PNEUMONIA CASE FATALITY RATE IN CHILDREN UNDER-FIVE: UNDERSTANDING VARIATIONS IN DISTRICT HOSPITALS IN MALAWI

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A thesis submitted in partial fulfilment of the requirements for the degree of
Master of Philosophy in International Community Health

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Abstract

Pneumonia case fatality rate in children under-five: Understanding variations in District Hospitals in Malawi

Background

The Acute Respiratory Infections (ARI) programme in Malawi aims to reduce pneumonia deaths among children under-five years of age. Pneumonia standard case management is implemented through the Child Lung Health Project. After 24 months a significantly reduced pneumonia death rate has been observed throughout the districts where the programme has been implemented, however, the reduction has varied from district to district. In some districts the pneumonia case fatality rate was reduced by 60%, while in others it was less than 10%.

Aim of the study: Was to investigate reasons for pneumonia case fatality rate variations in the different district hospitals in Malawi.

Methods: This was a retrospective study of all children less than five years admitted in the district hospitals with a cough and difficult breathing from 1st July 2002 until 30th June 2003. A total of 6480 children were admitted. Of the 6480 children, 6202 (95.7%) met the study criteria. Out of 6202 children, 523 children died (8.7% CFR). We also conducted structured interviews with district health management team members on health service delivery at the district hospitals. Logistic regression was applied to measure the effect of the patient related factors and examine the health service delivery factors on pneumonia deaths with adjustement for potential confounders. Adjustement for age and sex was made to separate the effect of the study factors on pneumonia deaths.

***Results**: We observed that case fatality rate was twice as high in Thyolo (14.1%) and in Machinga (14.6%) compared with Dedza (7.3%). In Mulanje the case fatality rate was lowest (4.9%) among the ten districts studied. The risk of death changed little after adjustment for age and sex. However, after adjusting for severity of disease at admission, the increased risk in Thyolo and the decreases risk in Mulanje were attenuated and no longer significantly different from Dedza. This implies that there were more children with very severe pneumonia admitted in Thyolo. On the other hand, the increased risk in Machinga persisted and increased risk was also found in Salima. After adjusting for missing doses of antibiotics in addition to age, sex and severity of disease, the risk of death in Machinga was almost twice* *that of Dedza, while in Ntcheu, Mulanje, Kasungu and Salima it was lower than Dedza. This implies missing doses was the main problem. Possible causes of variations in pneumonia case fatality rate across districts in this study include the admission of more severely ill children and missing doses of antibiotics.*

Conclusion: The findings contribute to the hypothesis that pneumonia case fatality rate variations are influenced by district service delivery factors. The results suggest some evidence for improving within-hospital management to reduce pneumonia deaths. If the children could receive the prescribed doses of antibiotics, the outcome may improve.

Key words (MeSH)*: community-acquired pneumonia, children under five years, patient related and health service delivery factors.*

PREFACE

Malawi is currently implementing a Project called Child Lung Health. The project is incorporated into Malawi's existing structure for organisation of health services and is implemented by personnel already working within the paediatric inpatient wards and outpatient, under 5 clinics. The project's goal is to reduce child deaths from respiratory diseases, particularly pneumonia. Pneumonia is the second biggest killer of children under-five years of age in the country.

Almost 20,000 children have been registered with the project during the period of September 2000 to July 2003. Overall, the pneumonia death rate has dropped from 17% to less than 10%, with case fatality reduction ranging from 10% to 60% across different districts. In light of these figures, the programme seeks to improve treatment outcomes in the districts that continue to have high pneumonia death rates, and sustain the reductions in the districts that have achieved lower death rates since the programme began. '***To us it is data but to the family it is one more life saved,'*** *Most Reverend Archbishop Desmond Tutu keynote address during the SADC region International Conference September 2003, Lilongwe, Malawi.* Operational research is, therefore, crucial for the ongoing improvement of the programme. The operational research is designed to improve case management, care seeking behaviour and improve accessibility for effective care for children suffering from common diseases, such as ARI, which claim so many children's lives in Malawi.

This research is part of the effort to improve the care of children with cough and/or difficult breathing in children less than five years of age. The formulation of the specific research area was a collective effort on behalf of the project workers, the UNION, academics and the

Ministry of Health and Population, with a goal to improve child survival in Malawi. Children are our future nation.

Thorough analysis of this research data resulted in sharing intermediate results at a policy level, district level and at the UNION, to facilitate improved intervention services that will ultimately save more lives.

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This study would not have materialized had it not been for the financial support from the NORAD program.

LIST OF ABBREVIATIONS

AIDS……………….………Acquired Immunodeficiency Syndrome

ARI…………………………Acute Respiratory Infections

CI……………..……………..Confidence Interval

CFR…………….…………Case Fatality Rate

CHAM………………………Christian Hospital Association of Malawi

CLHP……………………….Child Lung Health Project

CMR…………………………Child Mortality Rate

DHMT……………………….District Health Management Team

EHP………………………….Essential Health Package

GDP………………………….Gross Domestic Product

HIV…………………………..Human Immunodeficiency Virus

IM……………………………Intramuscular

IMCI…………………………Integrated Management of Childhood Illness

IMR………………………….Infant Mortality Rate

IUATLD/UNION…………..International Union against Tuberculosis and Lung Diseases

IV…………………………….Intravenous

MOHP……………………….Ministry of Health and Population

NORAD……………………...Norwegian Agency for Development Cooperation

OR……………………………Odds Ratio

PCP…………………………Pneumocystis carinii pneumonia

SCM…………………………Standard Case Management

SPSS…………………………Statistical Package for Social Science

STI……………………………Sexually Transmitted Infection

WHO…………………………World Health Organization

GLOSSARY

ARI: is an acute infection of the ear, nose, throat, larynx, trachea, bronchi, bronchioles or lung.

Childhood: for the purpose of this study is defined as under age 5 (i.e. 0-59 months of age).

Chest in-drawing: when the lower part of the chest (lower ribs and lower sternum) depresses as one breathes in. It is a sign of severe pneumonia, a wheeze condition or croup.

Pneumonia: an acute infection of the lungs. It's severity is classified according to clinical signs.

Young infant: child less than 2 months.

Case Fatality Rate (CFR): rate of death, expressed as percentage (numerator being total deaths and denominator being total cases, within a given period).

Standard Case Management: the first stage of the process involves assessing a child with cough or difficult breathing and subsequently classifying them according to severity of the condition (very severe pneumonia or very severe disease (for children less than 2 months), severe pneumonia, non-severe pneumonia (pneumonia), or no pneumonia/cough or cold). The second stage involves giving the child appropriate treatment and supportive care according to severity and age.

Staff turnover: the movement of health workers that were trained in pneumonia standard case management to another district or place during the time of data collection.

Health worker: medical doctors, clinical officers, medical assistants and nurses.

Health services delivery: the management and organization of services provided by the district hospital. Factors isolated in this study included allocation of health workers trained in pneumonia case management, organization of the paediatric ward, monitoring of very sick children, drugs and supplies availability, health facilities in the districts, communication service, practice of pre-referral treatment prior to hospitalization, financial resources, disease profile for common causes of illness and death among children under-five years of age, and HIV prevalence.

Associated conditions: other infections or conditions, such as malaria, malnutrition, anaemia, that also occurs with pneumonia.

District Hospital: secondary health care facility that provides comprehensive health care in the district catchment's population and is financially supported by the government.

Age groups: categorized as less than 2 months of age, 2 to 11 months and 12 to 59 months.

Missing dose: when a child does not receive the prescribed dose at the correct time e.g. 6 hourly, 8 hourly or 12 hourly, and subsequently continues receiving the same antibiotic after the missing dose/s for some time before discharged, or death. Missing doses are classified as an absence of a tick or signature on the pneumonia inpatient record treatment section, or on the treatment sheet.

Supportive care: includes controlling temperature, nutrition, daily maintenance of fluids, providing oxygen when required.

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CHAPTER 1 INTRODUCTION

Acute respiratory infections, predominantly pneumonia, are one of the leading causes of death amongst young children in developing countries (1-6). The World Health Organization estimated 10.8 million children aged under-five years died in 1998, with approximately 99% of from the developing world. About 3 million deaths were attributable to acute respiratory infections (ARI) (5). In 2002 ARI contributed 18% of deaths in this age group (7). In Malawi, ARI contributed to 25% of deaths among hospitalized children in 2001 (8). ARI is the second most common cause of outpatient attendances among children under-five years and is one of the three most common causes of hospital deaths (9) and account for 18% of hospital admissions (8) in Malawi.

Hospital-based data from Malawi indicated that the impact of ARI on mortality remains unacceptably high. In our quest to reduce pneumonia-related deaths, Malawi has begun to implement the Child Lung Health Project, which is based on the International Union Against Tuberculosis and Lung Diseases: Management of the child with cough and/or difficult breathing: A guide for low income countries (10). It incorporates the World Health Organization (WHO) ARI programme case management (11) and Management of the child with a serious infection or severe malnutrition: Guidelines for care at the first referral level in developing countries (12). The project is in collaboration with International Union Against Tuberculosis and Lung Diseases (IUATLD) hereafter referred to as the UNION.

The technical rationale for implementing the project by the UNION is that standard case management of children with pneumonia by trained staff with a regular supply of effective antibiotics should result in a significant decline of deaths in district hospitals. The programme applies the UNION model for successful public health service for tuberculosis, to the problem of respiratory disease amongst children in low-income countries.

In the districts implementing the project, pneumonia case fatality rates ranged from 11% to 28% at the time of initiation. Since its inception pneumonia deaths among children under-five years have declined in many of these districts regardless of initial rates. The overall national reduction rate was 39.7% (13). Each district is monitored through the collection of routine data. It has been observed that pneumonia case fatality reduction varies from district to district. In the districts where this study was conducted variations in pneumonia case fatality rates were found to be significantly different with some districts achieving a reduction of well above 60%, some just above 30% and others below a 20%. This study was designed to understand the differences and to identify factors that contribute to the variations in the pneumonia case fatality rate when applying the WHO standard case management. These reductions in mortality were achieved despite the HIV/AIDS situation in the country. Districts can manage to reduce childhood pneumonia deaths by addressing the most important areas in the health service delivery and patient related factors.

As background to this research several studies were reviewed, namely:

1.1 A literature review to find out what is known about how to reduce pneumonia mortality and to address the causes and risk factors. How childhood pneumonia is management in small hospitals.

A MEDLINE search was done in order to find relevant articles and original reports on pneumonia in children. In addition textbooks and readers in child health, pediatrics and health care in developing countries were read, refer to the references listed.

Key words: Community-acquired pneumonia, risk factors and health service delivery.

1.1.1 The WHO global programme for control of ARI

Concern about the important contribution of ARI deaths to overall mortality was raised at the World Health Assembly in 1976 and at this time WHO Geneva established a Technical Advisory Group on ARI and a global programme for control of ARI. The central objective was to reduce the severity of, and mortality, from pneumonia (2-4, 14). Global efforts on mortality control focus on ARI case management and improving the coverage of immunization (14, 15). Case management intervention studies demonstrated substantial impact by treating children with inexpensive antibiotics (3).

1.1.2 ARI Standard Case Management (SCM)

ARI standard case management means a child with cough or difficult breathing is correctly assessed using the clinical signs (e.g. respiratory rate, chest in-drawing), and the danger signs (convulsions, sleepy/difficult to awake, unable to breastfeed/ drink, stridor). The child is classified according to severity of the condition (very severe pneumonia, or very severe disease (for children less than 2 months), severe pneumonia, non-severe pneumonia

(pneumonia), or no pneumonia/cough or cold). Then the child is treated with appropriate treatment and supportive care according to severity and age (12, 6, 14, 16). Several case management interventions studies have demonstrated sustainable impacts (6). It is estimated that standard case management can reduce child mortality by 20%. Pneumonia–specific mortality can be reduced by 50% (17, 4) when standard case management is used and guidelines are adhered to (18).

1.1.3 Use of antibiotics

Many studies have been conducted on the etiology of bacterial pneumonia and in the developing countries it has been confirmed that *Streptococcus pneumoniae* and *Haemophilus influenzae* are the most common bacterial agents of community-acquired pneumonia (19, 6, 20, 21). In Malawi, the situation is similar (22, 23). However, viruses cause the majority of community-acquired pneumonia. In developing countries the result of studies on viruses in ARI have varied greatly, but show the presence of viral infection in up to 50 per cent of childhood pneumonia patients with a considerable proportions of combined viral and bacterial infections with more than one virus at the same time (14).

Most young children in developing countries carry pneumococci *(Streptococcus pneumoniae)* and *Haemophilus influenzae* in their upper respiratory tract, which are the most common causes of severe pneumonia. Empirical therapy is capable of curing pneumonia due to *Streptococcus pneumoniae*. The WHO developed simple treatment guidelines and encouraged developing countries to adopt and promote these guidelines for small hospitals (11, 15). Malawi also developed drug standard guidelines (24).

1.1.4 Risk factors

A number of risk factors related to the host and environment increase the morbidity and/or mortality from pneumonia (3, 14). These include: low birth weight, malnutrition, lack of immunization or low socioeconomic status and poor hygiene (25-28). A study in Yemen found that risk factors such as malnutrition, rickets and nutritional anaemia influenced pneumonia-specific case fatality rate (27). Anaemia and malnutrition are risk factors related to children with severe pneumonia (26).

1.1.4.1 Young age

Pneumonia mortality is highest during the first year of life being three-to ten folds higher than between the ages 1 to 4 years (14). Many studies confirmed high deaths rates during the first year twelve months (26-28) of life.

1.1.4.2 Associate conditions (or co-morbidities)

ARI do not always occur alone, but may be in association with other infections or conditions, such as malnutrition, diarrhoea or chronic conditions (25, 1, 4). Several clinical studies have highlighted difficulties in distinguishing malaria and pneumonia in children with cough, fever and fast breathing in Africa (5). In Malawi, common complaints amongst the under-five outpatients are fever, cough and diarrhea and it is not uncommon to find a child with co-infection including pneumonia (29).

Recent studies have also shown that HIV contributes to a high pneumonia mortality rate in children (30). In Malawi, a study conducted in Blantyre, one of the big cities in the southern region, showed that *Pneumocystis carinii* pneumonia (PCP) is common and contributes to the high mortality from pneumonia in Malawian children (23).

1.1.5 Health service delivery

A study in Zambia showed that case management of pneumonia was inconsistent despite both pre-service and in-service training programmes. Health workers were not using treatment protocols, despite their availability in the health institutions (28). Case fatality rate for pneumonia in Yemen remained unchanged over five years despite extensive efforts to improve case management for inpatients by adopting the WHO-ARI programme and conducting several workshops on ARI case management. Banajeh (27) concluded in his paper that several factors contributed to the high, case fatality rate (CFR) therefore remained unchanged. He indicated that malnutrition, rickets and nutritional anaemia were risk factors for developing and dying from pneumonia. Other factors that could have explained the unchanged CFR were attributed to multi-drug resistance to streptococcal pneumoniae (27).

Health service delivery needs to be addressed if we are to effectively reduce child mortality. Duke et al (25) stated that addressing the commonest causes of death could reduce child mortality. These causes include underlying disease states, microbial pathogens, adverse social circumstances and health service failure. Health service failure include failing to carry-out standard treatment, or treatment delays for the severely ill patients, not giving oxygen when needed, prolonged stays in hospital, inappropriate early discharge and failure to correct severe anaemia. Systematic mortality audits are useful for settings priorities and providing continuous feedback on the quality of care provided and the outcome of health reforms (25).

CHAPTER 2 BACKGROUND

The study described in this document was conducted in ten district hospitals in Malawi.

2.1 COUNTRY PROFILE, MALAWI

Malawi is a landlocked country situated south of the equator in sub-Sahara Africa in the east of southern Africa. It lies between latitudes 9ºS and 17ºS, and longitudes 33ºE and 38ºE. It is bordered to the north and northeast by the United Republic of Tanzania; to the east, south, and southwest by the People’s Republic of Mozambique; and to the west and northwest by the Republic of Zambia.

The country is 901 kilometres long and ranges in width from 80 to 161 kilometres. It has a total area of 118,484 square kilometers of which 94,276 square kilometres is land area. The remaining area is mostly composed of Lake Malawi, which is about 475 kilometres long and runs down Malawi's eastern boundary with Mozambique. The country is divided into three regions: the North, Central and South. There are 27 districts in the country: six districts in the north, nine districts in the center and twelve in the southern region. Districts are further subdivided into Traditional Authorities, each covering groups of villages that constitute the smallest administrative units in the country. Districts are also subdivided into constituencies, which are the smallest political administration areas represented by a Member of Parliament.

Malawi has a tropical, continental climate with maritime influences. Rainfall and temperature vary depending on altitude and proximity to the lake. From May to August the weather is cool and dry. From September to November, the weather becomes hot. The rainy season begins in October or November and continues until April.

2.2 Population and demographic characteristics

Malawi has experienced continued population growth over the years. The latest population census in 1998 showed a total population count of about 10 million. The total population increased by 24% over the ten-year period from 1987 to 1998. This represents a growth rate of about 2%. The average population density is 105 persons per square kilometre however it varies considerably at regional level. The north has 46, central region 114 and the south has 144 persons per square kilometre (31).

The population of Malawi is largely rural; about 86% of the population lives in the rural areas and 14 percent live in urban areas. Eleven percent of the total population live in four major urban areas (Lilongwe, Blantyre, Zomba and Mzuzu) and only 3 percent live in other urban areas, which mostly consist of district headquarters, referred to as BOMA (31).

The population of Malawi is young. According to the 1998 population census, nearly half of the total population (44%) is under 15 years of age while persons aged 65 years and above make up only 4%. Children under five years account for about 17% and infants aged less than one- year account for about 4% of the total population. The mean age of the total population is 22 years. Life expectancy at birth is 40 years for female it is 44 years, for males it is 40 years. The infant mortality rate is 104/1000 live births; the under- five mortality rates is 189/1000 live births (9) and maternal mortality ratio is 1120 per 100,000 live births women (32).

2.3 Economy

Malawi is classified as a low-income country (33). The country suffers inequities in the distribution of income, with over sixty percent of the population living below the absolute poverty line (9). Agricultural products are the main source of income. Agricultural produce accounts for 35% of the GDP, 93% of export earnings are primarily from tobacco, with tea and sugar also being major exports commodities (9). Manufacturing accounts for only 13-14% of GDP, other industry for 20%, with other services accounting for the remainder. In the World Development Report 2003, Malawi was ranked as low-income. The Gross National Income (GNI) is US$170 per capita (34).

2.4 Overview of health care delivery system

Nearly all formal health care services in Malawi are provided by three agencies. The Ministry of Health and Population (MOHP) provides 60% of these services. The Christian Health Association of Malawi provides 37% and the Ministry of Local Government provides 1%. Other providers, namely private practitioners, commercial companies, Army and Police, provide 2% of health services (9). The Christian Health Association of Malawi (CHAM) is the major government partner in health care delivery and is subsidized by the government through an annual grant for personnel emoluments. CHAM is made up of independent church-related and other private voluntary agency.

Health services are provided at three levels: primary, secondary and tertiary. At the primary level, services are delivered through rural hospitals, health centres, health posts, outreach clinics and community initiatives such as Drug Revolving Funds. The primary level represents the first point of contact for health care services at the community level. Each district except three has a district hospital owned by government. District hospitals provide secondary level health care services. The secondary level mainly functions to backup the activities of the primary level by providing surgical backup services, mostly for obstetric emergencies, general medical and pediatric inpatient care for acute conditions. At present, tertiary level hospitals provide services similar to those at secondary level, along with a small range of specialist surgical and medical interventions. CHAM provides almost, all types of health services and some have specialist functions. However, CHAM health services require user fees for services with few exceptions. These include growth monitoring, immunization, and community based preventive services that include treatment for specific communicable diseases such as TB, STI and leprosy.

One year after the Alma Alta conference in 1978, the government endorsed the concept of Primary Health Care as the main health service delivery strategy in achieving the worldwide health theme of "Health for all by the year 2000". The Ministry of Health and Population (MOHP) develops 5 or 10 year plans that address emerging policies, goals, objectives and strategies of the government and follow the world goals. In the fourth National Health Plan (1999-2004) it indicated major health service delivery challenges. These included low geographical access with only 46% of the population living within 5-kilometre of a health facility. By the year 2000, there were about 510 primary health care facilities accessible to the general public, each serving an average of about 16,000 persons (34). These health facilities are inequitably distributed (9). Shortages and maldistribution of trained health personnel was another major problem experience. Between 1990 and 1996 there were only 2 physicians and 6 nurses per 100,000 people (35). The Ministry has inadequate resources with inefficient resource allocation at less than four US Dollar per capita (9). Shortage of essential drugs, medical supplies and equipment were reflected in the plan. Maternal mortality rate has remained unchanged for ten years and child mortality rates have only marginally improved.

2.5 Child mortality and morbidity in Malawi: The Burden

Malawi's health indicators are among the worst in the world (32, 9). Under-five mortality is unacceptably high. It is estimated at 189 per 1000 live births and infant mortality rate is estimated at 104 per 1000 live births (9). The average pattern of mortality shows that 22% of these deaths occur during the neonatal period, while 33% occur during the postnatal period and over 45% of deaths occur at 1-4 years (9). Causes of illness and deaths in children under five are malaria, respiratory infections especially pneumonia, malnutrition, diarrhoea diseases and anaemia (9).

Malawi strives to reduce the high childhood death rates and this was reflected in the MOHP National Health Plan (1999-2004). The plan aimed to reduce infant mortality rate from 134 to 100 per 1000 and under-five mortality rate from 234 to 150 per 1000 live births. In view of the National Health Plan the ARI programme, through the MOHP, made proposals to several donor agencies for assistance, the UNION through a grant from Bill and Melinda Gates Foundation responded to the request for technical and financial assistance and started the implementation of the Child Lung Health Project (CLHP) in Malawi. It is a five-year project (2000-2004) covering all district hospitals in the country. To date all districts hospitals, with the exception of 3 new districts without government hospital, are implementing the project.

2.6 District profile

The district hospital is a basic unit of management for planning, logistics, quality assurance and report. A district health officer heads it. Prior to the implementation of the project, situational analyses were conducted in five district hospitals. Results indicated that the main causes of morbidity and mortality in children less than five years of age were malaria, anaemia and pneumonia while malnutrition was endemic. Case management was not strictly followed as no severity classification of pneumonia was performed. Records of inpatient admissions were not sufficiently detailed to indicate other outcome aside from discharged well, death or absconded. This did not satisfy the project information system. The treatment outcome was required to enhance the ability of the district health team to evaluate and improve their health services. Oxygen supply for pediatric care was not readily available. Prior to implementation of the programme districts are assessed. The district hospitals studied Nkhatabay, Dedza, Ntcheu, Thyolo, Mulanje and Rumphi, Kasungu, Salima, Balaka and Machinga were enrolled in September 2000 and March 2001 respectively. Some of the characteristics of the districts are summarized overleaf:

District	Nkhata-Bay	Dedza	Ntcheu	Thyolo	Mulanje
Population Under five population IMR CMR Average bed occupancy rate	209,250 41,850 119/1000 38/1000 Up to 400%	490,383 96,631 Not known Not known 200-300%	513,000 87,210 Unknown Unknown Up to 200%,	464,858 79,026 Unknown Unknown Up to 200%	428,000 65,200 175/1000 Unknown Up to 200%
Staff available Nurses in pediatric ward	1 MD, 4 CO, 4 MA, 27 Nurses 1-2 Nurses per shift	1 MD, 9 CO, 4 MA, 25 Nurses 1Nurse per shift	1MD, 9 CO, 1 MA, 31 Nurses 1Nurse per shift	0 MD, 5CO, 0 MA, 29 Nurse 1Nurse per shift	1 MD, 8 CO, 2 MA, 43 Nurse 2 Nurses per shift
Health worker(s) trained in CDD/ARI SCM	No records	No records	No records	No records	No records
Leading causes of	Malaria	Malaria	Malaria	Malaria	Malaria

pediatric admission	Pneumonia	Pneumonia	Pneumonia	Pneumonia	Pneumonia
Leading causes of deaths	Malaria Pneumonia	Malaria Pneumonia	Malaria Pneumonia	Malaria Pneumonia	Malaria Pneumonia Severe malnutrition
Pneumonia CFR (Oct-Dec 2000)	17.2	27.9	13.8	21.4	19.0

	Rumphi	Kasungu	Salima	Balaka	Machinga
Population Under five population IMR CMR Average bed occupancy rate	135,294 23,000 28/1000 38/1000 200-300%	493,000 88,707 177/1000 Unknown Up to 400%	338,952 59,687 167/1000 Unknown 200-300%	289,011 51,031 Unknown Unknown Up to 200%	393,283 66,858 173/1000 229/1000 Up to 150%
Staff available Nurses in pediatric ward per shift	0 MD, 5 CO, 2 MA, 22 Nurses 1-2 Nurses	1 MD, 7 CO, 1 MA, 24 Nurses 0.5 Nurse	0 MD, 7 CO, 2 MA, 24 Nurses 2 Nurses	0 MD, 4 CO, 1 MA, 24 Nurses 2 Nurses	1 MD, 12 CO, 2 MA, 48 Nurses 1 Nurses
Health worker(s) trained in CDD/ARI SCM	15 trained in CDD/ARI case management	43 trained in IMCI	No records	No records	No records
Most leading causes of deaths in order of priority	Malaria Pneumonia Meningitis Anaemia Malnutrition	Malaria Pneumonia Anaemia Diarrhoea Meningitis	Malaria Pneumonia Malnutrition Anaemia Gastroenteritis	Malaria Pneumonia Anemia HIV/AIDS Tuberculosis	Malnutrition Anaemia Malaria Pneumonia Meningitis
Pneumonia	10.9	15.1	19.5	15.9	16.9

CFR (April-June 2001)					

Key MD= Medical Doctor, CO= Clinical Officer, MA= Medical Assistant

2.7 Prevalence of ARI in the under fives

Globally ARI causes an estimated four million deaths in children annually, of which more than 90 percent occur in developing countries (14). It is estimated that the incidence of ARI is 5-9 episodes/child /year in the first 5 years of life, which is the same in developing and developed countries (22, 4). In the recent Malawi Demographic and Health Survey 2000 showed that the prevalence of respiratory illness varies according to age with the highest prevalence occurring at 6-11 months. Sex was not associated significantly with ARI prevalence. ARI prevalence was much higher in the rural areas (28 percent) than in the urban areas (16 percent) and was slightly higher in the central region than in the northern and southern regions. Prevalence ranged from 9% to 34% in different areas. The same survey showed that 27% of children under five were ill with cough and short, rapid breathing sometime during the two weeks preceding the survey (32).

2.8 Existing ARI Control Programme in Malawi/Child Lung Health Project (CLHP)

Malawi has had a functional ARI control programme since 1985. The programme's strategy is to improve standard case management for respiratory infections, especially pneumonia. The programme did not have adequate funds to conduct it's activities. Now the MOHP in collaboration with the UNION are implementing the CLHP. The Project is incorporated into Malawi's existing structure for organisation of health services and is implemented by the personnel already working within the services of the paediatric inpatient wards and outpatient under-five years' old clinics. The project aims to improve care at the hospital level. Its target is to reduce pneumonia case fatality rate by 30% (36). The project's impact is monitored by routine data collection and analysis, and feedback information is provided to the district staff. The information system contains epidemiological data and allows monitoring of standard case management provided to children admitted with cough and difficult breathing. A standardized pneumonia record form is used across all districts included in the project. The record form has demographic information, including history of illness; signs and symptoms, weight, temperature, classification, treatment regime and outcome of treatment refer annex 2. Full analysis of case management outcome is analyzed monthly. Recording and reporting of outcomes assist the district hospitals to order standardized drugs and supplies for the management of children admitted with cough and/or difficult breathing.

In each district involved in the project, ten health workers are trained to improve their skills on standard case management (SCM). The training is a five-day clinical course on diagnosis and treatment, standardized drugs and other supplies to treat and manage pneumonia cases. Districts are supplied with appropriate drugs and supplies to manage pneumonia cases. To avoid interrupted supply of drugs and other supplies, a monthly report of cases is used to order drugs for the following month with additional buffer stocks being included. One-day follow-up visits are conducted four to six weeks after the training to support the district in setting up the SCM, and extensive supportive visits are conducted every month for six months to help the district establish the clinical case management. Every three months, visits are done to monitor the SCM. Every six months there is an evaluation conducted by external consultants from the UNION. At each of these visits, reports and recommendations are made. In each district, there is a district coordinator who is either a clinical officer or a nurse. Districts are encouraged to have in-service training to orient other health workers on the SCM.

Records for pneumonia cases managed were not reliable prior to the inception of the project. Pneumonia cases were not classified following the WHO classification of very severe pneumonia, severe pneumonia, pneumonia or non-severe pneumonia. Almost all cases admitted were indicated as severe pneumonia or just pneumonia. For this reason we could not use the baseline pneumonia case fatality rate as a measure of success or failure later during the implementation. Therefore, a decision was made to use the first three months of project implementation to obtain a baseline. The project provided inpatient pneumonia recording forms, which are used as patient record. Patient’s names and all the particulars are recorded in a district inpatient pneumonia register. Cases management can be assessed and data compiled using these records.

There was a profound change in the practice of case management of pneumonia in children admitted with cough or difficult breathing that resulted in decline of pneumonia deaths. After six months of implementation pneumonia case fatality rate had been reduced in all the districts. A closer review by end of 2002 (24 month period) has revealed that pneumonia case fatality rate reduction was different amongst the district hospitals. In the first phase districts, two districts had achieved well above 50%, reduction, one district over 30%, two districts above 20%. Amongst, the second phase districts, one district showed above 50% reduction; one district above 30%; one above 20% and two districts were below 10%.

2.9 Justification of the study

The ARI programme in Malawi aims to reduce pneumonia deaths among children under-five years of age as declared by the World Summit (33, 13) and as Malawi is implementing SCM can we expect to reduce pneumonia–specific mortality and lower the overall child mortality. This research was aimed at understanding differences and identifying factors that contribute to the variation in the pneumonia case fatality rate while applying WHO SCM. Most of the studies reviewed in the literature did not evaluate performance of health workers in relation to the WHO guidelines for SCM. Quality of care was not evaluated in relation to allocation of available resources, hospital organization and management (37-38). This study was designed to understand reasons for pneumonia case fatality and the differences amongst the various districts. It focused on factors associated with health services delivery in the hospital setting and patient related risk factors. The findings of the study are descriptive and hopefully will assist decision makers at all levels of health delivery to address some of the problems in the provision of quality care (39, 40, 21). The overall reduction in pneumonia deaths will lower the unacceptably high number of deaths in children. The ultimate goal is to improve child health care in Malawi.

CHAPTER 3 RESEARCH QUESTION, HYPOTHESIS AND OBJECTIVES

3.1 Research question

Why are the pneumonia case fatality rates in children under- five years of age varied from district to district in Malawi?

3.2 Research hypothesis

The null hypothesis was that pneumonia case fatality rate is not due to health services delivery factors. The alternative hypothesis was pneumonia case fatality rate is influenced by district service delivery factors.

The MOHP, at national level supports the districts to improve their standard of care by training the staff in SCM, as well as providing drugs and supplies. However, district hospital, as an implementation unit, organizes their own health service management. It is possible that the variations in the case fatality rates between the various hospitals may be related to the level of care in delivery of the SCM in each district. In addition, variation could be explained by different exposure to the related risk conditions such as malaria, malnutrition, anemia and HIV, between different districts.

3.3. Broad objective of the research:

To study pneumonia case fatality rates in the district hospitals in Malawi.

3.3.1 Specific objectives

To establish pneumonia case fatality rate in the districts.

To examine how SCM is delivered in the district hospitals.

To measure patient related risk factors such as age, gender, severity, or associated conditions in a child with cough and/or difficult breathing by district.

To study health service delivery factors in relation to pneumonia case fatality.

To examine how much of the pneumonia case fatality rate can be explained by patient risk factors and/or the health service delivery factors.

CHAPTER 4 METHODS AND MATERIALS

4.1 Study setting

The study was conducted in district hospitals in Malawi where there is paediatric inpatient care for common acute conditions. Districts that are implementing Child Lung Health Project were studied. They were enrolled in September 2000 and April 2001. The districts are from the all the three regions of the country. Nkhatabay and Rumphi districts are from the northern region, Kasungu, Dedza, Ntcheu and Salima districts are from the central region and Balaka, Machinga, Thyolo and Mulanje districts from the southern region(refer annex 1 Map of Malawi). The study was conducted from the beginning of August to the end of November 2003.

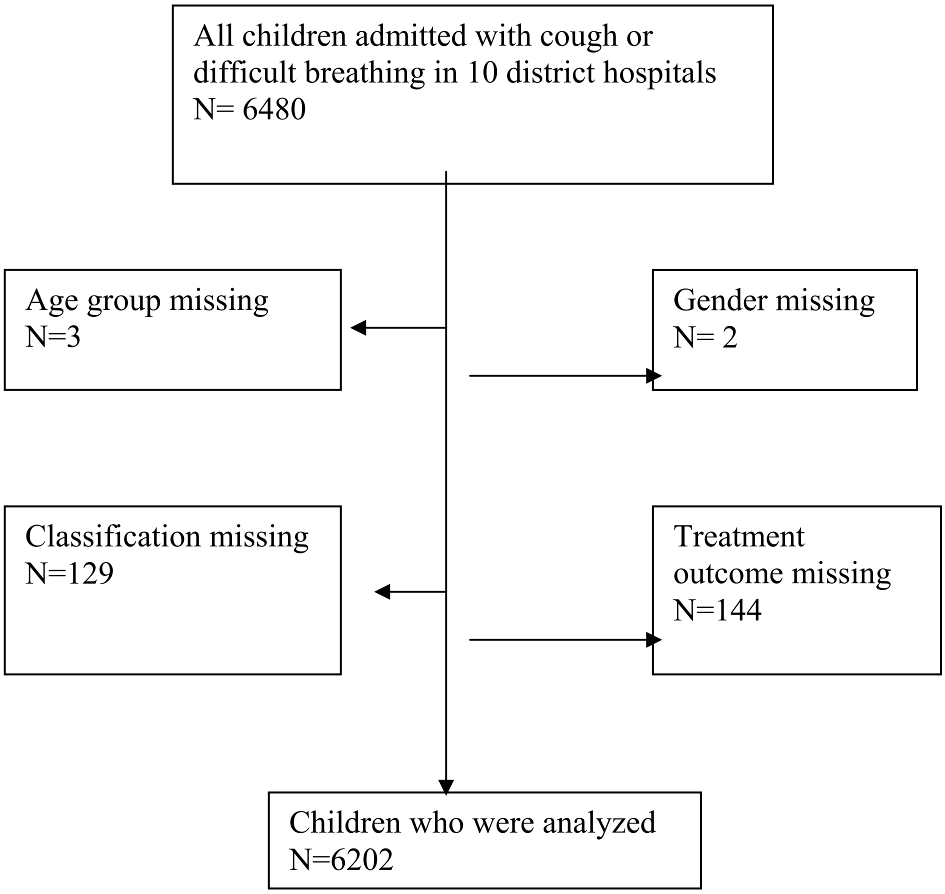
4.2 Research design

This was a retrospective study. We reviewed the pneumonia recording forms for all children admitted with cough or difficult breathing from 1st July 2002 to 30th June 2003. We also reviewed the drug availability in the districts during the study period. To minimize possible information biases and be accurate, we also reviewed supervisory reports for this purpose. We reviewed the common causes of admissions and deaths in children under-five in the districts by reviewing the disease profile from the health information records and conducted interviews with some members of the district health management team to provide information on health service delivery.

4.2.1 Study population

This included all children less than five years admitted in the district hospitals with cough and/or difficult breathing from 1st July 2002 up to 30th June 2003. A total of 6480 children were admitted over a period of twelve months. According to our study we evaluated pneumonia inpatient recording forms which had age, sex, classification of illness and treatment outcome recorded. Of the 6480 children, 6202 (95.7%) met these criteria (Figure 1). The study was based on the remaining 6202. Of these 523 children died.

Figure 1 Children admitted with cough and/or difficult breathing in ten district hospitals July 2002-June 2003



In examining the health service delivery a total of three members from each hospital were interviewed using a structured questionnaire (Annex 3). Respondents were purposely chosen who could provide the district service delivery information. These included the district matron, the In-charge for the paediatric ward and the district hospital administrator. Face-to-face interviews were conducted to obtain good response. To minimize information recall bias the respondents were free to use supportive documents related to their field.

4.2.2 Sampling method

Districts that had implemented the project for one year or more at the time of research designing were eligible. These districts were chosen because they would have gained experience in SCM and could be compared against each other. All districts that were enrolled in September 2000 and in April 2001 were therefore studied. These districts were from all the three regions of the country.

4.2.3 Inclusion criteria

The inclusion criteria for cases were children aged 2 weeks to 59 months, admitted with cough or difficult breathing from 1st July 2002 through 30th June 2003. Children who had used pneumonia inpatient recording forms as their main source of patient record and were recorded in the pneumonia district register were studied. The inclusion criteria for respondents to the questionnaire were senior staff members of the district hospital involved in district management. However, participation was voluntary, and all agreed to participate and signed consent form (Annex 4).

4.2.4 Exclusion criteria

Children who were admitted with cough and/or difficult breathing in other hospitals in these districts were excluded. Also infants less than 2 weeks of age admitted in departments of the hospital other than the pediatric ward and those who did not have pneumonia inpatient recording form as the main patient record were excluded from this study.

4.3 Data collection exercise

Permission to perform the study was granted by the MOHP and the officer in charge of Community Health Sciences Unit. At the district level courtesy calls were done to the District Health Officer and permission requested for their staff to be interviewed and to collect pneumonia inpatient recording forms for the entire period of study. The data collection was carried out from 5th August to 30th November 2003. The data were collected on Mondays-Fridays. We conducted face-to-face interviews with the respondents using the pre-tested questionnaire. Interviews lasted for one hour and were conducted in respondents' working environment. Respondents were allowed to refer to their working documents to avoid recall biases. The data collectors went into the paediatric ward and made some observations, which were recorded on the questionnaire. With the ARI District coordinator, pneumonia inpatient recording forms were verified in the pneumonia district register and were collected for data entry at the central unit. Supervisory reports for the study period were collected and information extracted relevant information for this study. Other reports such as the District Health Information System 2002 annual report and 2001 National HIV/AIDS Control Programme sentinel report were also used.

The researcher and one assistant collected all the information. The research assistant received one week's training in interview techniques, how to verify the recording forms *collected and to collect other relevant information for this study. The training was given during the pilot phase of the questionnaire.*

4.3.1 Pilot study

A pilot study was carried out in order to identify potential problems and revise the methods before the onset of the actual data collection. The aim was to test the questionnaire to find out if questions were understood and if they were in an appropriate sequence. The pilot study took place in two districts that were also implementing the project (Mchinji and Ntchisi district hospitals annex 5). A total of six respondents participated and 90 pneumonia inpatient recording forms were collected in this exercise.

After pre-testing the questionnaire was revised. An example of a subsequent change is that we revised the data sheet to include the names of the health workers trained and not simply the number of health workers trained in pneumonia case management. The districts were only asked to verify the staff trained. This assisted the respondent to recall all the health workers trained in their particular district. It was not possible to get the actual numbers of children under-five years of age admissions for a common illness such as malaria, at the district level. Subsequently, we decided to use the national statistics information, as it was possible to retrieve 2002 information by district.

4.3.2 Research tools

Two research instruments were used:

(i). Pneumonia inpatient record form (Annex 2) provided demographic information, including history of illness, signs and symptoms for classification, associate conditions, treatment regimes, and treatment outcome for every child admitted. This information provided an indication as to what extent SCM is practiced in each district. However, only relevant information for this study was extracted.

(ii). Questionnaire (Annex 3). The questionnaire was pre-tested, structured questionnaire with closed and open-ended questions. The questionnaire was written in English. It’s major content included information about district health delivery services: district demography, including district budget; number of health workers trained in pneumonia case management turn-over; organization and monitoring of severe cases in the pediatric ward; procedure manuals and charts; drug availability and supplies. The questionnaire also included information on district disease profile for the most common causes of illness and death among children under five years old, and the HIV/AIDS prevalence among adults (15-49 years old).

4.4 Definitions used in the data collection

Below are definitions used on the pneumonia inpatient record form and data handling, either to evaluate the SCM practiced at the district hospitals or to report the cases analyzed in this study:

The total pneumonia cases managed were evaluated and expressed in percentage

1) Age: measured in months and grouped as recommendation by WHO into; (i) less than 2 months, (ii) 2-11 months and (iii) 12-59 months.

2) Gender: male or female

3) The treatment outcome. a) Cured/treatment completed: Course of antibiotics completed and child fully recovered.

b) Failure cases at 48 hours or at 120 hours: Failure was defined as worsening of fast breathing, worsening of chest in-drawing, development /persistence of abnormal sleepiness or difficulty in awakening, development/inability to drink or poor breastfeeding.

c) Death within 24 hours of admission or death after 24 hours after admission. Case fatality rate was calculated from the total death against total cases admitted

d) Left against advice: Child removed from the hospital against medical advice before treatment was completed.

e) Transferred: child was referred for treatment to another health facility and the result of treatment was not known. When the result was known, the result was recorded in place of transfer.

f) Treatment outcome unknown: when caretaker did not return with child for follow-up visit once antibiotic(s) were finished.

As for this study children were analyzed whether alive or dead after treatment. We have calculated the pneumonia case fatality rate. We have examined the pneumonia case fatality rate with the research variables.

4) Classification for a child with cough or difficult breathing (see below figure 2):

Figure 2 Classifications for children with cough and/ or difficult breathing

Age	Classification	Signs and symptoms
Child 2 to 59 months	Very severe pneumonia	v Chest in-drawing plus at least one of the following: v Central cyanosis v Unable to drink/breast feed vConvulsions/lethargy vSevere respiratory distress
	Severe pneumonia	vFast breathing vChest in-drawing
	Pneumonia	vFast breathing

Infant Less than 2 months	Very severe pneumonia/severe pneumonia	v Fast breathing vSevere chest in-drawing vStopped feeding well vAbnormally sleepy or difficult to wake vNasal flaring vWheezing vFever >37.5°C vLow temperature <35.5°C vCentral cyanosis vGrunting

6) Breathing rate per minute

Age in Months	Child has fast breathing:
< 2	If >60 breaths per minute or more
2-12	If >50 breaths per minute or more
12-59	If >40 breaths per minute or more

7) Treatment regime refer below figure 3

Figure 3 Treatment Guideline for children with cough and /or difficult breathing

Age	Classification	Treatment and dosages
Child 2 to 59 months	Very severe pneumonia	chloramphenicol 25mg/kg every 8 hours IM or IV until child has improved and then oral suspension at the same dose a 125mg/5ml suspension to complete 10 days.

	Severe pneumonia	benzylpenicillin 50000units/kg intramuscularly every 6 hours (for at least three days) and then oral amoxicillin 15mg per kg every 8 hours (to complete 5 days of antibiotic treatment)
	Pneumonia	Oral cotrimoxazole 4mg/kg trimethoprim 20mg/kg sulfamethoxazole twice a day for 5 days
Infant Less than 2 months	Very severe pneumonia/severe pneumonia	benzylpenicillin 50000 units /kg every 6 hours (After 1 week of life) for at last four days then switched to oral amoxicillin for five days and gentamicin 7.5mg/kg (after 1 week of life) once a day for 8 days

8) Associated conditions or co-morbidity conditions in a child with pneumonia were taken from the recording form as recorded by the clinician who made a final diagnosis for the case. Laboratory results were also taken if they were recorded on the form. The associated conditions were:

a) Malaria… clinical diagnosis indicated on pneumonia inpatient record form
b) Anemia… clinical diagnosis indicated on pneumonia inpatient recording form
c) Malnutrition…clinical classification indicated on pneumonia inpatient recording form

Health workers are included medical doctors, clinical officers, medical assistances, registered nurses and enrolled nurses or community nurses.

4.5 Variables

Characteristics of a child
Age in months (numerical) then categorized to age group: Less than 2 months, 2-11 months and 12-59 months.

Gender: male or female

Body weight measured to the nearest 100gram. Children were measured with clothes on.

Axillary temperature measured in centigrade

Respiratory rate calculated as number of breaths per minute

Standard Case Management (SCM)

Practice of health workers in classifying a sick child

Their use of the clinical signs and symptoms to match with the classification

Their use of appropriate antibiotics to matching with the classification

Their use of tick or initials on the treatment schedule indicating that treatment dose was given to the child

Antibiotic drug measured as

Dosage in units or milligram or grams

Treatment outcome per child

Treatment completed, left against advice, died within 24 hours of admission, failure at 48 hours of treatment, transferred, died after 24 hours of admission, failure at 120 hours of treatment, and outcome unknown.

Other information
HIV status, measles during the past 2 months, and severe malnutrition

Careseeking behaviour
Number of days of signs and symptoms on admission

Self-referral

Referred
District referral management

Antibiotic treatment prior to coming to hospital

Staff-turn over
Number of health workers trained in pneumonia SCM available at the district hospital

District Health delivery services
Demography: population of the district and also the under-five population, number of health facilities in the district (including other health facilities apart from the government health facilities). The district hospitals were evaluated if they had effective communication with other health facilities in their catchments. We evaluated the number of working radio communication devices or telephone each district.

Placement of heath workers after special training

Practice of changing of health workers from one department to another (expressed in months)

Number of health workers working in pediatric department, per day shift and night shifts.

Organization of the pediatric ward

Drugs and logistics available for pneumonia case management by quarter

Procedure manuals, tables and charts availability by quarter

Disease profile: most common causes of morbidity and mortality for children under- five years of age

Frequency of monitoring very sick children expressed in hours

Annual budget: Percentage of annual budgeted money received from the government during the financial year 2002

HIV prevalence profile: estimated from adults (15-49 years) infected with HIV up to 2001.

4.6 Data handling and analysis

Statistical Package for Social Science (SPSS, version 13) was used for all statistical procedures and analysis (41). Data clerk entered the data in the field from the second week of August to first week of September 2003. The researcher was checking the quality of data entered by retrieving data from the computer and recording the information on a new recording form. This was done on every 30th pneumonia recording form. About 98% of pneumonia record forms were correctly entered. The 2% with errors were mostly due to difficulty reading, handwriting of the health workers, and the errors were rectified. Chi square test was used to test significance between variables. Multiple logistic regressions were used to measure independent effect of each variable on case-management outcome. The Odds Ratio (OR) and 95% confidence intervals were calculated to estimate the risk (including significance testing) after adjustment for confounders (age, sex, district etc). The OR might be regarded as an estimate of relative risk in situations when the endpoint studied. Otherwise the OR over estimates the relative risk.

4.7 Ethical considerations

The study received ethical clearance by the “Regional Committee for Medical Research, Health Region West, Norway”. The Malawi MOHP, Research Unit approved the study. The Officer In-Charge for Community Health Sciences Unit and at the districts hospitals the district health Officers authorized data to be collected.

CHAPTER 5.0: THE STUDY RESULTS

The results include findings from review of pneumonia inpatient recording forms of children admitted with cough and/or difficult breathing from 1st July 2002 to 30th June 2003 (12 months period) and information through a questionnaire and observations done during data collection. The data was collected in ten district hospitals throughout Malawi in 2003.

A total of 6480 children aged 2 weeks to 59 months were hospitalized in the ten districts with cough and/or difficult breathing. Pneumonia inpatient recording forms that did not indicate age, classification or treatment outcome were excluded from this study. Among the study population, 6202 (95.7%) had adequate information and were included in the analysis for this study (refer figure 1).

5.1 General descriptive data

5.1.1. Demographic characteristics of the children studied

Out of the 6202 children studied 3310 (53.4%) were males and 2892 (46.6%) females. The number of children that died was 523 (8.4%). Of these deaths, 249 (47.6%) were males and 274 were female (52.4%). The death rate amongst females was 1.3 times higher than amongst males (table 1).

Table1. Pneumonia case fatality by gender of children admitted with cough and/or difficult breathing in ten district hospitals in Malawi, July 2002-June 2003.

N=6202

Sex	Cases	Deaths	CFR (%)	Odds Ratio*	95% confidence interval
Male	3310	249	7.5	1.00	Reference
Female	2892	274	9.5	1.31	1.09-1.56

*Adjusted for district and age

The children were categorized into three age groups: less than 2 months (16.9%), 2 to 11 months (45.8%) and 12 months to 59 months (37.3%). Case fatality rate in young infants (<2 months) was more than twice as high compared with children in the 12-59 months age group while in children between 2-11 months it was 1.9 times higher compared to the children 12-59 months. (table 2).

Table2. Pneumonia case fatality rate by age group
N=6202

Age in Months	Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence Interval
<2	1049	113	10.8	2.32	1.78-3.04
2-11	2839	283	10.0	1.94	1.60-2.47
12-59	2314	127	5.5	1.00	Reference

*Adjusted for district and sex

The children studied were classified according to the severity of the condition. Children aged 2-59 months who presented with cough and fast breathing were classified as non-severe pneumonia (pneumonia); children with chest in-drawing and /or fast breathing were classified as having severe pneumonia; children with fast breathing and had one or more of the danger signs (convulsions, sleepy/difficult to awake, unable to breastfeed/ drink, stridor) were classified as having very severe pneumonia. The classification for children less than 2 months was as follows: severe pneumonia if they presented with fast breathing and severe chest in-drawing; very severe pneumonia if they presented with fast breathing, severe chest in-drawing and any of the danger signs (stopped breast feeding well, abnormally sleepy, central cyanosis, grunting or low or high fever) refer to classification figure 2.

Of the children studied 30.8% presented with very severe pneumonia, 67.5% with severe pneumonia, and 1.7% with non-severe pneumonia. Only one child had PCP (0.02%).

Children who were classified as presenting with very severe pneumonia had a higher case fatality rate. It was around 6 times greater than in the children classified as severe pneumonia. Few children were admitted with non-severe pneumonia (pneumonia) and 6 of them died. A higher case fatality rate for non-severe pneumonia compared to children who had severe pneumonia was observed, but the difference was not significant (table 3).

Table 3 Severity of pneumonia cases and death rates

N=6202

Classification	Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence interval
Very severe Pneumonia	1903	367	19.3	6.52	5.28-8.04
Severe Pneumonia	4191	150	3.6	1.00	Reference
Non-severe Pneumonia (Pneumonia)	107	6	5.6	1.36	0.58-3.18

* Adjusted for district, age and sex

We further categorized the classification by age group: less than 2 months, 2-11 months and 12–59 months.

In children less than 2 months about half were classified as presenting with very severe pneumonia. In children 2-11 months, around one quarter presenting with very severe pneumonia. Similarly, in the 12-59 months age group around one quarter presenting with very severe pneumonia (table 4).

Table 4 Distribution of pneumonia severity by age group.
N=6202

Age in months	Classifications				Total
	Very severe pneumonia	Severe pneumonia	Non-severe pneumonia (Pneumonia)	Pneumocystis carinni pneumonia (PCP)	
<2	530	515	4	0	1049
2-11	802	1988	49	0	2839
12-59	571	1688	54	1	2314
Total	1903	4191	107	1	6202

5.1.2. Patient related risk factors

5.1.2.1. Associated conditions (or co-morbidities)

Of the 6202 children analyzed, 3130 (50.5%) presented with associated conditions apart from pneumonia. And of the 523 children that died, 291 (55.6%) of them had associated conditions.

In general, associated conditions were associated with poor outcome. However, malaria alone did not confer additional risk. On the other hand, malaria with anaemia or malaria with malnutrition was associated with considerably increased death rates, and so was malnutrition and anaemia without malaria (table 5).

Table 5 Children admitted with cough and/or difficult breathing and associate condition.

N= 6202

		Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence Interval
Children without associated Condition		3072	232	7.6	1.00	Reference
Children With associated Condition	Malaria	2077	111	5.3	0.91	0.71-1.13
	Malnutrition	65	16	24.6	5.04	2.66-9.55
	Anaemia	212	38	17.9	3.66	2.41-5.56
	Malaria and Anaemia	363	62	17.1	2.55	1.81-3.60
	Malaria and Malnutrition	26	7	26.9	6.56	2.50-17.20
	Others conditions	387	57	14.7	1.99	1.41-2.79

*Adjusted for age, sex, classification and district

We compared the pneumonia inpatient recording forms that indicated malaria with the laboratory results indicated on the recording forms. Of the children who had pneumonia with both malaria and anaemia or pneumonia with malaria or malnutrition, only 899 (36.5%) were tested for *Plasmodium falciparum* parasites (table 5 B). However, all the children who had a classification of malaria apart from the pneumonia were treated for malaria following the malaria treatment guidelines.

Table 5B: Number of children who had laboratory results for malaria

Malaria Parasite	Pneumonia& Malaria	Pneumonia& Malaria &Anaemia	Pneumonia& Malaria &Malnutrition	Total
Positive	401	152	7	560(22.7%)
Negative	281	55	3	339(13.7%)
Unknown	1217	132	14	1363(55.3%)
Information missing	178	24	2	204(8.3%)
Total	2077	363	26	2466

We also reviewed recording forms for those children who had both pneumonia with anaemia or pneumonia with malaria and anaemia. Only 146 (25.4%) children of 575 with these classifications were tested for haemoglobin concentration. Of the 146 children tested, 140 (96%) had severe anaemia (table 5C).

Table 5 C Number of children who had laboratory results for anaemia

Haemoglobin Concentration (g/dl)	Pneumonia& Anaemia	Pneumonia& Malaria &Anaemia	Total
1-5g/dl	56	84	140(24.4%)

5-9.3g/dl	2	1	3 (0.5%)
9.4+g/dl	3	0	3(0.5%)
Unknown	151	278	429(74.6%)
Total cases	212	363	575

5.1.3. Care-seeking behaviour and practice in the districts on providing antibiotic prior to hospitalization

The pneumonia record form provided information on the number of days prior to hospital admission that a child had signs and symptoms. The time period was recorded as less than 21 days or more than 21 days. This is in line with policy guidelines for the tuberculosis control programme in Malawi. The use of this pre-recorded data was a weakness because we could not determine the specific number of days. However, it provided information on acute verses chronic cough. There was a lower death rate amongst those that presented with an acute illness compared to chronic illness. The case fatality rate in the children, who were admitted with signs and symptoms for more than 21 days, was twice that of acute cases (table 6).

The case fatality rate for referred cases was twice high as compared to those that were not referred. The death rate tended to be higher amongst children who were given antibiotics prior to hospitalization compared to those that did not receive antibiotics. However, after adjusting for severity of diseases (classification), this increased risk vanished.

The case fatality rate for referred cases was twice high as compared to those that were not referred again the death rate was higher amongst children who were given antibiotics prior to hospitalization, than in those that did not receive antibiotics but the difference was not significant (table 6).

Table 6. Care seeking behaviour

N=5176

		Cases	Deaths	CFR (%)	P value	Odds Ratio*	95% confidence Interval
Number of days before Hospitalization	≥21 days	127	22	17.3	0.001	1.85	1.09-3.12
	<21 days	5049	387	7.7		1.00	Reference
Antibiotics prior to	Yes	1362	147	10.8	0.216	1.05	0.81-1.36

hospitalization	No	3814	262	6.9		1.00	Reference
Type of Referral	Self	4365	289	6.6	0.001	0.49	0.37-0.64
	Referred	811	120	14.8		1.00	Reference

*Adjusted for age, sex, classification and district

We reviewed cases that both were referred and received antibiotic prior to hospitalization. There was no statistically significant difference between those who received antibiotic prior to hospitalization and those that did not receive the antibiotic (table 7).

Table 7 Referred cases and antibiotic prior to hospitalization

N= 823

Antibiotic prior to hospital	cases	deaths	CFR (%)
Received	563	83	14.7
Not given	260	40	15.4

5.1.4 Standard Case Management (SCM)

We examined how the districts followed the pneumonia SCM. Three variables were used to evaluate pneumonia SCM including: correct classification, correct prescription of antibiotic, and correct dosage and frequency that the antibiotics were provided to the children in the districts hospitals.

5.1.4.1 Classification

Health workers assess and classify the sick children. A child presenting with cough and/or difficult breathing is assessed and classified according to signs and symptoms presented, confer figure 2. Of 3676 children classified with severe pneumonia, 3613 (98.3%) were correctly classified and 1.7% were incorrectly classified. Thirty-six (1%) of those incorrectly classified did not present with chest in drawing and another 27 (0.7%) children chest in-drawing was not indicated on their pneumonia recording form. High rates of correct classification for children with severe pneumonia were observed across all districts.

5.14.2. Identifying type of antibiotic treatment

When the severity of a child's illness has been classified, appropriate treatment is identified. Treatment guidelines for children vary across ages and severity of illness. Children less than 2 months receive benzylpenicillin and gentamicin, when they present with severe or very severe disease. Children aged 2-59 months receive chloramphenicol, when they present with very severe pneumonia, benzylpenicillin when they present with severe pneumonia and cotrimoxazole when they present with pneumonia, confer figure 3. In this study, we observed that some children were incorrectly treated. The death rate was higher amongst children that were incorrectly treated (table 8) but this did not apply to those with very severe pneumonia (table 8B).

Table 8 Correct or incorrect type of treatment and death rate
N=6201

Antibiotic treatment	Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence Interval
Correct	5147	395	7.7	1.00	Reference
Incorrect	1054	128	12.1	1.48	1.09-2.02

*Adjusted for age, sex, classification and district

Table 8B Correct or incorrect type of treatment prescribed for the classification
N=6201

	very severe pneumonia (N=1903)		severe pneumonia (N=4191)		non-severe pneumonia (N=107)	
	correct	incorrect	correct	incorrect	correct	incorrect
Cases	1390	513	3676	515	81	26
Died	272	95	121	29	2	4
CFR	19.6	18.5	3.3	5.6	2.5	15.4

5.1.4.3 Providing antibiotic treatment

We examined how antibiotics were administered to the children. Out of 6202 pneumonia recoding forms, 6094 (98.3%) were reviewed. A large proportion of children missed doses in the hospital with 25% missing 2 or more doses and about 39% losing a full day's course of treatment (table 9).

Table 9 Missing doses by classifications.

N = 6094

Classification	Cases analyzed	0-1 Missed Dose N (%)	2-3Missed Doses N (%)	4 or more Missed doses N (%)
Very severe Pneumonia	1844	1346(73.0)	360(19.5)	138(7.5)
Severe pneumonia	4146	3111(75.0)	744(18.0)	291(7.0)
Pneumonia	104	73(70.2)	20(19.2)	11(10.6)
Total	6094	4530(74.4)	1124(18.4)	440(7.2)

Missing doses were observed across all the age groups, with children less than 2 months experiencing the highest frequencies of 2-3 and 4 or more missed doses (table 9B).

Table 9 B Missing antibiotic doses by age group.

N = 6094

Age-group in months	Cases analyzed	0-1 missed dose N (%)	2-3 Doses N (%)	4 or more N (%)
<2	1015	663(65.3)	247(24.3)	105(10.3)
2-11	2797	2118(75.7)	480(17.2)	199(7.1)
12-59	2282	1749(76.6)	397(17.4)	136(6.0)
Total	6094	4530(74.4)	1124(18.4)	440(7.2)

The case fatality rate increased dramatic with increasing number of doses missed (table 9C). Children missing at least 2 doses constituted only a quarter of the children but 60% (284/474) of the deaths.

Table 9 C Case fatality rate in relation to missing doses of antibiotics
N= 6094

Frequency Of missing Dose	cases	died	CFR (%)	Odds ratio	95%Confidence Interval
0-1 doses	4530	190	4.2	1.00	Reference
2-3 doses	1124	187	16.6	6.47	5.02-8.33
4 or more	440	97	22.0	10.42	7.57-14.34

*Adjusted for age, sex, classification and district

The same pattern of case fatality rates in relation to missing doses were present across all classifications, but was higher in children classified with very severe pneumonia (tables 9 D and table 9 E).

Table 9 D Missing antibiotic doses in children classified with very severe pneumonia
N= 1844

Missing doses	Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence Interval
0-1 dose	1346	121	9.0	1.00	Reference
2-3 dose	360	141	39.2	9.28	6.68-12.89
4/+	138	67	48.6	14.87	9.68-22.83

* Adjusted for age, sex and district

Table 9 E Missing doses in children classified with severe pneumonia
N=4146

Missing doses	Cases	Deaths	CFR (%)	Odds Ratio*	95% Confidence Interval
0-1 dose	3111	66	2.1	1.00	Reference
2-3 dose	744	45	6.1	3.58	2.32-5.51
4/+	291	28	9.6	5.84	3.45-9.84

*Adjusted for age, sex and district

5.1.5. Health service delivery factors

Classification of children with cough and /or difficult breathing, prescribing of antibiotic treatment and giving of antibiotic relates to performance of the health workers examined health service delivery. A total of 30 respondents were interviewed in the ten district hospitals. These were the hospital administrator, the district matron and the nurse–in charge of the paediatric ward. We conducted interviews and made some observations in the paediatric ward to study and examine how much of the health service delivery factors influence on pneumonia case fatality rate. A structured questionnaire was used (refer annex 3).

Statistical analysis of health service delivery factors was carried out using X^2 test for comparing them with the observed differences in CFR. The variables are staff turnover, deployment of staff and drug availability in the different hospitals studied. Since these data was collected at the hospital level, and not could be related directly to the individual child, the association with CFR should be interpreted with caution.

5.1.5.1. Staff turnover

Health workers in the districts implementing the CLHP received training on inpatient pneumonia case management. In each district, ten health workers were trained when implementation started and a few additional health workers were trained later. A total of 122 Health workers were trained throughout the ten participating districts. After about 30 months of the training period some health workers were not working in the district hospitals any longer. During the data collection we found only that 53(43.4%) were available. Five (7.2%) health workers had died, 22(31.9%) had resigned from the civil service, 4(5.8%) had retired, 26(37.7%) were transferred out of the district and 12(17.4%) were on study leave (table 10).

Table 10 Staff turnover in the ten districts

District	Number trained	Available N (%)	Reasons for staff turnover				
			Died	Resigned	Retired	Transferred	Study Leave
Ntcheu	12	4(33)	0	4	0	4	0
Thyolo	14	4(29)	2	4	0	3	1
Machinga	13	5(38)	0	2	2	2	2
Mulanje	13	5(38)	0	2	0	5	1
Balaka	12	6(50)	0	5	0	1	0
Dedza	12	5(42)	0	1	1	4	1
Kasungu	11	6(55)	0	1	0	3	1
Rumphi	12	8(67)	1	1	1	0	1
Salima	11	4(36)	0	2	0	2	3

Nkhatabay	12	6(50)	2	0	0	2	2
Total	122	53(43)	5	22	4	26	12

5.1.5.2 Other health service delivery variables

Staffing levels

The minimum staffing level in the district hospitals was 27 health workers and the maximum was 51. One nurse on day duty was the minimum while the maximum was 2 nurses. For the night duty, the maximum was one nurse on duty and in some hospitals the nurse for the paediatric ward also managed other ward(s). Two clinical officers was the minimum and 5 the maximum for the hospitals.

We related the staffing levels to the pneumonia cases in this study. There was no clear pattern between total number of health workers and CFR. Neither was there a clear association between number of clinical officers and nurses on duty per shift, both day and night and CFR. There was no significant difference with the pneumonia deaths for both day and night shifts (table 11).

Table 11 Staffing levels in relation to pneumonia deaths in the districts
N=6202 except number of clinical officers in the hospital N= 6184

Variable	Cases	Deaths	CFR (%)	
Total health workers				
27	308	19	6.2	
32	938	78	8.3	
37	838	54	6.4	
38	2159	169	7.8	
42	720	105	14.6	
48	842	41	4.9	
51	397	56	14.1	
				p=0.000
Number of nurses working in the pediatric ward				
0	323	24	7.4	
4	1244	98	7.9	
5	1564	146	9.3	
6	2268	186	8.2	
7	803	70	8.7	
				p=0.579
Number of nurses on night duty shift				
1	5378	466	8.7	
Others	824	57	6.9	
				p=0.051
Number of nurses on day duty shift				
1	3820	332	8.7	
2	2382	191	8.0	
				p=0.190
Number of Clinical Officers in the hospital				
1	819	97	11.8	
3	613	43	7.0	
4	3433	275	8.0	
5	1319	108	8.2	
				p=0.002

Staffing levels and rotations were analyzed across the districts in this study. It was found that pneumonia CFR were twice as high when staff rotations occurred at random in comparison to regular, 3 monthly staff rotations (table 11 B).

We examined how health workers are deployed after attending a short course like IMCI, STI, and ARI. We observed that there was positive impact when the health workers were posted to the relevant department, than when was not deployed to the paediatric ward after the short course in pneumonia SCM (table 11 B).

Table 11 B. Deployment of staff
N=6202

Variable	Cases	Deaths	CFR%	
Clinical officers changing to other department				
3 months	3824	259	6.8	
6 months	1043	129	12.4	
12 months	516	38	7.4	
At random	819	97	11.8	
				p=0.001
Nurses changing to other ward/department				
3 months	838	54	6.4	
One year	5364	469	8.7	
				p=0.013
Health workers after training				
Returned to Previous ward/Dept.	1142	146	12.8	
Went to relevant ward/department				
As by training	5060	377	7.5	
				p=0.001

Most of the pneumonia inpatient recording forms did not indicate the HIV status. Of the 6202 recording forms we had reviewed less than 1% had the HIV status recorded (table 12).

Table 12 Recording of the HIV status on pneumonia inpatient recording form

N= 5883

HIV Status	Cases	Percentage
Positive	8	0.1%
Negative	35	0.6%
Unknown	5840	99.3%

5.1.5.3 Drug supply

The CLHP provide drugs and supplies to manage the pneumonia cases in the districts. The drugs are: chloramphenicol both injectable and oral suspension, benzylpenicillin, amoxicillin both as tablets, and oral suspension, cotrimoxazole paediatric tablet (Sulphamethoxazole/trimethoprim 100/20 mg), gentamicin 20mg vial, water for injection (5 ml ampoule), syringes with needles and dispensing bottles for the suspension drugs. During the study period, some districts did not have adequate stocks of drugs for the project in some quarters during the study period. And we observed that in those districts CFR was 1.55 times higher where benzylpenicillin was 75% available compared to 100% available (table 13).

Table 13 Drug availability in relation to CFR in the 12 months period (July 2002-June 2003). N=6202 except on Benzylpenicillin N=6201

Type of drugs available	Cases	Deaths	CFR (%)
Chloramphenicol injectable			
100% available	5091	434	8.5
75% available	1111	89	8.0
			p=0.312
Benzylpenicillin			
100% available	3249	217	6.7
75% available	2952	306	10.4
			p=0.000
Gentamicin			
100% available	5399	453	8.4
50% available	803	70	8.7
			p=0.399
Cotrimoxazole			
100% available	308	19	6.2
75% available	1455	116	8.0
50% available	3601	334	9.3
25% available	838	54	6.4
			p=0.018

5.2 Variations across the districts

To understand pneumonia CFR differences in the districts we examined the patient and health service delivery factors. Pneumonia case fatality rate for each district was established for the study period. Dedza was used as reference in the logistic regression model. We observed that the case fatality rate was twice as high in Thyolo (14.1%) and in Machinga (14.6%) compared to Dedza (7.3%), and in Mulanje the CFR was lower (4.9%), compared to Dedza. Other districts were in-between these rates (table 14).

Table 14 Pneumonia case fatality rates in the ten districts during July 2002-June 2003
N=6202

District	Cases	Deaths	CFR (%)	Odds Ratio	95% Confidence Interval
Ntcheu	803	70	8.7	1.22	0.87-1.71
Thyolo	397	56	14.1	2.10	1.45-3.03
Machinga	720	105	14.6	2.18	1.59-2.98
Mulanje	842	41	4.9	0.66	0.44-0.97
Balaka	323	24	7.4	1.03	0.64-1.65
Dedza	1033	75	7.3	1.00	Reference
Kasungu	838	54	6.4	0.88	0.61-1.26
Rumphi	516	38	7.4	1.02	0.68-1.52
Salima	422	41	9.7	1.37	0.92-2.05
Nkhatabay	308	19	6.2	0.84	0.50-1.41

The risk of death changed little after adjustment for age and sex (table 15). The percentage of children with very severe pneumonia differed between the districts (table in appendix). For example, in Thyolo 60% of the children had very severe pneumonia compared to the average of 31% in the total study population. After adjusting for severity of disease at admission, the increased risk in Thyolo and the decreased risk in Mulanje were attenuated and no longer significantly different from Dedza. However, the increased risk in Machinga persisted and increased risk was also found in Salima (table 15).

Table 15: Risk of death at the different hospitals for children admitted with cough and/or difficult breathing from July 2002-June 2003

N=6202

District	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
	Adjusted[a]		Adjusted b	
Ntcheu	1.19	0.84-1.67	1.12	0.79-1.60
Thyolo	2.01	1.39-2.91*	1.43	0.97-2.10
Machinga	2.18	1.59-2.99*	2.50	1.80-3.48*
Mulanje	0.58	0.39-0.86*	0.80	0.53-1.20
Balaka	0.96	0.59-1.55	1.32	0.81-2.18
Dedza	1.00	Reference	1.00	Reference
Kasungu	0.84	0.58-1.21	1.37	0.94-2.01
Rumphi	0.96	0.64-1.45	1.10	0.72-1.67
Salima	1.28	0.86-1.92	1.88	1.23-2.85*
Nkhatabay	0.80	0.48-1.35	0.99	0.58-1.69

([a]) Adjusted for age and sex. (b) Additional adjusted for pneumonia severity
* Significant

After adjusting for missing doses of antibiotics (in addition to age, sex and severity of disease), Machinga district still had an increased risk of mortality. In comparison, the odds ratios for Ntcheu, Mulanje, Kasungu and Salima were significantly lower than 1.00 (table 15B).

Table 15B Risk of death at the different hospitals after adjustment for missing antibiotic dose from July 2002 to June 2003

N=6094

District	Cases	Deaths	CFR (%)	Odds Ratio	95% Confidence Interval
Ntcheu	782	60	7.7	0.52	0.35-0.78*
Thyolo	395	54	13.7	1.17	0.77-1.78
Machinga	716	104	14.5	1.57	1.09-2.27*
Mulanje	837	38	4.5	0.42	0.27-0.67*
Balaka	320	21	6.6	0.63	0.36-1.11
Dedza	1024	70	6.8	1.00	Reference
Kasungu	811	50	6.2	0.37	0.24-0.58*
Rumphi	508	33	6.5	0.82	0.51-1.31
Salima	392	25	6.4	0.57	0.33-0.96*
Nkhatabay	308	19	6.2	0.83	0.47-1.46

Odds ratio adjusted for age, sex, classification, missed doses and district
* Significant

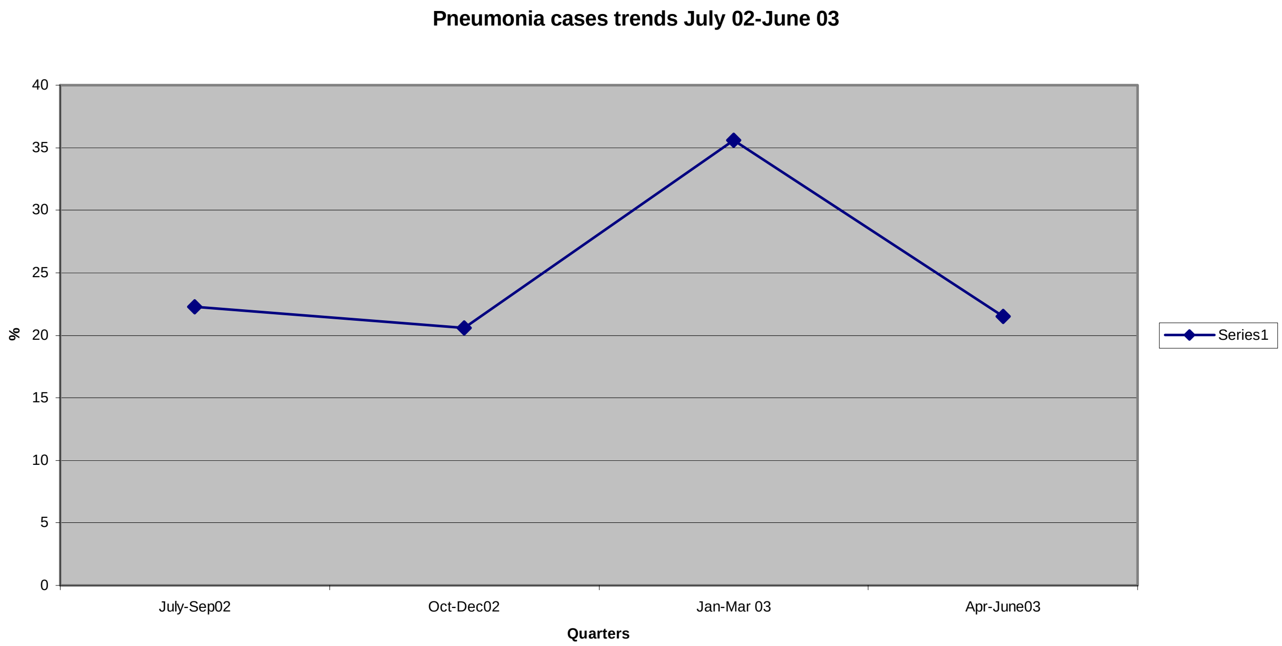
5.3. Pneumonia trends for the study period

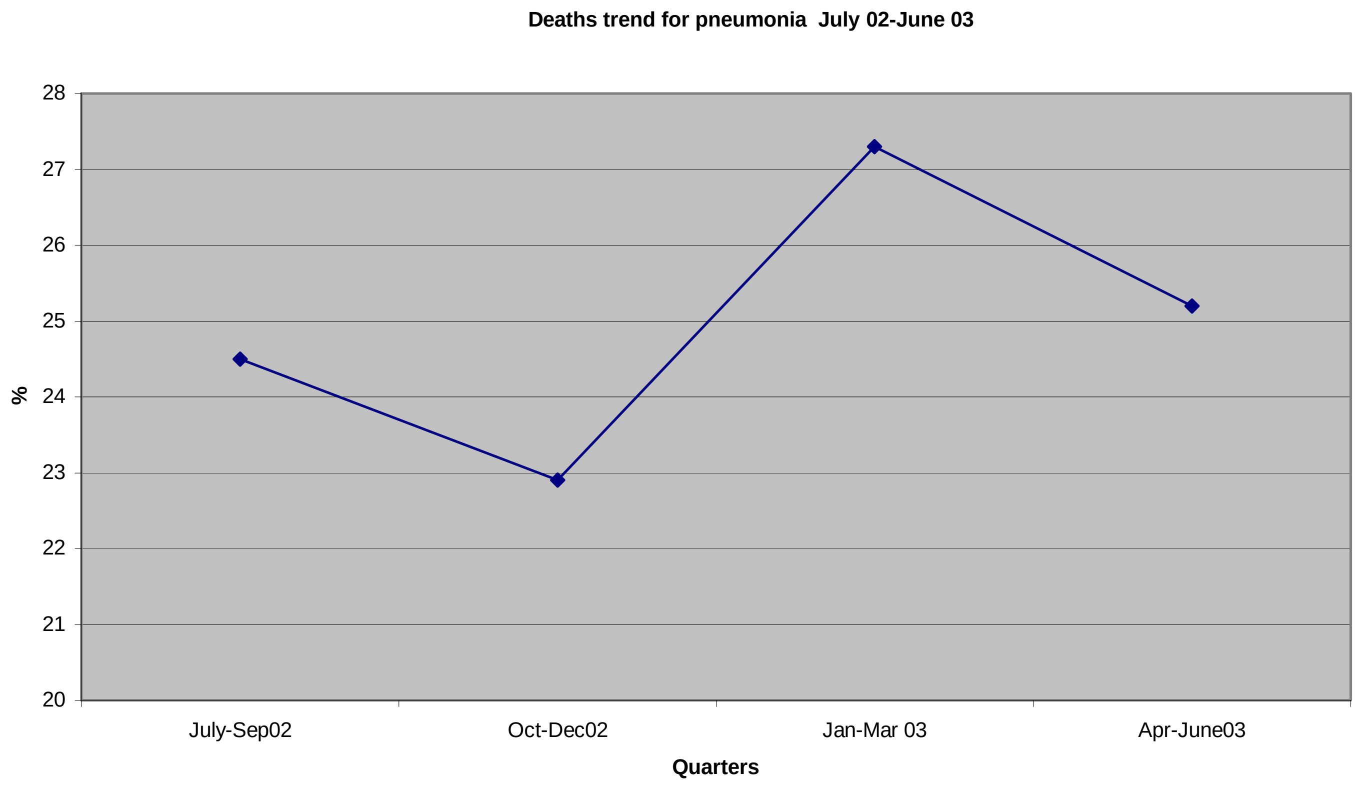
Generally the pattern of pneumonia cases does not vary between the seasons in Malawi except in January through March and slightly peaks up again in the cool/dry season June and July. January through March coincides with the rainy season where there is a peak for both malaria and malnutrition (tables 16 and the graphs)

Table16 Overall trend for pneumonia cases admitted in the ten district hospitals from July 2002 to June 2003

Quarter	Cases (N=6202)	Deaths (N=523)

July-September	1383	128
October-Dec	1279	120
Jan-March	2209	143
April-June	1331	132

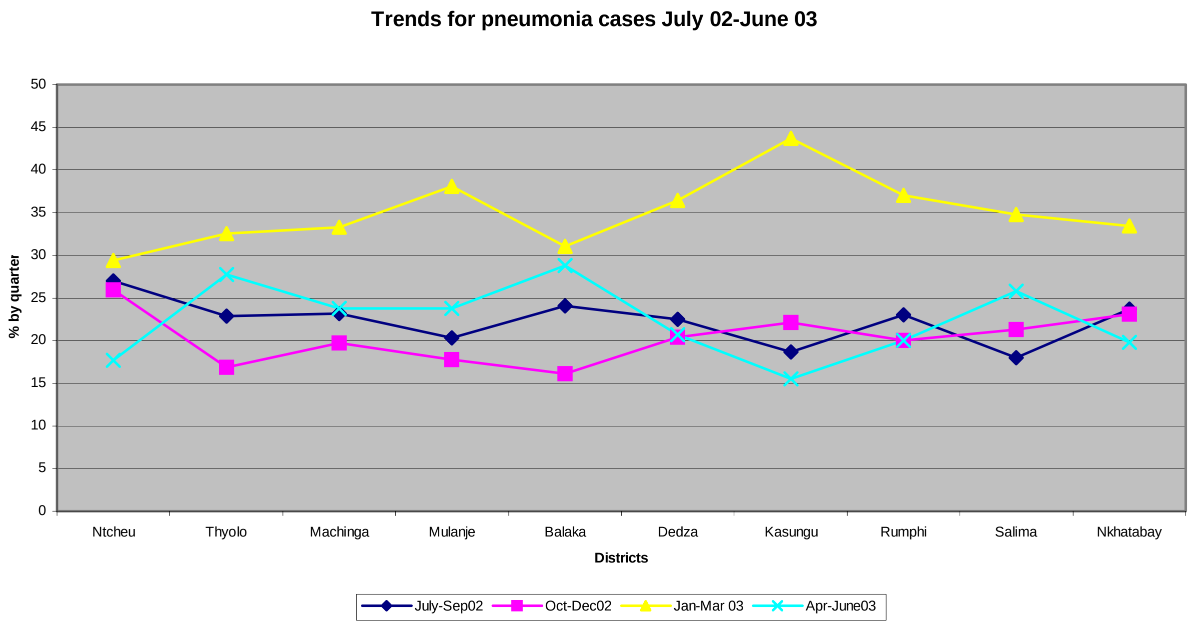



Deaths trend for pneumonia July 02-June 03
%
28
27
26
25
24
23
22
21
20
July-Sep02
Oct-Dec02
Jan-Mar 03
Apr-June03
Quarters

Pneumonia caseload trends were almost similar in each quarter in the districts

Table 16 B Pneumonia caseload by quarter by district July 2002-June 2003 in the ten districts

District	July-Sep 02	Oct-Dec 02	Jan-Mar 03	Apr-Jun 03	Total
Ntcheu	217	208	236	142	803
Thyolo	91	67	129	110	397
Machinga	167	142	240	171	720
Mulanje	171	150	321	200	842
Balaka	78	52	100	93	323
Dedza	232	211	376	214	1033
Kasungu	157	185	366	130	838
Rumphi	121	103	191	101	516
Salima	76	90	147	109	422
Nkhatabay	73	71	103	61	308
Total	1383	1279	2209	1331	6202



CHAPTER 6 DISCUSSIONS

This research has been conducted in district hospitals, which are small hospitals that provide inpatient paediatric care in the district catchments. Ten district hospitals that use pneumonia SCM were studied in an attempt to better understand pneumonia case fatality rates. This research aims to evaluate the information available at this stage of the project to bring about improvements in the care provided, and ultimately, to save the lives of more children.

In this chapter, the results will be discussed in light of international recommendations, previous studies both in Malawi, sub-Sahara Africa and other developing countries. In addition, the limitations of the study will be discussed. The main focus for this study was to identify factors associated with high pneumonia death rates in children under- five years, with an emphasis on application of SCM. The goal is to contribute reduction of childhood deaths due to pneumonia in Malawi. The districts enrolled in the study had been involved in implementing the CLHP for more than one year (refer annex 5). It was considered appropriate that these districts be compared, as they were likely to have similar experiences, problems, and challenges in the provision of care. Six thousand, two hundred and two (95.7%) of the 6840 children under-five years admitted in the ten district hospitals with cough and/or difficult breathing during the study period, met the criteria for this research and were included in the analysis.

We classified children as dead or alive based on a question with multiple outcome alternatives. Of the 6202 children, 4989 (80.4%) had completed treatment, 283 (4.6%) died within 24 hours, 240 (3.9%) died after 24 hours, 332 (5.4%) had left the hospitals without advice, 97 (1.6%) had failed treatment after 48 hours, 45 (0.7%) were transferred to other departments or other places, 68 (1.1%) had failed treatment after 120 hours and 148 (2.4%) were discharged from the hospitals and did not return for review after completion of antibiotic treatment.

A major finding of this study is that the practice of health workers (including correct prescription and provision of prescribed doses) has a major impact on pneumonia case fatality in the districts. In addition, young age, severity of condition, delay in care seeking, and associated conditions were found to be associated with high pneumonia case fatality rates. It appears that staff turnover was not a significant factor associated with pneumonia case fatality in this study. The results will be discussed later in this chapter.

6.1 Validity and limitations of the study

6.1.1 Study design

A retrospective study design was chosen as it was the most feasible design to obtain a representative sample of pneumonia deaths that could best estimate the pneumonia case fatality in the study population. From this study design it was possible to measure (42) pneumonia case fatality rate. This type of design was also preferred due to financial resources and time for fieldwork experience (43-44). The pneumonia inpatient recording forms were used as a source for data because it was the most appropriate record available (45).

6.1.2 Pneumonia inpatient recording form

The pneumonia inpatient record forms were considered an appropriate source of data for this study for two reasons. Firstly, it is compulsory for health workers to complete the pneumonia inpatient record form before they can order appropriate drugs and supplies from the pharmacy department. Secondly, data from the forms could be compared between districts as staff implementing had put in place strategies for reviewing the quality and completion of the record forms. The CLHP have a set of indicators to measure the quality of record keeping. The target for record keeping is to attain 90% filling of the pneumonia inpatient form. Districts are encouraged to use and record the entire recording form whenever they admit a child with cough and/or difficult breathing. However, use of pre-existing record form had some limitations. For example, in the light of previous reports that a delay in seeking medical care contributes to higher pneumonia mortality rates (25, 28), it would have been preferable to identify the exact number of days before the children suffered signs and symptoms prior to medical care being sought after. As a result of using the existing pneumonia record forms we could only determine if it was less than 21 days, or more. Other factors that can influence care seeking behaviour (26, 37) including caretakers' educational background, socio-economic and cultural background and births order status of the child admitted, we were unable to determine from the pneumonia record forms.

Supportive care to the children with severe and very severe pneumonia is important and can be effective in reducing pneumonia case fatality (12, 16). We were also unable to determine what levels of supportive care the children received, including nutrition and fluid management as these were not recorded on the pneumonia inpatient recording form. Health workers use separate sheets for such data, which were not always attached to the recording form. It was decided not to use the information on supportive care recorded on separate records sheets because the information was not consistent and often missing. This weakness could have been overcome if we had conducted this study prospectively. However, that was not a feasible option. On the other hand, the pneumonia recording form saves time as the health workers most of the time just tick the variables instead of writing, and are compelled to follow the process in admitting the child like weighing the child to use for calculating the drug dosage, the record also assists for classify children in accordance to the signs and symptoms and follow the child throughout the treatment period including plan for discharge hence it was most appropriate to use.

6.1.3 Confounding factors

Some potential patient related factors, which may have affected the results, were controlled for in this study. Factors that may contribute to pneumonia deaths such as age, sex and associated conditions (including malaria, malnutrition, anaemia or HIV) were included in logistic regression analysis to evaluate their influence on pneumonia deaths. Unfortunately, information on HIV status was not constantly recorded on the pneumonia inpatient recording forms.

6.1.3.1 Tuberculosis

In this study, children were not screened for tuberculosis on admission. However, if they were not responding the antibiotic treatment, they were examined for the presence of other conditions, including tuberculosis. It appeared that four children in this study were referred to the Tuberculosis Control Programme as they had chest x-ray and they were transferred to another department after not responding to treatment. They also initially presented with signs and symptoms for more than 21 days prior to admission. Children with tuberculosis were not managed in this study, as there are separate treatment guidelines for tuberculosis in Malawi (46).

6.1.4 Baseline CFR data

District hospitals in Malawi collect routine data on cause-specific morbidity and mortality, which are aggregated hospital discharge diagnoses and hospital mortality-by cause (47, 25). It has been suggested previously that those data may not include sufficient details for assessing quality of care in the hospitals or providing and adequate basis for planning specific interventions (25). The CLHP collect data by district each quarter, and it has shown that the official hospital data often underestimates the real situation (36) and is often backdated (48) It has also been found that few cases were ever classified as having very severe pneumonia when presenting with cough and /or difficult breathing prior to the CLHP implementation (36). For these reasons, we used the first quarter of project to obtain a baseline so that we could compare outcomes in the proceeding years. The drawback of this approach is that the intervention probably already had an effect on CFR in this period.

6.1.5 Selection bias

Government health services in Malawi are free. All children admitted with cough or difficult breathing during the study period had the same chance to be included in study. We included all districts that had implemented the project for one year or more, as these districts would have similar experiences. We could have compared districts with worse and best statistics but this brings bias. It is possible that unwillingness from staff in the hospitals with poor results to participate in the study also could have influenced the findings.

6.1.6 Recall bias

We aimed to reduce recall bias in this study by asking respondents to use related records to assist them with answering some interview questions. For example, for the question on staff trained in pneumonia case management, the research team provided a list and the respondent verified this document.

6.1.7 Other tools used in the study

We used a structured questionnaire to collect data on district health service factors. Pre-testing the tool prior to the data collection validated the instrument. We also reviewed supervisory and consultant reports, which are standardized and always used during supervision and consultation visit.

The practice of the health workers' who were supposed to be using SCM should not have been affected by the implementation of this study because it was retrospective in nature. In reviewing the record form we were able to assess the health worker skills in applying SCM. Anonymity was maintained for all district staff that participated in interviews so that they were able to openly express themselves.

6.2. General discussion of the findings

6.2.1 Pneumonia case fatality rate

In our study, we have established that 523 out of 6202 children admitted with cough and/or difficult breathing died. The pneumonia case fatality rate (CFR) of this study is 8.4% and is similar to studies conducted in Yemen (CFR of 8.7%), Zimbabwe (CFR of 9%), Bangladesh (CFR of 8%) and Nigeria (CFR of 9%) (27). The CFR in this study was 30% higher amongst female than male children in this study. This finding differs from most other studies that have reported higher CFR in males (27, 37). However, the higher female CFR in our study is similar to a study from Brazil (49).

6.2.2. Age

Our study has shown that the majority of children under-five years admitted with cough and/or difficult breathing were in the first year of life and 27% of these were below 2 months of age. Case fatality in children less than 2 months was twice as high as for children aged 12-59 months. The mortality was slightly lower in the age group 2-11 months and was 1.9 times higher than in the children aged 12-59 months). Among children that died, 76% were in their first year of life. Similar results have been reported from studies conducted in other developing countries (3-4, 26-27, 14).

6.2.3 Severity of pneumonia

In our study 31% of the children were assessed as having very severe pneumonia. Two-thirds had severe pneumonia whereas 1.7% had non-severe pneumonia (pneumonia). Children who had very severe pneumonia had 6-fold higher death rate than those with severe pneumonia. And it was particularly observed in Thyolo. Children who are brought with cough and /or difficult breathing who have in addition the danger signs must be identified and immediately admitted as very severe pneumonia.

Non-severe pneumonia (pneumonia) cases are supposed to be managed as outpatients, but we found that 107 children with pneumonia were hospitalized. Some of these children died (CFR 5.6%). Although the pneumonia CFR in children with non-severe pneumonia was 1.4 times higher than children admitted with severe pneumonia, this difference was not statistically significant. We did not find other studies reviewed with similar findings.

When we analyzed age-group in relation to severity of pneumonia we found that 50% of children less than 2 months were classified as having very severe pneumonia. In children aged 2-11 and 12-59 months, 25% presented with very severe pneumonia in both age groups. We also found that children that were referred to the district hospitals with very severe pneumonia had a higher CFR that was almost 4 fold that of children referred with severe pneumonia. We can speculate that these children with very severe pneumonia were delayed to present themselves to the appropriate health workers. The higher CFR observed in children less than 2 months old could also mean that caretakers had difficulties in identifying the nonspecific signs that young infants present. Again cultural beliefs in taking very young infants outside the home environment could prevent caretakers from seeking care immediately when the infants showed signs of illness. Cultural practices on childcare influence careseeking were also observed in Bangladesh (50).

In the Malawi Demographic Survey 2000 (32) indicated that 22% of deaths among children under-five in Malawi occur during the neonatal period, while 33% occur during the postnatal period. The high pneumonia deaths in children less than 2 months could contribute to the high rates in this age group.

6.2.4 Associated conditions

Of the 6202 children admitted with cough and/or difficult breathing, 50.5% presented with an associated condition. The associated conditions significantly contributed to the overall pneumonia caseload and deaths. We adjusted for the associated conditions in the analysis and observed that one of four children who had malnutrition died, and nearly one of five children with anaemia died.

The data suggest that malnutrition is strongly associated with increased risk of mortality from pneumonia and is similar to the study by Rice et al (51). Others have indicated that pneumonia is more frequent and severe, and more likely to result in a fatal outcome, in malnourished children (6). Various studied have confirmed that *S. pneumonia* and *H.influenza* are the most common causes of pneumonia in both malnourished and well-nourished children (6), this study has confirmed the finding of a high case fatality rate in children with pneumonia and malnutrition co-existing (52, 53).

The children who presented with both pneumonia and anaemia or malaria and anaemia (OR 3.66 95% CI 2.41-6.56 and OR 2.55 95% CI 1.80-3.60) respectively had high deaths rates compared with children who presented with pneumonia only, whereas malaria without malnutrition or anaemia was not associated with increased risk. The finding in this study has shown that malaria and pneumonia coexist and is consistent with previous study conducted in Malawi (29). In that study the researchers found that 28% of the children studied had both malaria and pneumonia. Other studies showed that anaemia and severe malnutrition were associated with the severe respiratory distress and high death rates (25-28). Malaria and anemia are common conditions in Malawi. Frequent attaches of malaria predispose children to have anaemia. Severe anaemia often includes difficult breathing and signs of heart failure, and health workers could have problems when they attempted to classify children with cough and/or difficult breathing. There are services available at the district hospitals, including pathology laboratories that can be used to confirm the diagnosis of malaria or anaemia. However, among the children who were classified with malaria, only 36% had a laboratory examination done, and amongst the children who were diagnosed with anaemia, only 25% were checked for the haemoglobin level. Though the treatment guidelines for both malaria and anaemia support use of clinical signs to diagnose (such as fever above 37.5°C and palmar pallor as a sign of anaemia) (54, 55). Differential diagnosis is very important in managing sick children with overlapping conditions require, Services at the district hospital should be utilized better to provide quality care for malaria and anaemia in the children admitted in the hospitals.

6.2.5 Delay in care seeking

Children who were admitted to hospital after they had signs and symptoms for more than 21 days had a CFR twice as high as those admitted with less than 21 days of signs and symptoms. In Zambia, a similar pattern was observed (28). They observed that children who were brought to the hospital after more than two days of signs and symptoms, had higher death rate than presumably those brought in less than two days of symptoms. However, the measurement of the number of days of signs and symptoms were different in the study in Zambia.

Seeking care outside home is reported to be poor in Malawi. Both the DHS 2000 and IMCI baseline survey (32 56) identified delayed treatment for children with signs of ARI as a major problem. Again the IMCI baseline survey found that 54% of deaths among children in the surveyed area occurred at home. Some 80% of mothers did not consider taking a sick child with danger signs immediately to a health facility for various reasons (56). Another study conducted in Malawi showed that many deaths occur in the first 24 hours after arrival at the hospital. Some arrive too late (38). This study has found similar result that of the 532 children that died, 53.2% died within 24 hours of admission.

Causes of delay in care-seeking in Malawi include: inadequate knowledge in recognizing signs and symptoms of impending severity of cough and /or difficult breathing, low or no education of the mother, poor access to health services 46% of the population live within 5km of a health centre (32, 57).

6.2.6. Referral and antibiotic prior to hospitalization

In our study, 823 children were referred to the districts hospitals. The CFR in this group was higher than those children that were not referred. This suggests that this group of children were very ill by the time they were referred to the district hospitals for admission. On the other hand, the increased risk persisted after adjustment for severity of disease (classification). The CFR amongst the children referred was two-fold compared to those that were not referred. This finding is similar with the study conducted in Blantyre, at Queen Elizabeth Central Hospital (secondary and tertiary level) in the southern region of Malawi. In that study, they found that 45 out of 50 severely ill children admitted to the hospital died (38).

The CFR was higher amongst children who were given antibiotics prior to hospitalization, than in those was did not receive antibiotics. However, after adjusting for severity of pneumonia, there was no significant difference between the two groups. Further analysis of these children indicated the main problem was SCM in the hospital.

6.2.7. Standard Case Management (SCM)

6.2.7.1. Adherence to treatment guidelines

The emphasis on pneumonia SCM is to firstly correctly classify the children presenting with cough and/or difficult breathing, and secondly to adhere to treatment guidelines recommended for each classification. Of the cases evaluated, 5147 (83%) were correctly classified. A qualitative study in Zambia suggested that the treatment protocol was not used and that this practice may have contributed to high deaths (28).

6.2.7.2 Missing doses of antibiotics

Missing doses of antibiotics while in hospital were observed across almost all of the hospitals studied. Some children missed a full day's course. There was a 4 times higher CFR amongst children who missed 2-3 doses, and a 5-6 times higher CFR in children who missed 4 or more doses, both compared to those who missed 0-1 doses. In the 4530 children that missed 0-1 doses, the CFR was as low as 4.2%. The impact of missing doses on health outcome is not surprising, however, this finding was unique, as none of the other studies had documented missing doses in pneumonia case management. It has been previously suggested that pneumonia deaths are due to failure to give simple antibiotics (59). However a study in South Africa reported similar finding where nurses' error contributed to 28% of deaths due to giving antibiotic doses hours ahead of schedule to severe malnutrition cases (60).

We do not have data to know why children missed doses in the hospitals. However, from observations made during data collection and supportive visits. In some district hospitals, the bed occupancy rate was as high as 400%. More than one child was put on one bed. When a child is not on IV fluids or on oxygen, the caretaker sometimes opt not to put the sick child on the bed and may carry the child on the caretakers' lap or at her back and sometimes sit in the corridors or on the veranda during the day. The caretaker may easily fail to go back in the ward during medication time. Other reason could be the wards are very full and hardly will the nurse have enough space to move the medicine trolley in the ward to give medication. Hence medication can sometimes be given near the nurses' station or on bay between the ward sections. As described, children could easily miss doses if the mother was not around during the time of giving the medications. Another reason that could probably explain missing doses is lack of drugs or syringes or diluents in the paediatric ward even if the district hospital pharmacy department could have adequate stock of these items. This could be experienced especially during the night shifts. Therefore nurses could postpone giving the drugs until such items were available in the ward. The reasons for missing doses warrant further investigation.

6.2.8. Selected health delivery services factors

We had conducted interviews to some members of the DHMT to evaluate some of the factors involved in pneumonia case management and selected variables are discussed below:

6.2.8.1. Staff turnover

Health workers in the districts implementing the CLHP received training on inpatient pneumonia case management. During data collection for this study, only half of the health workers that were trained were still available in the districts. For the health workers who had been transferred to other district hospitals and for those on study leave, we can assume that they will continue to use the skills learnt on the SCM and will be able to apply them in the other hospitals. But for those who resigned, their skills may be lost unless they are employed elsewhere in the health sector.

This finding is similar with the overall staffing status in Malawi. In the Malawi National Health Plan (1999-2004), the Ministry alluded to loss of trained health personnel and increased vacancy levels (9). Similarly, the Consultant April 2002 Report presented that only 57 (57%) of health workers trained in SCM were still available in April 2002 (45).

Prior to the study, we had hypothesized that staff turnover would have an impact on CFR variations. But no particular pattern was observed to explain the relationship between staff turnover and CFR. For example, Rumphi retained 67% of the trained workers and the CFR was 7.4%, while Mulanje and Machinga retained only 39% of their trained health workers and their CFR were 4.9% and 14.6% respectively. In summary, no direct relationship between CFR and staff turnover was found in this study.

6.2.8.2. Other major district health service delivery factors

6.2.8.2.1. Human resource management in the districts

Staffing levels and changes were analyzed across the districts in this study. It was found that pneumonia CFR were twice as high when staff changes occurred as a result of staff instability, in comparison to regular, 3 monthly staff rotations however, this finding is not consistent as 6 months rotation had high death rates. However, the 3 months rotation may suggest that there is skills transfer prior to the rotation. Staffing levels were also analyzed with respect to the number of clinical officers and nurses on duty per shift, both day and night. There was no significant difference with the pneumonia deaths for both day and night shifts across hospitals.

We examined how health workers are deployed after attending a short course like IMCI, STI, and pneumonia SCM. We observed that there was positive impact when the health workers were posted to the relevant department, for example, deployed to the paediatric department after attending an ARI case management course. There were almost 40% higher CFR in hospitals that did not deploy the health workers to relevant departments after courses, compared to those that did. This relates to a finding in a South Africa study where an increase in CFR appeared to be related to lack of experience of doctors in treating malnutrition (60).

6.2.8.2.2 Drug supply

The CLHP provide drugs and supplies for the management of pneumonia in children under-five years and the drugs are kept at the central medical stores at the regional level. Districts order the drugs on monthly basis using figures on drug usage from the previous month with an additional one-month’s buffer stock and keep the drugs at their district pharmacy. In this study we reviewed the drug stock by quarter and related it to the 12 months study period. We used supervisory reports and consultant reports to calculate the stock levels. We observed that most of the drugs were always available at the district hospital pharmacy, except in a few districts. However, benzylpenicillin for example, was not always available throughout the study period and this was associated with increased CFR. In a Zambian study, they did not find shortage of drugs at the time of the study, however, it was noted that the drug supply in the country was not reliable (28).

6.2.9 Disease profile

We reviewed the common causes of morbidity and mortality in children under fives and the prevalence of HIV to understand the disease burden between the districts. Again we examined pneumonia trends across districts.

6.2.9.1 Common diseases in the districts

Across all of the districts, malaria is the leading cause of admissions. Pneumonia is the second most common cause of admission, along with anaemia and malnutrition. However, the Health Information System indicators on malaria and anaemia in 2002 did not provide information by age group (47) to compare the death rates in the under-fives.

6.2.8.2 HIV/AIDS

A study conducted in Blantyre, Malawi, showed that HIV infection significantly increased the risk of pneumonia related mortality (61, 23). However, in this study the HIV status for our study population was largely unknown. HIV is not routinely tested, of the 6202 pneumonia inpatient record forms, the status was not available for 99.3%. The treatment algorithm is not sensitive enough to help the clinician establish or confirm the HIV infection (61). Therefore, we were not able to study how much the differences in mortality between the hospitals could be explained by differences in HIV infection. However, to get an indication, we used national HIV prevalence estimates from sentinel surveillance data 2001 (62) to provide an estimate of prevalence amongst the study population. We observed that HIV prevalence was higher in Mulanje compared to other districts, yet Mulanje district had the lowest pneumonia CFR (4.9%). On the other hand, Malawi is severely affected by the HIV/AIDS epidemic. For example tuberculosis cases have increased in Malawi. The increase in cases was particularly marked in children and adults aged 15-34 years (reproductive age group) and these findings were similar with the National AIDS prevalence figures in the country (63). Again the increased illness and death is experienced in the hospitals, over 70% of hospital beds are occupied by people with HIV/AIDS-related conditions (64). In view of the of the high HIV prevalence and deaths due to HIV/AIDS related illness, HIV/AIDS and STD prevention and treatment services is amongst the main MOHP priorities (9).

6.3. Variations across the districts

Pneumonia CFR varied across districts in this study. The risk of death in Machinga and Thyolo districts remained high after we had controlled for age and sex. The risk of death was 14.6%, in Machinga and 14.1% in Thyolo compared to 7.3% in Dedza and 4.9% in Mulanje.

During analysis when we adjusted for severity of disease at admission, the increased risk in Thyolo and decreased risk in Mulanje were attenuated and no longer significantly different from Dedza. This implies that there were more children with very severe pneumonia admitted in Thyolo district hospital. On the other hand, increased risk in Machinga persisted and a greater risk was now found in Salima.

After adjusting for missing doses of antibiotics in addition to age, sex and severity of disease, Machinga still had increased risk of mortality. This implies that the increased risk in Machinga could not be explained by missing doses. Conversely the odds ratio in Ntcheu, Mulanje, Kasungu and Salima were significantly lower after adjustment, implying that missing doses was explanatory for the high CFR in these hospitals. The high CFR in Machinga still needs to be further investigated.

The data we collected on pneumonia deaths could not strongly relate to the deployment of health workers trained in SCM. We were unable to identify the health workers who had managed the children and therefore the findings on deployment of staff after training or example should be interpreted with caution. However, improvements in case fatality rate has been observed in districts that have health workers trained in SCM (13, 45). Districts that did not appropriately deploy trained staff experienced higher death rates. Districts that had random staff changes presented with higher death rates.

CHAPTER 7 CONCLUSION AND RECOMMENDATION

7.1. CONCLUSIONS

The overall pneumonia case fatality rate in this study was 8.7% with CFR ranging from 4.9% to 14.6% across districts. In this study we have observed that case fatality rate was twice as high in Thyolo (14.1%) and in Machinga (14.6%) while in Mulanje the case fatality rate was lower (4.9%) all compared to reference Dedza (7.3%). Possible causes of variations in pneumonia case fatality rate across districts in this study include the admission of more severely ill children and missing doses of antibiotics.

We have also observed other factors that contribute to high CFR. These include young infants with respiratory infections, incorrect classification and prescribing wrong type of antibiotics in relation to the classification made; shortage of antibiotics; associated conditions and changing of staff at random. High staff turnover could not explain the pneumonia case fatality rate variations in the districts studied.

Overall, this study has found that CFR variations are heavily influenced by district service delivery factors particularly missing doses. The results should be of interest at the district, national, international level and the project implementers in particular. The results suggest some evidence for improving within-hospital management to reduce pneumonia deaths. If the children could receive the prescribed doses of antibiotics, the outcome may improve. Missing antibiotic doses compromises the effective management for the children admitted with cough and /or difficult breathing. The missing doses results should be studied further, and used to initiate action in all districts in the management of children with pneumonia, but also other conditions.

Children with very severe pneumonia had six fold higher death rates than those with severe pneumonia. In the hospital, extra care is required to improve the outcome of these children. We can apply the findings of other studies conducted in Malawi (38, 65) on emergency care of very sick children starting from the outpatient to the paediatric ward and monitoring the quality of care provided.

In the community, caregivers can be empowered to identify signs and symptoms of illness that requires care beyond the home environment, with an emphasis on seeking care from an appropriate health provider.

7.2. Implications for clinical practice and future research

This study has shown that some health delivery service factors such as children missing doses in hospitals and also patient related factors such as severity of condition, associated conditions, young age increases risk of dying. To effectively reduce pneumonia deaths these factors should be tackled carefully when implementing case management.

7.2 .1 Health delivery service factors

7.2.1.1 Missing doses

To improve quality of treatment in providing the prescribed antibiotics is a challenge that requires ongoing commitment from physicians, nurses and even the parents (65, 66). The drug schedule needs to be strictly adhered to. This is crucial because missing antibiotic doses not only have an impact on death rates but also create bacterial resistance in the community. Other studies have shown that resistance to commonly used antibacterial has emerged and spread in each of the main bacteria causing community-acquired respiratory tract infections in children i.e. *S. pneumoniae, H. influenzae*, and *S. pyogenes* (67). Optimizing antibacterial use in childhood respiratory infections is important both in the care of individual patients and within strategies to address the wider problem of antibacterial resistance (67). A further research direction would be to study on the missing doses and why children miss antibiotic doses while in the hospital so that we could better address these problems.

In-service education to establish continuous quality improvements in SCM amongst health workers working in the paediatric ward is crucial, as shown in other studies (65). Districts should plan such activities in their hospitals to facilitate learning in their own setting (68). However pre-service training in standard case management is also vital.

7.2.1.2 Improve paediatric care at the district hospitals

Infants less than 2 months as shown in our study contributed to 50% of the children with very severe pneumonia and again children with very severe pneumonia had the highest death rate. A special area within the district hospitals paediatric ward should be considered for the most severely ill children who need emergency treatment but also among those who need priority attention for prompt life-saving treatment (65, 66, 68). Paediatric death audits (66, 69) should be encouraged at the district hospitals to solve local problems such as the missing doses to improve child survival.

Another way of improvement is nursing clinical records. Though the results on observations made by nurses and clinical staff was not statistically significant to pneumonia deaths it is still worth discussing. Of the cases found in the ward at the time of data collection, nurses' notes were almost not available. Information on care provided apart from the treatment *charts and blood transfusion charts when the child was transfused was hardly documented. Clinicians' notes however were observed in the patients' files. The nurses do not write observations apart from the temperature and drugs provided to the patients. This area needs to be actively worked on to facilitate quality care in the hospitals. Simple tool as advocated by WHO to be used in these hospitals (65, 38).*

7.2.3 Patient related risk factors

7.2.3.1 Delay care seeking

We have observed that in Thyolo they admitted more very severe cases and we can assume that the children delayed to seek medical care. The delay in care seeking can best dealt by strengthening community interventions. Districts should plan to include health promotion activities in order to empower caretakers with knowledge on signs and symptoms. We recommend carrying out a study to address on the knowledge of signs and symptoms. Again the CLH therefore needs to include social mobilization intervention however should be tailored within the IMCI concept (70). Caregiver's health promotion messages on importance of getting all the treatment at regular interval should be advocated and they should demand that their children receive the recommended drugs.

Long-term recommendations include that the MOHP continue training health workers so that patient/nurse/clinician ratio is improved (9, 13, 45) priority to districts with high death rates. Nurse or clinical staff allocation should be according to the workload to ensure children do not miss doses apart from other essential management. Hospitals are overcrowded with bed occupancy rates ranging from 150% in Machinga up to 400% in Kasungu the MOHP should continue to improve the hospitals as stated in the National Health Plan. Overcrowding compromises quality care.

In summary, the results of this study have shown that health service delivery factors and patient related factors were important to be studied to achieve optimal treatment outcome. All hospitals should apply the SCM and Malawi will reduce unnecessary deaths due to pneumonia.

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Appendix tables
(a) Distribution of classifications by age group,
N=6202

Age in months	Classifications				Total
	very severe pneumonia	severe pneumonia	pneumonia	pneumocystis carinii pneumonia (PCP)	
<2	530(50.5)	515(49.1)	4(0.4)	0(0)	1049(16.9)
2-11	802(28.3)	1988(70.0)	49(1.7)	0(0)	2839(45.8)
12-59	571(24.7)	1688(72.9)	54(2.3)	1(0.04)	2314(37.3)
Total	1903(30.7)	4191(67.6)	107(1.7)	1(0.02)	6202

Age group p=0.0001, classification p=0. 0001

The following tables are the district results

(b) Percentage of age group, sex and very severe pneumonia by district.
N=6202

District	cases	(%) < 2months	(%) males	(%) very severe pneumonia
Ntcheu	803	16.2	52.9	40.5
Thyolo	397	15.6	50.4	59.7
Machinga	720	10.8	54.6	31.5
Mulanje	842	25.0	55.6	23.4
Balaka	323	18.0	54.8	23.2
Dedza	1033	14.9	49.8	36.2
Kasungu	838	16.8	55.8	16.2
Rumphi	516	18.0	54.1	31.2
Salima	422	20.4	53.8	21.8
Nkhatabay	308	12.0	51.6	25.6
Total	6202	16.9	53.4	30.7

(c) Children admitted with cough and difficult breathing and had associate conditions by district
N= 6202

District	cases	children without overlap	children with overlap
Ntcheu	803	422(52.6)	381(47.4)
Thyolo	397	160(40.3)	237(59.7)
Machinga	720	371(51.5)	349(48.5)
Mulanje	842	378(44.9)	464(55.1)
Balaka	323	174(53.9)	149(46.1)
Dedza	1033	573(55.5)	460(44.5)
Kasungu	838	555(66.2)	283(33.8)
Rumphi	516	121(23.4)	395(76.6)
Salima	422	215(51.0)	207(49.0)
Nkhatabay	308	103(33.4)	205(66.6)
Total	6202	3072(49.5)	3130(50.5)

(d) Care seeking behavior, practice in the district health service delivery in relation to practice on referral cases in the districts

N= 6202

District	cases	<21days N (%)	children who received antibiotic prior hospitalization N (%)	self referred N (%)
Ntcheu	803	666(82.9)	173(21.5)	555(69.1)
Thyolo	397	344(86.6)	133(33.5)	263(66.2)
Machinga	720	462(64.2)	164(22.8)	424(58.9)
Mulanje	842	685(81.4)	162(19.2)	604(71.7)
Balaka	323	286(88.5)	53(16.4)	262(81.1)
Dedza	1033	996(96.4)	121(11.7)	956(92.5)
Kasungu	838	619(73.9)	144(17.2)	592(70.6)
Rumphi	516	377(73.1)	161(31.2)	306(59.3)
Salima	422	334(79.2)	179(42.4)	176(41.7)
Nkhatabay	308	280(90.9)	72(23.4)	227(73.7)
Total	6202	5049(81.4)	1362(22.0)	4365(70.4)

(e) Treatment pattern according to classification by district

N= 6201

District	cases	correct (%)	incorrect (%)
Ntcheu	803	727(90.5)	76(9.5)
Thyolo	397	356(89.7)	41(10.3)
Machinga	719	658(91.5)	61(8.5)
Mulanje	842	614(72.9)	228(27)
Balaka	323	264(81.7)	59(18.3)
Dedza	1033	859(83.2)	174(16.8)
Kasungu	838	661(78.9)	177(21.1)
Rumphi	516	410(79.5)	106(20.5)
Salima	422	306(72.5)	116(27.5)
Nkhatabay	308	292(94.8)	16(5.2)
Total	6201	5147(83.0)	1054(17.0)

(f) Proportion of missing doses by district
N=6094

District	cases	missed 0-1 dose (n %)	missed 2-3 doses (n %)	missed 4 or more (n %)
Ntcheu	782	551(70.5)	157(20.0)	74(9.5)
Thyolo	395	334(84.6)	54(13.7)	7(1.8)
Machinga	717	558(77.8)	114(15.9)	45(6.3)
Mulanje	837	611(73.0)	190(22.7)	36(4.3)
Balaka	320	235(73.4)	75(23.4)	10(3.1)
Dedza	1024	977(95.4)	19(1.9)	28(2.7)
Kasungu	811	294(36.3)	327(40.3)	190(23.4)
Rumphi	508	440(86.6)	54(10.6)	14(2.8)
Salima	392	261(66.6)	98(25.0)	33(8.4)
Nkhatabay	308	269(87.3)	36(11.7)	3(1.0)
Total	6094	4530(74.3)	1124(18.4)	440(7.2)

(g) Case fatality rate for children who had missed dose by district

N=6094

District	cases	missed 0-1 dose (CFR) %	missed 2-3 doses (CFR) %	missed 4 or more (CFR) %
Ntcheu	782	551(3.8)	157(18.5)	74(13.5)
Thyolo	395	334(6.0)	54(59.3)	7(28.6)
Machinga	717	558(5.2)	114(56.1)	45(24.4)
Mulanje	837	611(2.9)	190(6.3)	36(22.2)
Balaka	320	235(2.6)	75(9.3)	10(80.0)
Dedza	1024	977(4.0)	19(42.1)	28(89.3)
Kasungu	811	294(6.1)	327(4.3)	190(19.5)
Rumphi	508	440(4.6)	54(16.7)	14(50.0)
Salima	392	261(3.5)	98(8.2)	33(24.2)
Nkhatabay	308	269(3.7)	36(19.4)	3(66.7)
Total	6094	4530(4.2)	1124(16.6)	440(22.1)

(h) District differences for pneumonia case fatality rate as variables were added
N=6202

District	cases	deaths	CFR	age		sex		classifications	
				OR	95%CI	OR	95%CI	OR	95%CI
NU	803	70	8.7	1.77	0.84-1.66	1.19	0.84-1.67	1.12	0.79-1.60
TO	397	56	14.1	2.00	1.38-2.29*	2.01	1.39-2.91*	1.43	0.98-2.10
MH	720	105	14.6	2.16	1.57-2.95*	2.18	0.39-0.86	2.50	1.80-3.48*
MJ	842	41	4.9	0.57	0.39-0.85*	0.58	0.59-1.55	0.80	0.53-1.20*
BK	323	24	7.4	0.94	0.58-1.52	0.96	0.58-1.21	1.32	0.81-2.18
DZ	1033	75	7.3	1.00	Reference	1.00	Reference	1.00	Reference
KU	838	54	6.4	0.83	0.58-1.19	0.84	0.58-1.21	1.37	0.94-2.01
RU	516	38	7.4	0.95	0.63-1.43	0.96	0.64-1.45	1.10	0.72-1.67
SA	422	41	9.7	1.27	0.85-1.90	1.28	0.86-1.92	1.88	1.23-2.89*
NB	308	19	6.2	0.79	0.47-1.34	0.80	0.48-1.35	0.99	0.58-1.69

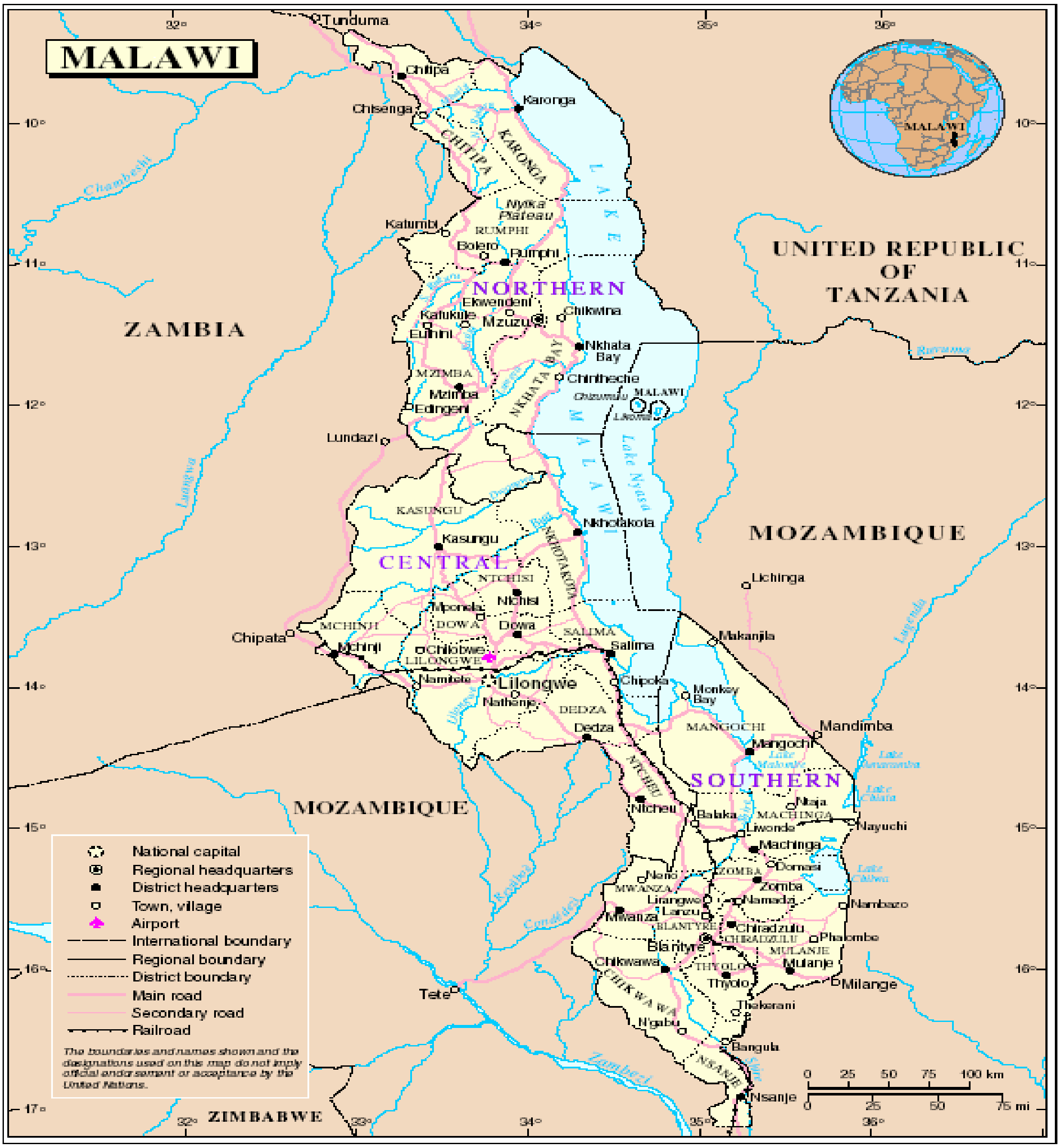
Adjusted for age, sex, classification and district
* Significant

(i) Differences still continued as other variables were being added
N=5176

District	cases	deaths	CFR	careseeking		associate condition		correct type	
				OR	95%CI	OR	95%CI	OR	95%CI
NU	672	48	7.1	0.80	0.54-1.19	0.73	0.49-1.10	0.72	0.48-1.04
TO	365	52	14.3	1.11	0.74-1.67	1.37	0.91-2.07	1.26	0.83-1.92
MH	500	62	12.4	1.77	1.20-2.61*	1.83	1.23-2.72*	1.80	1.21-2.64*
MJ	688	33	4.8	0.74	0.48-1.15	0.79	0.50-1.25	0.75	0.48-1.13
BK	291	21	7.2	1.21	0.71-2.05	1.47	0.86-2.51	1.44	0.84-2.46
DZ	1006	73	7.3	1.00	Reference:	1.00	Reference:	1.00	Reference
KU	627	39	6.2	1.27	0.83-2.05	1.37	0.89-2.10	1.34	0.87-2.06
RU	394	30	7.6	0.93	0.58-1.43	0.97	0.60-1.56	0.87	0.54-1.42
SA	341	35	10.3	1.47	0.91-2.35	1.83	1.14-2.92*	1.44	0.89-2.33
NB	292	16	5.5	0.71	0.40-1.23	0.75	0.41-1.37	0.71	0.39-1.30

Adjusted for age, sex, classification, Careseeking behaviour, associated conditions and district
* Significant

Annex 1 Map of Malawi



PNEUMONIA INPATIENT RECORDING FORM

Name:

Address: ______________________________

Age ____________ (months): Sex (M/F): ____________

Number of days of signs/symptoms: More than 21 days ☐ Less than 21 days ☐

Antibiotic treatment prior to coming to hospital: Yes ☐ No ☐ Self referral ☐ Referred by Health Centre ☐

Date of hospital admission: ____________________

Weight ____________ Kgs Temperature ____________ ^{0}C Respiratory rate x 1 minute ________________

Clinical features		Classification			
CHILD 2 MONTHS TO 5 YEARS			Antibiotic	Dose	Day 1
Chest in-drawing	Yes☐ No ☐	Very severe pneumonia ☐	Benzyl penicillin		| | |
Severe respiratory distress	Yes☐ No ☐	Severe pneumonia ☐	Amoxicillin		| |
Central cyanosis	Yes☐ No ☐		Chloramphenicol		| |
Sleepy/difficult to wake	Yes☐ No ☐		Cotrimoxazole		|
Convulsions	Yes☐ No ☐	Pneumonia ☐	Other antibiotic (specify)		
Able to breastfeed well	Yes☐ No ☐	PCP ☐			
Able to drink	Yes☐ No ☐	Other (specify) ☐			
Wheeze	Yes☐ No ☐		Other treatment		

YOUNG INFANT < 2 MONTHS			Antibiotics	Dose	Day 1	Day
Severe chest in-drawing	Yes ☐ No ☐	Very severe pneumonia/disease ☐	Gentamicin			
Central cyanosis	Yes ☐ No ☐		Benzyl penicillin		| | |	| |
Sleepy/difficult to wake	Yes ☐ No ☐	Severe pneumonia ☐	Amoxicillin		| |	|
Able to breastfeed well	Yes ☐ No ☐		Other antibiotic (specify)			
Wheeze	Yes ☐ No ☐	PCP ☐				
Grunting intermittent	Yes ☐ No ☐					
Grunting continuous	Yes ☐ No ☐	Other (specify) ☐	Other treatment			
Nasal flaring	Yes ☐ No ☐					
Apnoeic spells	Yes ☐ No ☐					
Convulsions	Yes ☐ No ☐					

HIV status	Positive ☐	Negative ☐	Unknown ☐	Measl
Blood film (malaria)	Positive ☐	Negative ☐	Unknown ☐	Severe

- Severe malnutrition is visible severe wasting or oedema in both feet

please turn over

Hospitalisation

Duration of hospitalisation in either ____________ Hours ________________ D

Admission diagnosis ________________________ Discharge diagnosis ________

Discharge and Follow-up

Course of antibiotics to be completed at home Yes ☐ No ☐	Child returned for fo
Mother informed to return with child once antibiotics completed Yes ☐ No ☐	Course of antibiotic c
	Child fully recovered

Treatment Results

Treatment completed(1)☐ Failure at 48 hrs (2)☐ Failure at Day 5☐
Left against advise(3) ☐ Transferred (4)☐ Outcome unknown (5)☐
Died within 24 hours of admission ☐ Died after 24 hours of admission☐

Additional Remarks:

____

____

____

Rationale for Information/Recording System

When the decision is reached that the child has pneumonia and requires hospitalisation then the ***Pneumonia Inpati*** other forms that may be used, such as critical care pathways. The use of this form is a prerequisite of the Project p form is initiated when the patient is started on treatment and is completed on discharge. The form is provided to as for the patient. Information is transferred to the ***Pneumonia Inpatient Register.***

***** If NO then tick Outcome Unknown (5) in Treatment Results section

****** If YES then child can be registered as Treatment Completed (1) in Treatment Results section

1 Course of antibiotics completed and child fully recovered
2 Treatment failure means: Worsening of fast breathing, or Worsening of chest in-drawing, or Development/persistence of abnormal sleepiness or difficulty in awakening, or development/persistence of inability to drink or poor breastfeeding.
3 Child removed from the hospital against medical advice before treatment is completed
4 Child is referred for treatment to another health facility and the result of treatment is unknown; where the result is known, that result should be recorded in place of the result "transferred
5 When mother does not return with child for follow-up visit once course of antibiotic(s) is finished

Annex 3: Questionnaire

DATA COLLECTING TOOLS: HEALTH SYSTEM ORGANISATION IN THE DISTRICTS

1 Questionnaire to the District Matron or most senior Nurse in the district

Name of Interviewer ------------------------------Name of the District Hospital------
Date of interview (DD/MM/YY) -----/------/------ Questionnaire Number---------------------

Instruction: Introduce yourself and explain purpose of interview. Verify if interviewee wants to participate in the study. If so give her/him a form to sign as attached.

1. I understand your district is implementing Child Lung Health Project when did you start the implementation? Month/Year ……………

2. Records from the national level indicate that some of health workers train in the standard inpatient pneumonia case management, when was the training? (Month/Year)…………/…………… (3) Where?................

4. I would like to verify the health workers who were trained from the national record for this hospital and please indicate where the health workers are
Mention each health worker according to list of the district hospital

Name	Cadre	where is the health worker working now?
………………	…..	…………………
……………..	….	………………..
……………	….	………………..
…………….	….	……………….
…………….	….	……………….

5.For those who were trained in Pneumonia Standard Case Management indicate how many of them were working in the pediatric department/ward during July 02- June 2003

Quarter	Number of staff working in the pediatric department
July-September 2002	
October-December 2002	
January-March 2003	
April-June 2003	

6. Where is a health worker placed after attending training for example IMCI, CLH/ARI, FP, STI etc?
Circle appropriate response
A Goes back to the working place
B Posted to the relevant department according to the training
C Others (specify)
…………………………………………………………………………………………
………………………………………………………………………………………….

7. When a health worker is trained as above when is he or she posted to another ward/department?
Circle appropriate response
A After one month
B. After 3 months
C. After 6 months
D. After one year
E. Are not moved at all
F. Others (Specify)..

8. How often are nurses changed from one department (ward) to another ward?
Circle appropriate response

A. Every three months
B. Every six months
C. Once a year which month…………………………
D. Other (specify)………………………………………..

9. How often is the Clinical Officer/Medical changed?
Circle appropriate response

A. Every month
B. Every three-month
C. Every six months
D. Once a year which month?…………………………….
E. Other (Specify)……………………………………….

10. What is the Hospital status?

Ward	Number of Beds	Number of Nurses	Number of Clinical Staff
Maternity ward			
Female ward			
Male ward			
Children ward			
TB			
Other			
Total			

11. Can you tell me the number of health workers in this district hospital?
Indicate Number

Doctors…
Clinical Officers………………
Medical assistances…………..
Registered Nurses……………
Enrolled Nurses………………
Community Health Nurses…
Patient Attendants…………….
Pharmacy Assistant…………
Laboratory Technicians/Assistant…

2. Interviews with the Hospital Administrator
Introduce yourself and explain purpose of interview. Verify if interviewee wants to participate in the study. If so give her/him a form to sign as attached

I would like to record the communication and transport facilities you have in this hospital.
Record the response appropriately

12. How many health centres does this district have?……………
13. Other hospitals. …………(Specify)…………………………………………..
14. What is the distance covered from the district hospital to the farthest health facility in the district?
(Circle appropriate response)

A 250 and more
B 200-249km

C 150-199km

D 100-149km
E 50-99km
F 10-50km
G Other (specify)……………………….

15. What is the proportion of patients coming from that farthest health facility?
Indicate in percentage………………

16. What percentage of the health facilities has functioning communication radio or telephone? (To calculate percentage: Number of health facilities with communication over total health facilities in the district)
Circle appropriately response
A 100%
B 75%
C 50%
D 25%
E 0%
17. How many working ambulances/vehicles are available now?
Circle appropriate response
A 5 and more
B 3-4
C 1-2
D None
E Other (specify)………………………………..

18. In your opinion how many ambulances/vehicles would you consider at least adequate for your district considering problems of financial constraints in the country?
Circle appropriate response
A additional of 3 more
B additional of 2
C additional of 1
D None
E Don't know

19. What was the proposal annual budget for 2002- 2003 (1st July 02- 31st June 03)?
MK………………….
20. How does the district estimate its budget?
Explain……………………………………………………………………………….
………………………………………………………………………………………..
………………………………………………………………………………………..
……………………………………………………………………………………….
……………………………………………………………………………………….
21. How much did you receive during the annual budget (actual finances)? MK………..
22. What was the percentage received in relation to the proposed budget?
Circle appropriate response

A 91- 100% B 81-90% C 71-80% D 61-70% E 51-60%
F 41-50% G 31- 40% H 21 - 30% I 11-20% J less than 10%

23. How does the hospital use the limited funds?

A Buy fuel for local running and immunizations
B Transfer of patients
C Others utilities/activities (list in order of priority)……………………………………………..
……………………………………………………………………………………….
………………………………………………………………………………………….
Work with the District statistical clerk to get the following information

24. What is the district Population………………………………….
25. The under-five Population………………………………………..

26. District catchment's area coverage ---------------------Hectares

27. I would like to record patient load for this hospital.
Use the Health Management Information System records.
Record the first five causes of admission in children under-five years during July 2002 to June 2003 in the box provided

Condition/Classification	Number of Admissions	Remarks

Record the first five causes of death in children under-five years during July 2002 to June 2003 in the box provided

Condition/Classification	Number of Deaths	Remarks

3. Information for the paediatric ward.

Interview the most senior health worker in the ward preferably the ward sister in charge.

Introduce yourself and explain purpose of interview. Verify if interviewee wants to participate in the study. If so give her/him a form to sign as attached.

28. How many sick children (<5years old) do you have today? (Indicate the day of the week ……………..(then number of patients on that day)………………..

29. Is this a normal trend during this season? Yes (2)…No (1)…I don't know (0)…

30. How many of these have pneumonia (Indicate the day of the week ………………(then number of patients on that day)………

31. Calculate percentage of the pneumonia cases in relation to the total number of cases in the ward…

32. How many nurses are working in this ward today?
Circle response

A 1
B 2
C 3
D 4 and more
E Other Nurses combining with other wards

33. How many will be on night duty?
Circle response

A 1
B 2
C 3
D 4 and more
E Other (Specify)……………………………………………………..
………………………………………………………………………………………….

……………………………………………………………………………………………
34. Find out about the ward organisation.

Walk in the ward with the interviewee to observe the following and indicate appropriately.

Very severely ill children have a special/specific bay Yes (2) ….. No (1)…….

Young infants (<2months) have a special bay/space Yes (2) ……No (1) ……

35. How often do nurses observe very severe cases?
Circle response
A Every 24 hours
B Every 12 hours
C Every four hours
D Every three hours
E Every hour
F Other
(specify)…………………………………………………………………

36. How often do clinical staffs observe very sick children?
Circle response
A Every 24 hours
B Every 12 hours
C Every four hours
D Every three hours
E Others (specify)…………………………………………………………………..

37. Verify (***check nurses/clinical staff notes for at least 30% of the very sick children in the ward that day or choose at random five very sick children in the ward). Ask for the notes of the patients and record below:***

Patient name	Classification	Nurses Notes Present		Clinical Staff Notes Present	
		Yes	No	Yes	No

38. Drug supplies. ***Use supervisory reports and record the drug and supplies available for Child Lung Health Project July02-June 03. Indicate A for available or B for not available***

Item	July-Sept 02	Oct-Dec 02	Jan-March 03	April-June03	Average during the year
Benzyl penicillin 1MU vials					
Gentamicin 20mg/2ml vials					
Amoxicillin powder 125mg/5ml					
Amoxicillin tablets 250mg					
Cotrimoxazole pediatric dose					

Chloramphenicol injection 1 gram vial					
Chloramphenicol 125mg/litre bottle					
Water for injection vials					
Syringes 2ml/ B_D Discard II					

39. Charts and tables

Use supervisory report and record the drug and supplies available for Child Lung Health Project during July02 through June03 record by quarter

Table	*Description*	*July-Sept 02*	*Oct-Dec 02*	*Jan-March03*	*April-June 03*	*Average*
Table3	Differential diagnosis of child presenting with cough or difficult breathing					
Table 4	Differential diagnosis of young infant presenting with cough or difficult breathing					
Table 5	Classification of the severity of pneumonia					
Table 6	Differential diagnosis of the child presenting with wheeze					
Table 7	Differential diagnosis of the child presenting with stridor					
Table 8	Differential diagnosis of the child presenting with chronic cough					
Chart 2	Triage of all sick children					
Chart 15	Feeding recommendations during sickness and health					
Chart 17	Mothers card					
Chart 19	Weight for Age					
Assessment	Child 2 months to 5 Years- assessment, classification,					

	treatment					
	Young infant <2 months- Assessment, classification, treatment					
Antibiotics	Child 2-59 months					
	Pneumonia					
	Severe pneumonia					
	Very severe pneumonia					
	Infant < 2months(severe pneumonia and very severe pneumonia/disease					

40. Record the Child Lung Health Project supplies in the previous quarters.
Indicate A for available or B for not available

Item	July-September02	October-December 02	January-March 03	April-June 03	Average
Watch timer					
Weighing scale					
Stethoscope					
Thermometers					
Child Lung Health Manual					

PATIENT RELATED RISK FACTORS

Work with the ARI District Coordinator or deputy for the following section.

41.Can we have the pneumonia cards from 1st July 2002 to 30th June 2003 and district registers for the same period?

Collect all pneumonia recording forms as shown below and use recording forms only from July 2002 to June 2003. Verify the forms that they respond with the district inpatient pneumonia register. Check every tenth pneumonia recording from to verify numbers corresponds with the district inpatient register. Record the number assigned to pneumonia recording form and tick appropriately in relation to the district inpatient register.

Recording form number										
Yes										
No										
Number										
Yes										
No										
Recording form										

Number										
Yes										
No										
Recording form Number										
Yes										
No										

Collect all the pneumonia recording forms from1st July 2002 to 30th June 2003 for further analysis at Community Health Sciences Unit.

Annex 4…. Consent form

Request to Participate

I am--------------------from the Ministry of Health and Population. I'm here to conduct a study on children admitted with pneumonia in your hospital from July 2002 to June 2003. The study is trying to understand why pneumonia deaths among children are still high in our country. I would like to interview some hospital staff, and make some observations in the paediatric ward and pharmacy department.

Participation is voluntary and no negative consequences will be attached. Some questions will be asked on care of sick children in this hospital. Your answers will be written and later used for analysis. All the information provided will be handled as confidential and your individual answers will not be known to anyone apart from the interviewer and the co-ordinator of this study. The results will be used to improve child health services to reduce the high child mortality rate in the country. At least one hour will be required to discuss and record the information. Do you have any questions?

The results of the study will be communicated to the District Health Management Team after analysis.

If you agree with the information above and have no objections to participate, sign the consent form.

Consent Form

I understand the above information and I agree to participate in this study.

Signature……………………………….. Date (DD/MM/YY)………………….

Annex 5 Status of implementation for CLHP

Region	Districts Oct.2000	Districts April 2001	Districts April 2002	Districts April 2003	Districts June 2003	New Districts*
Northern	Nkhatabay	Rumphi	Mzimba	Karonga	Chitipa	Likoma
Central	Dedza Ntcheu	Kasungu Salima	Nkhotakota Lilongwe Ntchisi	Mchinji Dowa		
Southern	Thyolo Mulanje	Balaka Machinga	Chiradzulu Mwanza	Mangochi Zomba	Chikwawa Nsanje	Phalombe Neno
Total (cumulative)	5	10	16	21	24	27

* New district and no government hospital yet