistical Analysis System version 9.3 (SAS Institute, Cary, NC USA). Other statistical analyses were performed with the Statistical Package for Social Science version 22 (SPSS, Chicago, IL USA). All tests were two-sided. p values below 0.05 were considered statistically significant. No correction for multiple hypothesis testing was performed as the study was exploratory.

Ethics, consent and permission

The study was approved by the Regional Committee for Medical and Health Research Ethics Health region South-East (ID: 2010/1196a). All participants gave written informed consent to participate in the study after the procedure of the study had been explained to them by the ACT teams.

Results

Characteristics of the groups

Upon ACT enrollment, the high users were younger, more likely to be subject to involuntary outpatient treatment, more likely to live in supported accommodations, be in prison or homeless, and less likely to live alone, as compared to the low users (Table 1). There were no significant differences in scores on clinical rating assessments between the groups.

Hospitalization

There were few differences between the 12 ACT teams regarding patients' inpatient service use before ACT [total inpatient days (ICC = 7.4 %), involuntary inpatient

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days (ICC = 6.2 %)]. There were also only small differences between the teams regarding change in total inpatient days (ICC = 2.8 %) and involuntary days (ICC = 1.1 %).

For the total sample, the mean number of new admissions was the same before and after ACT enrollment; on average, patients had three admissions in the 2 years before and three admissions in the 2 years after enrollment (Table 2). However, both total and involuntary inpatient days were halved in the 2 years after ACT enrollment compared to the 2 years before. There were significant differences in the changes in inpatient service use between the high and the low users. Total and involuntary inpatient days reduced amongst the high users, whilst the low users experienced an increase in the same period.

When comparing the three hospitalization outcomes in the four time periods (TP1, TP2, TP3, TP4, Table 3), the high users experienced an increase in all outcomes before ACT (TP1–TP2) and a decrease after ACT enrollment (TP2–TP4). However, the low users experienced an increase in new admissions throughout the period (TP1–TP4). Total and involuntary inpatient days were stable before ACT amongst the low users (TP1–TP2) but both outcomes increased in the first year after ACT enrollment (TP2–TP3) and subsequently decreased during the second year (TP 3–TP4). Non-overlapping confidence intervals between to consecutive periods indicate significant change between these two periods.

Patient characteristics associated with changes in inpatient days

The exploratory regression analyses showed that fidelity was not associated with changes in new admissions, total inpatient days or involuntary days. There were also no significant associations between change in new admissions and patient characteristics. However, more severe negative symptoms and high use of inpatient services before ACT were significantly associated with reduction in both total and involuntary inpatient days after ACT enrollment (Table 4). Being subject to involuntary outpatient treatment upon enrollment was also significantly associated with a reduction in involuntary inpatient days after ACT enrollment.

Discussion

Our study documented a decrease in total and involuntary inpatients days over the 2 years of ACT follow-up but no change in number of admissions. The decrease in inpatient days was more evident for the high users whilst for the low users there was an initial increase and a subsequent decrease in inpatient days after ACT enrollment. More severe negative symptoms upon ACT enrollment

and high inpatient service use before ACT were significantly associated with a reduction in both total and involuntary inpatient days after ACT enrollment. Additionally, a reduction in involuntary inpatient days was significantly associated with being subject to involuntary outpatient treatment upon ACT enrollment.

Characteristics of the groups

Our findings that the high users were younger, more often subject to involuntary outpatient treatment and less likely to be living independently compared to the low users upon ACT enrollment is corroborated by previous studies [16, 17]. The fact that there were no differences in ratings of clinical problems between the groups may support the hypothesis of Mortimer and colleagues that ACT could be appropriate for patients with severe mental illness who are not high users of inpatient services [15]. According to the NICE guidelines, in addition to reducing the use of hospitalization, ACT teams should ensure continuous contact with services and improve psychosocial outcomes [3]. Intensive case management, including ACT, has been shown to have a significant advantage over other services in reducing the number of people who drop-out of contact with services [6]. It may be that the increase in hospitalization experienced by the low users represented an appropriate response to unmet clinical needs, or it may have shown a negative impact of ACT involvement. The fact that inpatient days reduced in the second year of ACT in this group perhaps gives more weight to the first explanation, suggesting that admission was necessary to attend to specific problems in order that the person could progress. Additionally, a recovery approach is an important part of ACT [14] and ACT may therefore provide a basis for recovery-oriented, assertive, and intensive services to patients with significant clinical needs who historically have not been high users of inpatient services.

Hospitalization

We found that the participants spent significantly fewer days in hospital during the 2 years of ACT follow-up compared to the 2 years before they enrolled into the teams. This is in contrast to findings from recent European randomized trials of ACT [19, 31], but is in line with several non-randomized studies [14, 15, 32, 33]. That the reduction in inpatient days was mainly found amongst the high users, supporting findings by Burns and colleagues [12] and Dietrich and colleagues [6].

Previous studies have suggested that ACT has most impact on hospitalization where there is less overlap with standard care services [11, 12]. In England, Crisis Resolution Teams (CRTs) and ACT teams were implemented simultaneously as part of a national policy and

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Table 1 Socio-demographic and clinical characteristics of high and low users upon ACT enrollment

	Non-high users		High users		p value
	N	%	N	%	
Socio-demographic characteristics					
Sex (male)	43	64	51	69	0.594[a]
Age, mean (SD)	*42 (10.8)*		*38 (9.7)*		*0.015[c]*
Ethnicity					0.890[b]
Norwegian	54	83	60	85	
Other European	6	9	5	7	
Outside Europe	5	8	6	8	
Marital status					0.710[b]
Unmarried	49	72	57	77	
Married/cohabitant	7	10	5	7	
Education					0.243[b]
Completed primary school	36	58	40	57	
Completed upper secondary school	23	37	21	30	
Completed higher education	3	5	9	13	
Employment status					0.669[b]
Unemployed	56	83	62	84	
Competitive job/study	5	7	3	4	
Other	7	10	9	12	
Living situation					*0.034[b]*
Alone	49	72	42	57	
With family	15	22	16	22	
Staffed housing/supported housing/institutions (hospital, prison, hospice)/homeless/unstable living situation	4	6	15	21	
Clinical Characteristics					
Diagnosis					0.659[b]
Schizophrenia, schizo-affective or other psychotic disorder	53	86	62	89	
Bipolar disorder	4	6	5	7	
Other psychiatric disorder	5	8	3	4	
Community treatment order (yes)	14	21	37	50	*<0.001[a]*
Substance abuse					0.321[b]
None	32	47	27	37	
Alcohol (AUDIT)	12	18	10	13	
Other substances (DUDIT)	11	16	14	19	
Alcohol and other substances (AUDIT and DUDIT)	13	19	23	31	
	Mean	**SD**	**Mean**	**SD**	**p value**
AUDIT total score	7.87	9.21	8.30	9.05	0.954[d]
DUDIT total score	7.54	11.37	10.58	13.01	0.141[d]
Psychiatric symptoms					
BPRS mean total score	2.51	0.82	2.40	0.79	0.408[d]
BPRS positive symptoms	2.50	1.32	2.47	1.23	0.938[d]
BPRS negative symptoms	2.60	1.24	2.39	1.07	0.316[d]
BPRS agitation mania	2.25	1.16	2.07	1.02	0.369[d]
BPRS anxiety/depressive symptoms	2.80	0.89	2.64	1.11	0.362[c]
Global level of functioning (GAF)	38.6	8.7	37.4	8.6	0.412[c]
Level of functioning (PSF)	4.33	4.33	4.25	1.58	0.781[c]
Engagement and acceptance of contact with services (HEAS)	9.42	3.00	9.89	2.97	0.360[c]

[a] Fischer's exact test

[b] Chi square

[c] Student's *T* test

[d] Mann–Whitney U Test

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Table 2 Hospitalization of total population, high and low users two years before and during ACT

Outcome	Population	Before ACT enrollment		After ACT enrollment		Change before-after ACT enrollment		
		Mean	SD	Mean	SD	Mean[a]	95 % CI	p value[b]
New admissions	Total population[c]	3.34	3.98	3.00	4.70	0.27	−0.49 to 1.04	0.480
	Low users[d]	1.28	1.23	1.62	3.02	−0.33	−0.96 to 0.29	0.284
	High users[e]	5.23	4.64	4.39	5.56	0.84	−0.52 to 2.20	0.223
Total inpatient days	Total population[c]	120.93	154.63	61.47	77.58	59.46	32.88 to 86.03	*<0.001*
	Low users[d]	26.57	31.37	50.94	82.82	−24.37	−43.37 to −5.37	*0.013*
	High users[e]	207.64	171.37	71.15	71.64	136.49	95.47 to 177.51	*<0.001*
Involuntary inpatient days	Total population[c]	80.82	147.45	36.63	64.99	44.20	19.30 to 69.10	*<0.001*
	Low users[d]	11.76	22.44	31.43	70.54	−19.66	−36.42 to −2.91	*0.022*
	High users[e]	144.28	181.68	41.41	59.51	102.88	61.55 to 144.20	*<0.001*

[a] Positive results indicate mean reduction in outcome after ACT enrollment compared to before while negative results indicate mean increase

[b] Analyses of changes using linear mixed models

[c] Total population N = 142

[d] Low users N = 68

[e] High users N = 74

Table 3 Hospitalization of total population, high and low users (four time periods)

Outcome	Population	TP 1[a]		TP 2[b]		TP 3[c]		TP 4[d]	
		Mean	95 % CI	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI
New admissions	Total population	1.39	1.05–1.74	1.94	1.55–2.34	1.61	1.23–1.99	1.45	0.99–1.91
	Low users	0.57	0.35–0.79	0.71	0.51–0.9	0.79	0.52–1.06	0.82	0.28–1.36
	High users	2.15	1.56–2.74	3.08	2.45–3.71	2.36	1.71–3.02	2.03	1.31–2.75
Total inpatient days	Total population	51.08	36.63–65.52	69.85	55.20–84.50	36.61	28.50–44.73	24.86	16.37–33.53
	Low users	12.63	7.23–18.04	13.94	9.24–18.65	29.41	17.59–41.24	21.53	6.93–36.13
	High users	86.41	61.51–111.3	121.23	99.09–143.37	43.23	32.02–54.44	27.92	18.36–37.47
Involuntary inpatient days	Total population	33.48	20.97–45.99	47.35	32.94–61.75	23.83	16.33–31.33	12.80	6.37–19.22
	Low users	6.72	2.36–11.08	5.04	2.26–7.83	21.81	10.34–33.28	9.62	−0.23–19.46
	High users	58.07	35.59–80.54	86.22	61.66–110.78	25.69	15.63–35.74	15.72	7.17–24.26

Not adjusted for ACT level

[a] TP1 = 24–12 months before ACT enrollment

[b] TP2 = 12–0 months before ACT enrollment

[c] TP3 = 0–12 months after ACT enrollment

[d] TP4 = 12–24 months after ACT enrollment

the subsequent reduction in use of hospitalization was attributed to the CRTs more than ACT [34], although this finding has been questioned [35]. In contrast, the CRTs in Norway were established before the ACT teams and serve a population with less severe symptoms [36]. This suggests that the presence of CRTs and ACT in the same catchment area is an unlikely explanation for the reduction in hospitalization found in our study.

When inpatient service use is already low, the effect of interventions aiming to reduce hospitalization is less likely to succeed [12, 37]. National data from 2009 [38] and 2013 [39] show that high users of inpatient services, of whom the majority suffer severe mental illness like schizophrenia, spend an average of 75–83 days in hospital per year. This is similar to the level of total inpatient days per year we found in our study in the 2 years before ACT but it is almost twice as high as the number of total inpatient days per year in the 2 years of ACT follow-up. This may indicate that, although the design of our study does not allow us to draw conclusions regarding the effect of ACT on hospitalization, it is unlikely that regression to the mean can fully explain the reduction found amongst high users in our study.

However, national policies on hospital bed availability can also influence use of inpatient services. Between 2009 and 2013 there was a 13 % reduction in the number

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Table 4 Multivariate linear mixed models: Associations between patient characteristics and change in total and involuntary inpatient days (N = 124)

Variables	Total inpatient days		Involuntary inpatient days	
	Regression coefficient (95 % CI)	p value	Regression coefficient (95 % CI)	p value
Age	37.88 (−15.72; 91.48)	0.164	43.35 (−9.55; 96.26)	0.107
Gender	−1.31 (−4.10; 1.49)	0.357	0.29 (−2.47; 3.05)	0.836
Involuntary outpatient treatment	28.37 (−29.86; 86.61)	0.336	62.93 (5.46; 120.41)	*0.032*
BPRS positive symptoms	−0.77 (−26.65; 25.10)	0.953	−4.49 (−30.02; 21.05)	0.728
BPRS negative symptoms	36.23 (11.24; 61.23)	*0.005*	31.95 (7.28; 56.61)	*0.012*
BPRS agitation mania	−16.82 (−49.03; 15.39)	0.303	−19.58 (−51.36; 12.21)	0.225
BPRS anxiety/depressive symptoms	−17.05 (−43.19; 9.09)	0.199	−13.66 (−39.46; 12.14)	0.296
AUDIT	0.69 (−2.43; 3.81)	0.663	−0.06 (−3.14; 3.02)	0.969
DUDIT	1.29 (−1.05; 3.63)	0.277	2.07 (−0.23; 4.38)	0.078
HEAS	7.71 (−1.72; 17.15)	0.108	7.73 (−1.58; 17.04)	0.103
PSF	15.57 (−3.20; 34.34)	0.103	9.29 (−9.23; 27.81)	0.323
High frequency user	141.14 (88.26; 194.02)	*<0.001*	95.52 (43.33; 147.71)	*<0.001*
TMACT mean score 30 months	32.31 (−66.15; 130.76)	0.517	45.39 (−51.78; 142.57)	0.357

of inpatient beds, a 15.3 % reduction in total inpatient days [39], and minor fluctuations in the use of involuntary inpatient treatment in Norway [40]. Although these figures include all patients, not only those with severe mental illness, they are unlikely to support the possibility that changes in inpatient services explain the much larger reduction in inpatient service use found in this study (reduction in total inpatient days for all participants 59.46 days, p < 0.001, reduction in involuntary inpatient days for all participants 44.20 days, p < 0.001). Furthermore, although total inpatient days were reduced during ACT follow-up, there was no increase in involuntary inpatient treatment. This could indicate that patients experiencing deterioration were identified at an earlier stage of relapse by ACT, prior to requiring involuntary admission.

Patient characteristics associated with changes in inpatient days

An increase in total inpatient days during ACT among patients with low baseline use has previously been reported [13, 14] and is not surprising, as reduction in total hospitalization is primarily found if baseline use is high [12]. High use of inpatient services and involuntary outpatient treatment were both associated with reduced inpatient service use, as was having more severe negative symptoms upon ACT enrollment. Although exploratory, our findings may support the hypothesis that hospitalization during ACT can mark the beginning of access to care and recovery for patients with prior low inpatient service use [13], and that ACT may contribute to more appropriate use of inpatient services and involuntary

hospitalization amongst patient both with and without high inpatient service use.

Our study showed no associations between the teams' fidelity score at 30 months and changes in hospitalization after ACT enrollment, in contrast to recent reports that higher TMACT scores were associated with decreased hospital use [41]. However, our study was exploratory so our findings should be interpreted with caution.

Strengths and limitations

A major strength of our study is that we have data from 12 different ACT teams operating in both urban and rural areas, covering all parts of Norway. Instruments with good psychometric properties were used. However, our study is an observational study and not a randomized controlled trial and therefore subject to potential confounders. We cannot conclude that the reduction in hospitalization observed was due to ACT, although the reduction was similar across teams and much higher than the national reduction in inpatient service use. Our sample included only those who gave informed consent and had received ACT for at least 2 years in Norway. Therefore our results may not be generalizable to all ACT patients. Finally, there were fewer participants than non-participants with substance abuse and the participants had statistically better functioning and less severe symptoms. This may have contributed to an overestimation of the reduction in total and involuntary inpatient days found in this study although the difference in symptom and functioning levels between the groups may not have been clinically significant.

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Hospitalisation of severely mentally ill patients with and without problematic substance use before and during Assertive Community Treatment: an observational cohort study

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Abstract

Background: Co-occurring substance use increases the risk of hospitalisation in people with severe mental illness, whereas Assertive Community Treatment (ACT) generally reduces hospitalisation in patients with severe mental illness and high inpatient service use. Because the superiority of ACT over standard services amongst patients with problematic substance use is uncertain, the present study examined inpatient service use amongst patients with and without problematic substance use in the 2 years before and the 2 years after they enrolled into ACT teams.

Methods: This naturalistic observational study included 142 patients of 12 different ACT teams throughout Norway. The teams assessed the patients upon enrolment into ACT using clinician-rated and self-reported questionnaires. We obtained hospitalisation data from the Norwegian Patient Register for the 2 years before and the 2 years after enrolment into ACT. We used linear mixed models to assess changes in hospitalisation and to explore associations between problematic substance use and changes in hospitalisation, controlling for socio-demographic and clinical characteristics.

Results: A total of 84 (59 %) participants had problematic substance use upon enrolment into the ACT teams. In the 2 years after ACT enrolment both participants with and without problematic substance use experienced a reduction in total inpatient days. Those with problematic substance use also had fewer involuntary inpatient days. Exploratory analyses suggested that symptom severity and functioning level interacted with problematic substance use to influence change in total inpatient days.

Conclusion: These findings may suggest that ACT teams successfully support people with complex mental health problems in the community, including those with problematic substance use, and thereby contribute to a reduction in inpatient service use.

Keywords: Assertive community treatment, Problematic substance use, Hospitalisation, Inpatient care

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Background

Substance use problems are more common amongst patients with schizophrenia than in the general population [1] with reported lifetime prevalence ranging from 47 to 60 % [1–3] and current prevalence ranging from 27 to 41 % [2, 4]. Substance use problems amongst people with schizophrenia also increase the risk of many negative outcomes, including increased hospital readmissions [5, 6], number of inpatient days [7], and involuntary admissions [8].

Assertive Community Treatment (ACT) is an intensive, multidisciplinary, community-based mental health service model that reduces hospitalisation amongst people with severe mental illnesses, such as schizophrenia, that are high users of inpatient care [9]. Many also suffer comorbidities, do not engage successfully with standard mental health services [10], and experience recurrent cycles of relapse, hospital readmissions [10, 11], and high use of inpatient services [9, 12, 13]. The ACT approach provides more flexible and intensive support than generic mental health services, delivering evidence-based, individually-tailored interventions in the community [10, 14]. The prevalence of current substance abuse in ACT populations ranges from 49 to 72 % [15–18], higher than other mental health outpatient groups.

Although ACT is generally superior to standard community-based services in reducing hospitalisation, the evidence amongst patients with co-occurring substance misuse problems is equivocal [19–21]. Few studies have compared hospitalisation amongst patients with and without co-occurring substance misuse problems before and after they engaged with ACT. One previous study that explored associations between patient characteristics and changes in hospitalisation, found that changes in total and involuntary inpatient days were not associated with the severity of alcohol or drug use problems. [22] Nevertheless, because substance use increases the risk of hospitalisation, patients with co-occurring substance misuse problems are likely to be higher users of inpatient services. We therefore hypothesized that ACT would have a greater impact on hospitalisation amongst this group, even though ACT has not been proven to effectively reduce substance use [19].

Aims and research questions

The aims of this study were to compare inpatient service use (new admissions, total inpatient days, and involuntary inpatient days) amongst ACT patients with and without problematic substance use and to explore associations between changes in inpatient service use and patient characteristics, including problematic substance use.

Our research questions were: First, are there differences in inpatient service use amongst patients with and without problematic substance use during the 2 years before and the 2 years after ACT enrolment? Second, is problematic substance use associated with changes in hospitalisation when adjusted for patient characteristics?

Methods

Design

We used a naturalistic observational study on ACT in Norway. For 142 patients of 12 Norwegian ACT teams, we combined cross-sectional socio-demographic and clinical data from enrolment into ACT and longitudinal hospitalisation data in the 2 years before and the 2 years after enrolment. Due to the nature of the funding and the implementation of the ACT model in Norway, we could not conduct a randomized trial.

Recruitment and sample

Between 1999 and 2008 a national program took place in Norway to improve mental health services. However, the evaluation of the program concluded that, despite major investments, expansion and reorganisations, the services were lacking continuity, they were fragmented, and approximately 4000 people with severe mental illness were not well engaged with services despite their need for treatment and follow-up [23]. Subsequently, in 2009, the National Health Authorities decided to fund the implementation of ACT teams across Norway to improve services for people with severe mental illness who suffered comorbidities such as substance misuse and needed more comprehensive services. A history of high inpatient service use was not mandatory for being taken on by the ACT teams because the aim was to reach people who were not well engaged with services. This could potentially include patients who had not been frequently admitted to hospital.

Between December 2009 and February 2011, 12 ACT teams started up across the country. Patient inclusion criteria included: 18 years or older, severe mental illness (schizophrenia, schizoaffective, other psychotic disorder, bipolar affective disorder), impaired level of functioning, and need for long-term, comprehensive follow-up by mental health and social welfare services.

Patients with co-occurring substance misuse were included if this was not the primary diagnosis.

A severe mental illness was diagnosed by referring agencies and was based on International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) criteria [24] for 69 participants (49 %); upon the "Mini International Neuropsychiatric Interview Plus" (MINI Plus) [25], or the "Structured Clinical Interview for DSM-IV Axis I Disorders" (SCIDI) [26], or other non-specified diagnostic instrument for 6 participants (4 %) while it was unknown how 27

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participants (19 %) were diagnosed. Data were missing for 40 participants (28 %).

The use of the Global Assessment of Functioning (GAF) scale is mandatory in specialised mental health care in Norway but not in primary care. The referral agencies therefore assessed the level of functioning based on clinical evaluation or on the GAF scale [27, 28].

For the present study we limited inclusion to the ACT teams' first year of operation. A total of 337 patients enrolled into the 12 teams and all patients were invited to participate in the study; 202 (60 %) gave written informed consent to participate after the teams had explained the procedures; and 142 participants (42 %) received ACT services for at least 2 years and were thus eligible for this study.

All 142 participants remained in contact with the teams during the 2 year follow-up period. A total of 12 participants (8 %) were admitted to inpatient substance use treatment in the 2 years before and/or after being taken on by the ACT teams. While three participants only were admitted in the 2 years before, seven participants were only admitted during ACT follow-up and two participants were admitted both before and during ACT follow-up. The mean number of inpatients days spent in substance abuse treatment in the 2 years before ACT was 17.4 days (SD 11.1) and median 13 days (min-max: 7–34 days). The mean number of inpatient days spent in substance abuse treatment during ACT follow-up was 39.3 days (SD 53.0) and median 11.0 days (min-max: 1–133 days). We have no data on periods of incarceration.

Participants and non-participants did not differ in age, gender, diagnosis of severe mental illness, or number of people being subject to involuntary outpatient treatment. Participants did, however, have less severe symptoms (mean score ± Standard Deviation [SD] on Global Assessment of Functioning – Symptom Scale [GAF-S], 41.4 ± 10.2 versus 38.8 ± 10.0, $p = 0.028$) and better functioning (mean score ± SD Global Assessment of Functioning – Function Scale [GAF-F], 39.7 ± 8.3 versus 37.6 ± 8.9, $p = 0.036$). Upon enrolment into ACT, fewer participants had problematic substance use ($n = 83$ versus 128, 59 versus 70 %, $p = 0.034$) compared to non-participants.

Most participants were male ($n = 94$, 67 %), and of Norwegian origin ($n = 114$, 84 %). They had a mean age of 39.8 ± 10.6 years. Most were single ($n = 106$, 75 %), living alone ($n = 91$, 65 %), and unemployed ($n = 118$, 83 %). Few had completed higher education ($n = 12$, 9 %). Almost all had a severe mental illness (according to the ICD-10 criteria, $n = 124$, 94 %) such as schizophrenia (F20-29, $n = 115$, 87 %) or bipolar disorder (F31, $n = 9$, 7 %). The mean age of illness onset was 25.9 ± 8.7 years. Overall, participants experienced severe symptoms (GAF-S 41.4 ± 10.2) and poor functioning (GAF-F 39.7 ± 8.3) at the point of enrolment (these scales are described in more detail below).

Measures

Problematic substance abuse was assessed using two self-reported questionnaires, The Alcohol Use Disorder Identification Test (AUDIT) [29] and the Drug Use Disorder Identification Test (DUDIT) [30], and two clinician-rated questionnaires, the Alcohol Use Scale (AUS) [31] and the Drug Use Scale (DUS) [32]. The AUDIT comprises 10 items with total score from 0 to 40 and the DUDIT comprises 11 items with total score from 0 to 44. Scores above specific cut-offs (AUDIT: men 8, women 6; DUDIT: men 6, women 2) indicate problematic substance use and higher scores indicate greater severity. The AUS and the DUS are 5-point scales with scores from 1 (no use) to 5 (severe dependence), with score 3 or higher indicating problematic substance use.

The ACT team clinicians also collected socio-demographic data using a form developed by the research group (*life situation and health-questionnaire*), and patients' global symptom and functioning levels using the Global Assessment of Functioning (GAF) scale [27], split version (symptoms scale [GAF-S] and functioning scale [GAF-F]) [28]. The GAF scales range from 0 to 100, and higher scores indicate less severe symptoms and better functioning. The expanded version of the Brief Psychiatric Rating Scale (BPRS) [33, 34] was used to assess the frequency and severity of psychiatric symptoms. The BPRS comprises 24 items, yielding four factors (positive symptoms, negative symptoms, agitation mania, and anxiety/depressive symptoms) [35]. Each item is rated from 1 (not present) to 7 (extremely severe). Everyday functioning was measured with the revised version of the Practical and Social Functioning Scale (PSF) [36]. PSF-revised comprises 32 items with a mean total score ranging from 0 to 8. Higher scores indicate better functioning.

Procedures

We obtained data from the Norwegian Patient Register on inpatient service use in mental health hospitals for the 142 patients in the 2 years before and the 2 years after enrolment into ACT. We used data from both clinician-rated and self-reported questionnaires. The ACT teams collected socio-demographic and clinical data when patients enrolled into teams through interviews with patients, care givers, professionals, and from direct observations and case-note reviews. Patients responded to the self-reported questionnaires (the AUDIT and the DUDIT) alone or together with a team member at enrolment onto the teams. The teams

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repeated the AUS and the DUS after 2 years with ACT while the participants in the study completed the AUDIT and the DUDIT after 2 years of ACT follow-up.

Fidelity of Norwegian ACT teams

The Norwegian teams' fidelity to the ACT model was assessed using the Tool for Measurement of Assertive Community Treatment (TMACT) [14] 12 and 30 months after establishment. The mean TMACT scores at 12 months ranged from 2.7 to 3.7, indicating low to moderate fidelity and at 30 months the scores ranged from 3.1 to 4.1, indicating moderate to high fidelity. The key principles of ACT, mainly measured on the subscales organization & structure, core team members, and core practices, represent the greatest differences with Norwegian standard mental health services. The ratings on these subscales showed moderate to high fidelity at both 12 and 30 months. Substance abuse specialist was present in 11 teams at 12 and 30 months fidelity evaluation. The mean TMACT scores on the five subscales relating to substance abuse specialist and Integrated Dual Disorder Treatment (IDDT) showed moderate to high fidelity. However, the scores on the different items showed large variations between teams (scores ranged 1–5, indicating none to full implementation).

Statistical analysis

We assessed differences in demographic and clinical characteristics between groups by Fisher's exact test for dichotomous variables, Chi-square test for categorical variables, Student's *T*-test for symmetrically distributed continuous variables, and Mann–Whitney *U* test for skewed continuous variables.

Three dependent variables assessed the change in hospitalisation; *new admissions, total inpatient days and involuntary inpatient days*. We defined these three dependent variables as the difference between the number 2 years before and the number 2 years after enrolment into ACT.

We analysed the difference between participants with and without problematic substance use in the three dependent variables by estimating linear mixed models, one for each variable. The models contained fixed effect for each patient group (with and without problematic substance use). Random effects for intercepts were included into the models to adjust for possible cluster effect due to intra-ACT correlations.

In the *exploratory* multivariate linear mixed models, we adjusted the associations between problematic substance use [Y/N] and the three dependent variables for demographic (age, gender) and clinical factors (involuntary outpatient treatment [Y/N], the four BPRS subscales, GAF-S, GAF-F, and PSF). In the same exploratory analyses, we also assessed interactions between the

problematic substance use variable and demographic and clinical characteristics in all three models. We used Akaike's Information Criteria [37] (the smaller the better) in model reduction. We applied standard residual diagnostic tests to assess the assumption of linear mixed models. The residuals were somewhat skewed, therefore we generated bootstrap based inference as well. However, as the differences were negligible, the results from the linear mixed model were presented. We considered these exploratory analyses as hypothesis-generating and not hypothesis-testing; therefore we did not correct for multiple tests.

We imputed missing values on PSF items ($n = 14$, 0.3 % of cases) by generating the empirical distribution for each item and drawing a random number from that distribution to replace the missing value. The process was repeated until all missing values were imputed. The GAF-S and GAF-F scores were close to normally distributed, and missing values (both $n = 4$, 2.8 % of cases) were therefore imputed by drawing a random number from the corresponding normal distribution. The BPRS was completed for 98.6 % of the participants and thus we imputed no scores. As the number of imputed values was low, no sensitivity analysis was performed.

We used the Statistical Analysis System version 9.3 (SAS Institute, Cary, NC USA) to estimate linear mixed models and the Statistical Package for Social Science version 22 (SPSS, Chicago, IL USA) for other statistical analyses. All tests were two-sided, considering *P*-values below 0.05 as statistically significant.

Results

Classification and characteristics of participants with and without problematic substance use

We based classification of problematic substance use primarily on the AUDIT and DUDIT scores. Seventy-two participants (51 %) had a score above cut-off on one or both scales. The mean AUDIT and DUDIT scores ± SD for participants with scores above cut-off indicated severe problems (AUDIT 17.1 ± 7.6 and DUDIT 21.0 ± 10.3).

For participants who had not completed the AUDIT and DUDIT ($n = 12$, 8 %) or who had a score below cut-off ($n = 58$, 41 %), we added the clinician-rated AUS and DUS. For nine participants the clinicians gave a score of 3 or higher on the AUS and/or the DUS, and we classified these participants as having problematic substance use. In addition, we identified three participants with missing AUS and DUS as having problematic substance use based on the clinician-rated assessment of substance abuse in the life situation and health-questionnaire.

Thus, 84 (59 %) participants had problematic substance use, while 58 (41 %) did not. The most commonly used substances were alcohol ($n = 54$, 74 %), amphetamine ($n = 34$, 54 %) and cannabis ($n = 30$, 52 %).

After 2 years with the ACT teams, 78 patients (93 %) still had problematic substance use. Four (7 %) of the 58 participants who were originally classified as not having a problem met the criteria for problematic substance use on follow-up, while six of the 84 participants (7 %) who had problematic substance use upon ACT enrolment no longer met the criteria after 2 years.

The mean scores ± SD on the AUDIT (16.2 ± 7.7) and the DUDIT (22.8 ± 10.0) for those who scored above cut-off again indicated severely problematic substance use at 2 years follow-up.

Table 1 presents the characteristics of each group upon ACT enrolment. Participants with problematic substance use were more likely to be of Norwegian origin, under involuntary outpatient treatment, and to have a lower level of educational achievement than participants without problematic substance use. They also had more severe psychiatric symptoms, in particular manic/agitated symptoms, and poorer functioning than participants without problematic substance use.

Changes in hospitalisation

Of the 142 participants in our study, 128 (90 %) were admitted to mental health hospital in the 2 years before and/or the 2 years after being taken on by the ACT teams. A total of 14 participants (10 %) were not admitted at all. Of these 14 participants, nine (64 %) did have problematic substance use while five (36 %) did not. Table 2 shows the mean number of new admissions, mean total inpatient days and mean involuntary inpatient days in the 2 years before and the 2 years after ACT enrolment for all participants with and without problematic substance use. According to the linear mixed models unadjusted for patient characteristics, the mean number of new admissions did not change after ACT enrolment in either group, but both groups experienced reduction in total inpatient days. Patients with problematic substance use also had fewer involuntary inpatient days after being taken on by ACT.

Associations between problematic substance use and changes in hospitalisation

We found only small differences between the ACT teams regarding changes in all hospital outcomes, as indicated by the low intra-class correlation coefficients (new admissions 2.7 %, total inpatient days 3.7 %, and involuntary inpatient days 1.4 %), but we adjusted all models for cluster effects.

No significant interactions occurred between problematic substance use and the adjustment variables (demographic characteristics [age, gender] or clinical characteristics [BPRS four factors, GAF-S, GAF-F and PSF]).

The multivariate exploratory linear mixed models showed no associations between problematic substance

use and changes in the number of new admissions or involuntary inpatient days but significant associations with change in total inpatient days emerged (Table 3). Symptom severity and functioning levels influenced these associations.

Less severe symptoms were associated with greater reduction in total inpatient days amongst participants without problematic substance use, but no association occurred between symptom severity and changes in total inpatient days amongst participants with problematic substance use (see Fig. 1).

Participants with less seriously impaired functioning (GAF-F score 45 or above) and problematic substance use experienced a reduction in total inpatient days while participants without problematic substance use with similar functioning level accrued more inpatient days in the 2 years with ACT compared to the 2 years before (see Fig. 2).

Additionally, amongst participants with more severely impaired functioning (GAF-F score up to 50) and problematic substance use, better functioning was associated with greater reduction in total inpatient days. This association was not found amongst participants with problematic substance use and less severely impaired functioning or amongst participants without problematic substance use.

We explored the linear mixed models further by adjusting for the change in status of 10 participants regarding their problematic substance use (six participants who had problematic substance use upon ACT enrolment no longer met the criteria after 2 years and four who did not have problematic substance use originally had developed these at the 2 year assessment point). The results remained unchanged.

Discussion

A total of 84 (59 %) participants had problematic substance use when they enrolled into the ACT teams and after 2 years with ACT, 78 (93 %) participants still had ongoing, severe substance use.

We found no changes in the number of new admissions after the participants enrolled into the ACT teams, but total inpatient days decreased. Participants with problematic substance use also had fewer involuntary inpatient days during ACT follow-up.

Exploratory analyses showed that changes in total inpatient days differed for participants with compared to participants without problematic substance use, and symptom severity and functioning level upon ACT enrolment influenced these changes.

Changes in hospitalisation

Our results confirm earlier reports in that total inpatient days were reduced during ACT, but without significant

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Table 1 Socio-demographic and clinical characteristics of participants with and without problematic substance use on ACT enrolment

Socio-demographic characteristics:	Non-substance group (N = 58)		Substance group (N = 84)		P-value
	N	%	N	%	
Sex (male)	34	59.6	60	71.4	0.151[a]
Age, *mean (SD)*	41.7 (11.7)		38.4 (9.6)		0.068[c]
Ethnicity					0.001[a]
Norwegian	38	70.4	76	92.7	
Marital status					0.056[b]
Unmarried	38	65.5	68	81.0	
Married/cohabitant	5	8.6	7	8.3	
Divorced	15	25.9	9	10.7	
Education					0.003[b]
Completed primary school	29	55.8	47	58.8	
Completed upper secondary school	13	25.0	31	38.8	
Completed higher education	10	19.2	2	2.5	
Employment status					0.291[b]
Unemployed	45	77.6	73	86.9	
Competitive job/study	5	8.6	3	3.6	
Other	8	13.8	8	9.5	
Living situation					0.625[b]
Alone	38	65.5	53	63.9	
With family	14	24.1	17	20.5	
Staffed housing/supported housing/Institutions (hospital, prison, hospice)/Homeless/unstable living situation	6	10.3	13	15.7	
Clinical characteristics:					
Diagnosis					0.710[a]
Severe mental illness (yes)	47	95.9	77	92.8	
Community treatment order (yes)	13	22.4	38	45.8	0.005[a]
Age of onset psychiatric illness, *mean (SD)*	27.3	9.4	24.8	8.1	0.135[d]
Psychiatric symptoms, *mean (SD)*					
BPRS mean total score, *mean (SD)*	2.24	0.66	2.60	0.86	0.015[d]
BPRS positive symptoms, *mean (SD)*	2.23	1.14	2.65	1.34	0.075[d]
BPRS negative symptoms, *mean (SD)*	2.59	1.18	2.43	1.14	0.432[d]
BPRS agitation mania, *mean (SD)*	1.78	0.77	2.42	1.19	0.001[d]
BPRS anxiety/depressive symptoms, *mean (SD)*	2.63	1.10	2.77	0.95	0.425[c]
Global level of functioning – symptom scale (GAF-S), *mean (SD)*	43.6	10.6	39.8	9.8	0.032[c]
Global level of functioning – functioning scale (GAF-F), *mean (SD)*	40.8	8.6	38.9	8.1	0.161[c]
Level of functioning (PSF), *mean (SD)*	4.63	1.62	4.05	1.50	0.033[c]

[a]Fischer's Exact Test
[b]Chi-square
[c]Student's *T*-test
[d]Mann–Whitney *U* Test

reduction in the number of admissions [9]. The reduction in total and involuntary inpatient days amongst participants with problematic substance use occurred despite on-going substance use. This may be explained by their high level of inpatient service use before being taken on by the ACT teams. [9] Our findings indicate that ACT

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Table 2 Hospitalisation during two years before and after ACT: participants with and without problematic substance use

		Before taken on by ACT		After taken on by ACT		Change before-after taken on by ACT		
		Mean	SD	Mean	SD	Mean[a]	95 % confidence interval	P-value[b]
New admissions	Non-problematic substance use[c]	2.79	3.06	2.78	5.07	0.05	−1.31 to 1.40	0.945
	Problematic substance use[d]	3.71	4.48	3.26	4.48	0.45	−0.68 to 1.57	0.436
Total inpatient days	Non-problematic substance use[c]	106.12	133.83	50.55	57.18	58.24	7.83 to 108.64	0.024
	Problematic substance use[d]	131.15	167.51	69.01	88.54	64.09	21.90 to 106.28	0.003
Involuntary inpatient days	Non-problematic substance use[c]	51.53	116.51	20.78	40.07	29.96	−14.92 to 74.83	0.191
	Problematic substance use[d]	101.05	163.09	47.57	75.99	55.69	19.16 to 92.22	0.003

[a]Positive means indicate mean reduction in outcome after being taken on by ACT compared to before while negative means indicate mean increase in outcome
[b]Analyses of change using linear mixed models, unadjusted model
[c]Non-substance group *n* = 58 (41 %), [d] Substance group *n* = 84 (59 %)

successfully reduces inpatient service use amongst patients with and patients without problematic substance use.

Changes in inpatient service use could also be influenced by temporal changes in national policies and bed availability. This threat to validity emerges particularly in uncontrolled pre-post studies such as ours. From 2009 to 2013, a reduction of only 13 % in inpatient mental health beds and 15 % in total inpatient days occurred in Norway [38], and fluctuations in the number of involuntary inpatient days were minor [39]. Additionally, national data from 2009 [40] to 2013 [38] showed that high users of inpatient services, the majority of whom suffer severe mental illness like schizophrenia, spent an average of 75–83 days in hospital per year. This is similar to the level of total inpatient days per year in the 2 years before ACT in our study but almost twice as high as the number of total inpatient days per year during the ACT follow-up. This suggests

that national changes in policies and bed availability cannot fully explain the reductions in our study and that the changes do not represent temporal effects. However, we cannot exclude that the changes observed in this study are regression to the mean.

Qualitative data have suggested that the ACT teams identified participants in an early state of relapse, thereby avoiding severe deteriorations that might have required long-term admissions [41].

Participants may also have been discharged earlier because of the availability of support and services from high intensity ACT teams.

Associations between problematic substance use and changes in hospitalisation

Exploratory linear mixed models showed no associations between problematic substance use and changes in the number of new admissions, or between

Table 3 Linear mixed models: Associations between problematic substance use and changes in hospitalisation (*n* = 128)

Variables	New admissions		Total inpatient days		Involuntary inpatient days	
	Regression coefficient (SE)	p-value	Regression coefficient (SE)	p-value	Regression coefficient (SE)	p-value
Problematic substance use (Y/N)	0.35 (0.91)	0.698	−113.00 (151.19)	0.456	56.30 (30.21)	0.065
BPRS Positive symptoms	0.35 (0.45)	0.439	−11.01 (16.23)	0.499	−13.93 (14.78)	0.348
BPRS negative symptoms	−0.45 (0.38)	0.230	19.83 (13.97)	0.159	17.70 (12.71)	0.166
BPRS agitation mania	0.56 (0.51)	0.277	−34.80 (19.49)	0.077	−35.55 (17.35)	0.043
BPRS anxiety/depressive symptoms	−0.88 (0.43)	0.042	−20.58 (15.24)	0.180	−19.15 (14.18)	0.180
GAF-S	0.16 (0.07)	0.027	3.46 (3.38)	0.308	−2.45 (2.36)	0.301
GAF-F	−0.12 (0.08)	0.151	−9.18 (4.38)	0.037	−0.68 (2.80)	0.809
PSF	−	−	15.02 (11.40)	0.191	8.68 (10.16)	0.395
Age	0.01 (0.04)	0.819	−1.95 (1.56)	0.214	−0.46 (1.45)	0.754
Gender	−0.58 (0.89)	0.514	51.78 (32.46)	0.114	53.40 (29.41)	0.072
Problematic substance use*GAF-S			−8.25 (4.52)	0.071*		
Problematic substance use*GAF-F			12.31 (5.77)	0.035*		

*P-values below 0.10 were considered significant for interactions

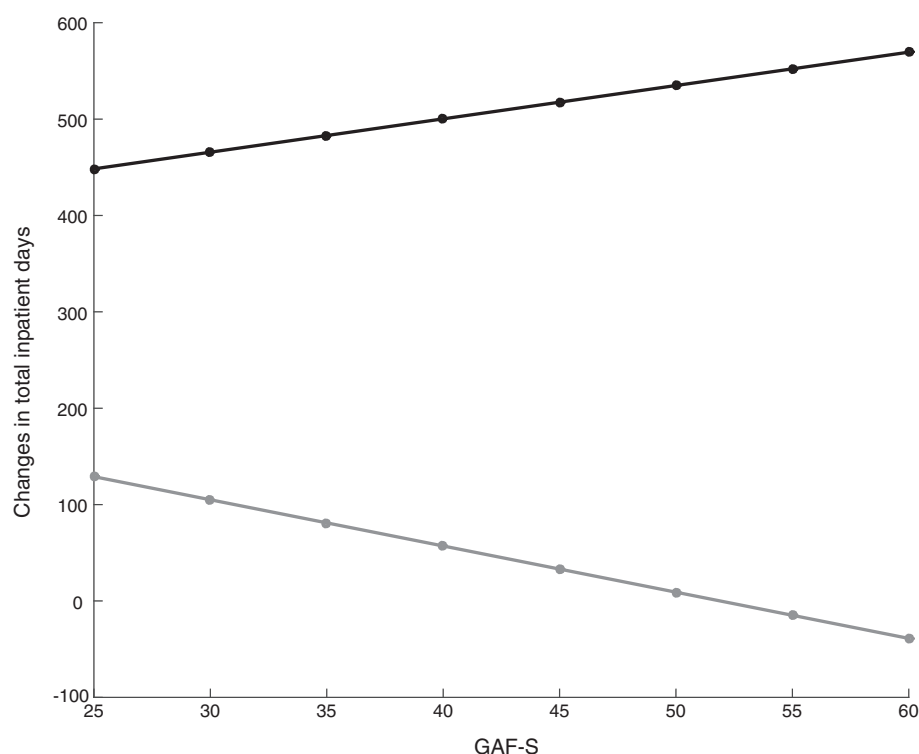Clausen *et al. BMC Psychiatry* (2016) 16:125

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Fig. 1 Association between changes in total inpatient days and level of symptoms for both groups: *Black line*: Participants without problematic substance use. *Grey line*: Participants with problematic substance use

problematic substance use and change in involuntary inpatient days despite a significant reduction amongst participants with problematic substance use and not amongst participants without problematic substance use. However, total inpatient days changed differently for participants with problematic substance use compared to those without in the sense that symptom severity and functioning level influences these changes.

These results were from exploratory analyses performed in a small sample, aiming to generate hypothesis. This aspect of our study may be under-powered and need replication before conclusions can be drawn.

Strengths and limitations
Strengths of our study included: data from 12 ACT teams operating in both urban and rural areas across Norway; instruments with good psychometric properties; and 4 years of longitudinal data. Weaknesses included: the observational design, which weakens causal interpretations; the high rate of non-participation that could lead to an overestimation of change in hospitalisation in one or both groups because fewer patients with more severe illness participated.; potential errors in the data from the Norwegian Patient Register; all

teams were newly established which may have had positive effects in that the ACT staff were motivated, enthusiastic and had (at least in the start-up phase) a low patient:staff-ratio. The negative effects may be that they implemented an unfamiliar model (to the Norwegian health system), did not have all necessary resources in place and lacked skills and training in providing evidence based treatment. Further limitations were the use of clinician-rated instruments and the large number of clinicians involved in the assessments; and the presumed accuracy of our multi-method diagnosis of problematic substance use which may have caused an under- or over representation of people with problematic substance use and thereby influenced an under- or overestimation of change in hospitalisation.

Conclusion
This study found that participants with and without problematic substance use had significant reductions in inpatient days during the ACT follow-up. In addition, those with problematic substance use also had fewer involuntary inpatient days, despite on-going problematic substance use. These findings may suggest that ACT teams successfully support people with
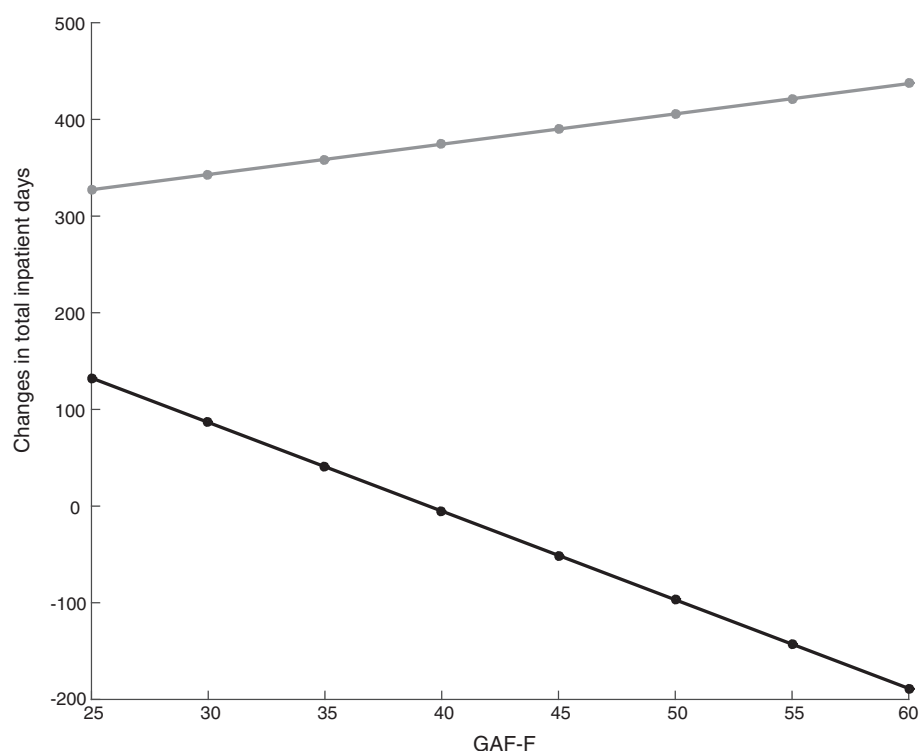
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Fig. 2 Association between changes in total inpatient days and level of functioning for both groups: *Grey line*: Participants with problematic substance use. *Black line*: Participants without problematic substance use

complex mental health problems in the community, including those with problematic substance use, and thereby contribute to a reduction in inpatient service use.

Ethics and consent to participate

The Regional Committee for Medical and Health Research Ethics Health Region South-East approved the study (ID: 2010/1196a) and all participants included in this paper have given written informed consent to participate after the ACT teams explained the procedure to them.

Consent to publish

Not applicable.

Availability of data and materials

The written consent from the participants does not allow for distribution of the data file to others than the research group that conducted the study. Other researchers that want access to the data may contact the principal investigator (TR), who will answer whether the requested data may be made available in a form that does not violate the written consent from the participants.

Abbreviations

ACT: Assertive Community Treatment; AUDIT: Alcohol Use Disorder Identification Scale; AUS: Alcohol Use Scale; BPRS: Brief Psychiatric Rating Scale; DUDIT: Drug Use Disorder Identification Scale; DUS: Drug Use Scale; GAF: Global Assessment of Functioning (GAF-S: symptom scale, GAF-F: function scale); ICD-10: International Statistical Classification of Diseases and Related Health Problems 10th Revision; IDDT: Integrated Dual Disorder Treatment; MINI Plus: Mini International Neuropsychiatric Interview Plus; PSF: Practical and Social Functioning; SAS: Statistical Analysis System; SCID-I: Structured Clinical Interview for DSM-IV Axis I Disorders; SD: standard deviation; SPSS: Statistical Package for Social Science; TMACT: Tool for Measurement of Assertive Community Treatment.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

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