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Risk factors of Lower Respiratory Tract Infections in the Northern part of Tanzania

A study conducted in Moshi, Tanzania

Master thesis in Medicine

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2 Abbreviations

AP	Aspiration Pneumonia
CAP	Community acquired pneumonia
COPD	Chronic Obstructive Pulmonary Disease
KCMC	Kilimanjaro Christian Medical Centre
MH	Mawenzi Hospital
PCP	Pneumocystis jiroveci Pneumonia
PTB	Pulmonary Tuberculosis
WHO	World Health Organization

3 Abstract

Risk factors of Lower Respiratory Tract Infections in the Northern part of Tanzania.

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Introduction: Tanzania is a low income country in Africa. Respiratory infections are the leading cause of death in low income countries. Risk factors include comorbidities and socioeconomic and environmental factors. Risk factors for severity include high age and comorbidities. Many factors are less well studied.

Purpose: To evaluate possible risk factors among adult patients with lower respiratory tract infection (LRTI) in Tanzania.

To establish which risk factors are common in more severe cases of community acquired pneumonia (CAP).

Methods: Analysis of medical files and a questionnaire distributed to patients admitted to medical wards at two hospitals, Mawenzi Hospital (MH) and Kilimanjaro Christian Medical Centre (KCMC). CRB-65 score was used to evaluate severity among CAP-cases.

Results: 70 patients with a mean age of 48 years. 44 % were male and 56 % female. 6 patients died.

HIV prevalence in the study population was 47 % compared to national prevalence 5 %.

Some factors that seemed to be associated with more severe cases were HIV-infection, unemployment and not having access to clean water.

Pulmonary tuberculosis (PTB) was more common in the urban population and CAP in the rural.

Mortality rate / total per LRTI was CAP: 1/38, Aspiration Pneumonia (AP): 3/8, PTB: 1/18 and Pneumocystis jiroveci pneumonia (PCP) 1/3.

Discussion: HIV is a strong risk factor for LRTI.

Unemployment may be a risk factor for more severe cases of CAP, due to financial reasons or a potential higher rate of comorbidities in this group, regrettably the study is too small to make any definite conclusions.

It is probable that an urban setting present risk factors for PTB, such as crowding.

4 Introduction

Worldwide lower respiratory tract infections (LRTI) are a common cause of both morbidity and mortality leading to more than 4 million deaths each year. Death rates are especially high in Africa, airway infections are the leading cause of death in low income countries [1].

Because of the limited resources in Tanzania diagnoses are mainly based on clinical investigations and treatment is often empirical [2]. Etiology is seldom established, cultivations are rare. Because of this problem it is sometimes difficult to differentiate between pulmonary tuberculosis (PTB), bacterial or viral pneumonia or even Pneumocystis jiroveci Pneumonia (PCP) among immunocompromised.

Pneumonia is an airway infection that affects the lung parenchyma, caused by any agent. Community acquired pneumonia (CAP) can be caused by both bacteria and viruses. The most common agent is Streptococcus pneumoniae. Other common bacteria are Haemophilus influenzae, which is common among chronic obstructive pulmonary disease (COPD) patients and can cause especially severe cases among children, but also Mycoplasma pneumoniae, common among children and young adults. Symptoms often include productive cough and sudden onset of high fever [3]. The infectious bacteria or virus can reach the lower respiratory tract by tree routes. The most common is micro-aspiration, this is the main mechanism when

the agent is pneumococci. The second mechanism is inhalation, predominantly for viruses and some atypical bacteria, such as Mycoplasma pneumoniae. In rare cases agents can also be carried to the lungs by the blood[4]. Known risk factors for CAP include high age, Chronic obstructive pulmonary disease (COPD), congestive heart failure, asplenia and HIV [4][5]. As well as high alcohol consumption and tobacco smoking [6][7]. Indoor air pollution is a risk factor among children but less is known of the impact on adults [1][8][9]. High age and smoking are also a risk factors for mortality in CAP [5][7][10][11].

Aspiration pneumonia (AP) occurs when gastric contents are aspirated into the lungs. The pneumonia is mainly caused by the chemical reaction of the acid, the bacterial infection that usually follows are most often caused by the oral flora and can include both aerobic and anaerobic bacteria. The prognosis is bad, due to the often necrotizing damage inflicted in the lung parenchyma. Known risk factors for AP are stroke, acute alcoholism and coma [3][6].

Pulmonary tuberculosis (PTB) is a type of chronic pneumonia mainly caused by Mycobacterium tuberculosis. Tuberculosis can affect the entire body but the lungs are the most common focus. The infection can remain latent for years and then reactivate when the function of the immune system decreases. Among HIV-patients it is common to be coinfected with tuberculosis, infection occurs when aerosols are inhaled. Common symptoms are malaise, weight loss, low grade fever and sometimes night sweats. The cough is often increasingly productive [3]. Approximately one third of the world's population is infected with tuberculosis, about 10 % of these develop an active disease [4]. Over 95 % of the deaths due to tuberculosis occur in low and middle income countries, it is the leading cause of death among HIV-positive [12]. Risk factors include crowding, chronic illness, malnutrition, alcoholism, HIV-infection and tobacco smoking [1][3].

Pneumocystis jiroveci pneumonia (PCP) is a type of opportunistic fungus infection that exclusively affect people with grave immunodeficiency. It is the most common AIDS defining diagnosis in western countries. Untreated, is has a high mortality rate. The onset is usually gradual with dry cough, fever and dyspnea [3][4].

Children in Tanzania are vaccinated with BCG- against tuberculosis and Hib against Haemophilus influenzae type B. Pneumococcal conjugate vaccine was recently included in the Tanzanian pediatric immunization program [13][14].

Treatment guidelines: There are national treatment guidelines for the Tanzanian mainland, the latest edition is from 2007. These guidelines are not strictly or formally used by any of the hospitals in this study though. KCMC have established their own treatment protocols. For CAP among adults the national guidelines recommend Amoxicillin or Cotrimoxazole for mild cases and Benzylpenicillin for severe cases. For CAP KCMC recommend Ampicillin, Amoxicillin or Erythromycin. If the patient has a comorbidity of HIV Cotrimoxazole is to be added. For hospital acquired pneumonia KCMC recommend Ceftriaxone, national guidelines propose Ampicillin and Gentamycin. Regarding aspiration pneumonia the national guidelines and KCMC both advocate Benzylpenicillin and Metronidazole but national guidelines also recommend Amoxicillin. For PCP national guidelines suggest Cotrimoxazole. For active PTB national guidelines recommend RHZE initially, Rifampicin, Isoniazid, Pyrazinamide and Ethambutol [12][15][16].

The United Republic of Tanzania is a Sub-Saharan low income country with a population of almost 48 million, 2012. Life expectancy at birth is 60 years. 38 % of the population was living under the national poverty line in 2007 [17]. The population is young, only 56 % are over 15 years of age. The Tanzanian mainland is divided into 21 regions [18]. The official language is Swahili but English is used for higher education. Medical records are written in

English. The present study was conducted at two hospitals in Moshi. “Kilimanjaro Christian Medical Centre” (KCMC) is a referral hospital for over 11 million people in Tanzania with over 450 beds. The hospital is connected to ”Kilimanjaro Christian Medical University Collage” [19]. Mawenzi Regional Hospital is a hospital for the Kilimanjaro region, with approximately 300 beds [20]. Moshi is situated in the Kilimanjaro Region, in the north eastern part of Tanzania, close to the border of Kenya [17][21]. The region is mainly rural except for the urban city of Moshi [20]. In the Tanzanian mainland, it was estimated in 2009 that, one medical doctor on average served a population of 64 000, In the Kilimanjaro region that number was one per 58 000. The World Health Organization (WHO) recommends that one doctor should serve a population of 10 000 [22]. Main providers of health services are the government (60 %), private practitioners(19%) and voluntary and religious organizations (15 %). The later are mainly organized under the “Christian Social Services Commission” (CSSC) and the Muslim Council of Tanzania” Health services are divided into three levels. The “Primary” is consisted of dispensaries and health centers. The “Secondary” mainly of district hospitals and CSSC-hospitals. The “Tertiary” resembles the “Secondary”, with the addition of some specialized surgical and medical interventions. The CSSC-facilities charge user fees, with the exception for some child- and preventive health care services. The government also has user fees commonly known as “cost sharing”. The development budget consists mainly of foreign funds, this combined with governmental funds provides for the expenditures of the health sector [23]. Gross domestic income per capita for Tanzania 2012 was $ 1500. Total expenditure on health as % of gross domestic product was 7,3 % in 2011 [24]. Education is divided into three levels, “primary school” seven years, “secondary school” six years and “university”. The Kilimanjaro region is the region with the lowest proportion of inhabitants who have never gone to school, and one of the regions with the highest mean years of attending school per person [25]. Lower respiratory tract infection is a common cause of morbidity

and mortality among adults in Tanzania [1]. Actions, such as vaccination programs, have been done to prevent LRTI among children but less is known and done about the adult population [14]. Since there are limited resources to diagnose and to treat LRTI in Tanzania it is important to learn about risk factors, in order to identify preventable causes. To evaluate the treatment of patients is crucial in order to identify possible areas of improvement. Studies carried out in other parts of the world show risk factors that the world has in common, such as tobacco smoking and high alcohol intake [6][7]. It is probable that these factors are equally important in Tanzania. It is plausible to believe, though, that some factors are important in Africa but lack relevance in other areas. Without studies being done in countries like Tanzania, important information may be overlooked. Examples of such possible risk factors are comorbidities of diseases and conditions common in Africa but unusual on other continents. Another example is that of local traditions, cooking by an open stove, sometimes indoors, generates air pollution of unknown impact. This behavior is rare in other parts of the world and therefore less studied than general risk factors, such as tobacco smoking. More knowledge will enable the physicians in Tanzania to save lives.

5 Aims

- To evaluate possible risk factors among adult patients with lower respiratory tract infection in the northern part of Tanzania.
- To establish which risk factors are common in more severe cases of community acquired pneumonia.
- To investigate which risk factors are connected to a higher mortality rate.
- To determine the treatment regime of patients diagnosed with lower respiratory tract infection at KCMC and MH.

6 Method

The general characteristics were outlined by the supervisors during a visit of the Swedish supervisor to Tanzania. KCMC was chosen because the universities have had previous contact and cooperation.

The material was collected at Kilimanjaro Christian Medical Centre (KCMC) during five weeks, in October and November, 2013. At Mawenzi Hospital (MH) the data was collected during two and a half weeks in November 2013. All patients admitted to the adult medical wards, who had a suspected lower airway infection, noted in the medical file, based on the assessment of the physician in charge, were asked to participate. These include both those who were admitted due to the pulmonary infection as well as those admitted due to another cause. Less than five patients who were eligible to participate were excluded, most because they were too ill to participate. The cases were divided into four different diagnosis groups based on the most probable type of infection, assessed by the Tanzanian physicians. The groups were “Community acquired pneumonia” (CAP), “Pulmonary tuberculosis” (PTB), “Pneumocystis jiroveci pneumonia” (PCP) and “Aspiration pneumonia” (AP). Patients of all ages were included if they were admitted to the adult medical wards. There were two medical wards at each hospital. The patients were found by a review of the “Admission-“ and “Round Books” at the wards as well as by help of the medical staff.

Since the present study is a small one, it was estimated that it would be too difficult to find a suitable control group, which would be sufficiently matched to the cases in the study. For that reason the results found in the study have been compared to statistical estimates found mainly on the web-pages of the “World Bank” and “World Health Organization (WHO)”, concerning Tanzania.

The questions were designed to cover previously known risk factors as well as less studied ones. The questions were also adapted to fit the setting in Tanzania. Some ideas for risk

factors were also brought to the attention of the writher by various articles [5][11]. To capture the patients' socioeconomic status questions such as which type of house they live in was added as well as occupation, source of income and monthly income. The questionnaire was translated into Swahili by the assistance of the Tanzanian supervisor. Neither the questionnaire nor the case record form have been used for any previous study. The outline of the case record form was mainly written by the Swedish supervisor, some adjustments were made by the student while collecting data in Tanzania, based on what information could be found in the medical records. In some cases information of more comorbidities were found in the medical record than those that the patient themselves reported. In those cases all the diagnoses found in either the file or the questionnaire was included.

To evaluate the severity of cases the case record form included questions to cover factors included in the CRB-65 scale. These factors are the following: confusion, respiratory rate ≥30/min, systolic blood pressure <90 mmHg or diastolic blood pressure ≤60 mmHg and age ≥65 years. Every occurring factor contribute with one point. The sum of the present factors add up to a total between 0-4 points, where a higher count is connected to higher mortality and worse prognosis [4]. The sum of CRB-65 were noted for all CAP patients, including the cases where all information couldn't be found in the journal. If there was no comment about confusion in the file, it was assumed that the patient was not confused. CRB-65 score is only accepted as a method for evaluating severity of CAP, not among other LRTI.

Mortality was defined as deaths that occurred during the hospital stay. No follow up was done concerning what happened to patients after they had been discharged, nor the outcome of the patients who were still admitted when the data collecting period was ended.

HIV status was divided into positive, negative and unknown. Patients were defined as positive if they reported to be so in the questionnaire or if the information of seropositivity could be

found in the medical journal. Patients were defined as negative if they had been tested negative during the present hospital stay. All others were classified as to have an unknown sero-status. Information about CD4-count was collected in order to evaluate in what stage of the infection the seropositive patients were. When the CD4-count drops below 250 * 10^6/L, the risk for opportunistic infections increases [4].

For some analyses, patients were divided into age-groups, for comparison. These groups were as follows: "≤24 years", "25-39 years", "40-54 years", "55-69 years" and "≥70".

Information about the treatment was collected from the medical journal and drug sheets. At KCMC all drugs in the drug sheets were noted down, with some additions for drugs that were ordinated in the file text. At MH the drug sheets were used if such a document could be found in the journals, at this hospital the main source of information was the medical file. All antimicrobials ordinated were included in the analysis since it seldom was specified on what indication a drug was given. Of the antimicrobials used one category is Anti-TB. The type of treatment was not specified more since it often could not be found in the file which drugs were used. In the cases it was specified the most common was RHZE- Rifampicin, Isoniazid, Pyrazinamide and Ethambutol.

How the questions in the questionnaire were put and which response options were available can be found in the attached document, under "Appendices". The question about alcohol concerned only present frequency of consumption. When it was found in the medical file or the patient themselves admitted to having had an overconsumption of alcohol in the past this was noted down but not asked for actively. The comorbidity group tuberculosis includes both cases with current TB as well as patients who has received this diagnosis in the past.

7 Ethics

Participation in the study was voluntary. The patients were informed about the study, as well as being asked to join, in Swahili, by a Tanzanian assistant. Patients or their close relative gave oral, informed, consent to participate in the study. All personal data was codified. No names were noted down. No intervention was performed. The questionnaires were filled in by the assistant or by the patients themselves. The project plan was reviewed and cleared by the Ethical Committee of Kilimanjaro Christian Medical University Collage, Moshi.

8 Data collection procedures and Statistical methods

The questionnaires at KCMC were filled out exclusively by the same assistant. At MH they were filled out by the patients themselves and in some cases by an assistant or close relative. The information noted in the case record form was all found in the medical journal and the data were collected exclusively by the Medical student conducting the study. Information such as blood pressure, temperature and pulse rate were collected from the journal entry the day of admission. Test results and chest x-ray results were included if they were performed during the current episode of illness. In some cases these investigations were ordered but not answered when reading the file for the first time, additional reviews were then preformed regularly to find the results of the investigations. For every seropositive patient, if the information could be found, the most recent CD4-count was noted down, regardless of how long time ago it was taken. Information about deaths as well as the number of days spent in the present hospital were found in the "Admission Book".

The medical data was entered into SPSS - Statistics Data Editor and analysed in this program.

9 Results

70 cases were included in the study, 43 from KCMC and 27 from MH. Mean age was 48 years, 47 years among the women and 49 years among the men. Median age was 45 years and

42 years, respectively. The ages ranged from 14 to 95 years. 31 patients (44 %) were male, 39 (56 %) female. The number patients of each gender were almost the same at KCMC, 22 males and 21 females. At MH the groups differed more, 9 men and 18 women were enrolled there.

Information that chest x-rays were done or planned was found among 84 % of the cases at KCMC and in 74 % at MH, and in 74 % of the male cases and 85 % of the female.

Six patients (9 %) were confirmed to have died during the hospital stay, two women and four men. All of the deceased patients had been enrolled at KCMC. Among the CAP patients, the CRB-65 scale, used to evaluate the severity of cases on admission was complete, with all the factors known, in 21 % of the cases. Most patients had zero points, none had three or four. A majority of the male patients at KCMC had ≥ 1, compared to 0 among the women. At MH a majority of both sexes had score 0. When comparing the two hospitals, cases at KCMC on average had a higher score than MH. KCMC had 9 patients with 0 points, 5 patients with 1 point and 4 patients with 2 points (33 % complete) whereas MH had 11 patients with 0 points, 7 patients with 1 point and 2 patients with 2 points (10 % complete). Only one of the deceased patients had CAP, that patient had score 0. Comparing different age-groups showed that the youngest and oldest age-groups both had most cases with 1 or 2 points. All the other age-groups had most cases with score 0.

Hospital	Gender	CRB-65	Frequency	Percent
KCMC	Male	0	1	14,3
		1	4	57,1
		2	2	28,6
		Total	7	100,0
	Female	0	8	72,7
		1	1	9,1
		2	2	18,2
		Total	11	100,0
MH	Male	0	3	60,0
		1	2	40,0
		Total	5	100,0
	Female	0	8	53,3
		1	5	33,3
		2	2	13,3
		Total	15	100,0

Table 1.Distribution of CRB-65 score related to hospital and gender.

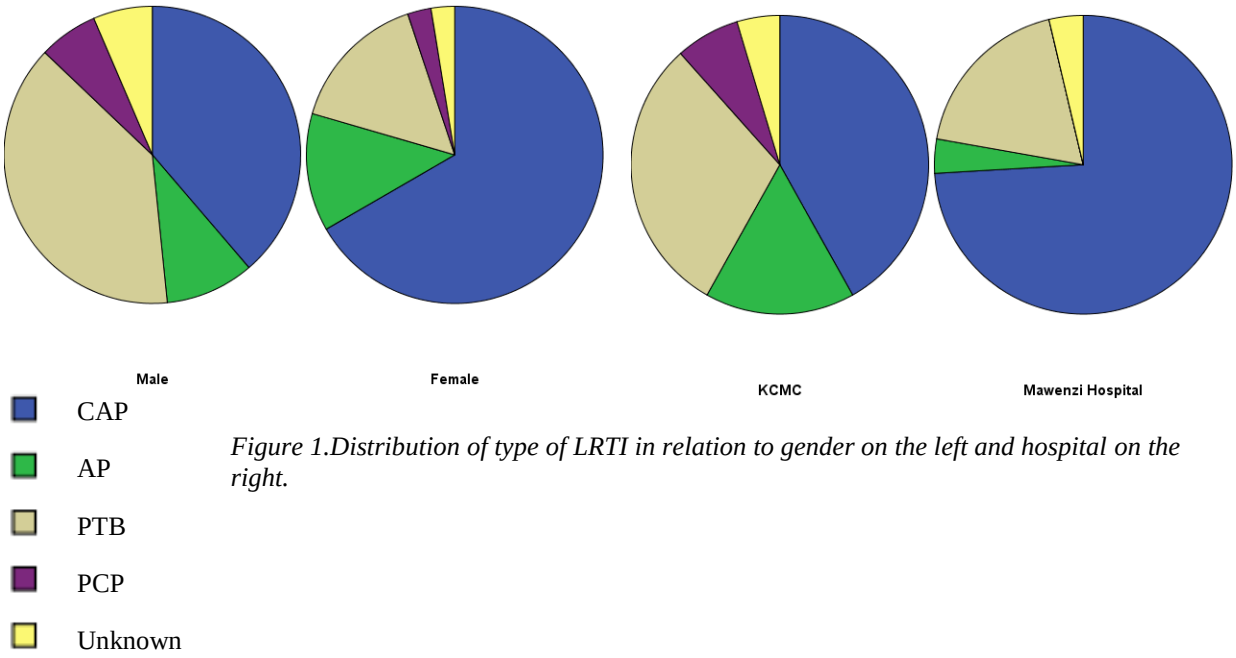


Figure 1.Distribution of type of LRTI in relation to gender on the left and hospital on the right.

The most common diagnosis among the cases of the study was Community acquired pneumonia (CAP), in 54 % of the cases. Second most common was Pulmonary tuberculosis (PTB), 26 %, followed by Aspiration pneumonia (AP), 11 % and Pneumocystis jiroveci pneumonia (PCP) 4 %. When analyzed for the hospitals separately the numbers were as shown in table 2. CAP was a more common diagnosis at MH, 74 % of the cases, whereas the diagnoses were more evenly distributed at KCMC. Comparing the sexes separately shows, as can be seen in figure 1, that women were more often diagnosed to have pneumonia than men, 67 % compared to 39 %. Men were more often diagnosed with PTB compared to women, 39 % compared to 15 %.

	Hospital					
	KCMC		Mawenzi Hospital		Total	
	Count	Column N %	Count	Column N %	Count	Column N %
Community acquired	18	42%	20	74%	38	54%
Aspiration	7	16%	1	4%	8	11%
Pulmonary TB	13	30%	5	19%	18	26%
PCP	3	7%	0	0%	3	4%
Unknown	2	5%	1	4%	3	4%

Table 2.Distribution of LRTI related to hospital.

Mean (Median) days of symptoms before admission was for CAP 26 (7), AP 20 (14), PTB 34 (30) and for PCP 14 (14)days. Among the HIV-positive patients the distribution of the number of cases with different diagnoses was CAP 17 (52 %), PTB 11 (33 %), PCP 3 (9 %) and AP 1 (3 %). Comparing the distribution of different LRTI-types in different age-groups showed that aspiration pneumonia increased with increasing age and that CAP was most common in all age-groups except for the oldest patients, age 70-95 years. In this age-group CAP and PTB was equally common but the most common type was AP. 38 % of the patients diagnosed with aspiration pneumonia had also been diagnosed with stroke, compared to 5 % in the entire study population. 50 % of the mortality cases were in the "aspiration pneumonia" group, 3/8 AP cases, the other groups had one mortality case each. CAP: 1/38, PTB: 1/18 and among PCP: 1/3 patients died.

Among the patients in the present study, 47 % of the cases were HIV-positive. The prevalence was higher among the female subjects, 56% compared to males, 35%. The percent of patients with unknown sero-status was higher among men. 58 % for men compared to 36 % among women. CRB-65 score differed between the groups of different HIV-status. All "seronegative" patients had 0 points. There was no difference between the "unknown" group and the "seropositive", there were 17 cases of CAP in both groups distributed according to score (number of cases): 0 (8), 1 (6) and 2 (3). 50 %, 3/6, of the patients that died were seropositive. In the HIV-positive group, CD4-count could be found for 22 patients (67 %). The mean cell count was 151*10^6/L, ranging from 1*10^6/L to 631*10^6/L. 82 % of the seropositive patients had a CD4-count below 250*10^6/L. The HIV-diagnosis had been known for a mean of three years, ranging between 0-16 years. Half of the cases where the year of HIV-diagnosis was known, 13 out of 26 cases, had been diagnosed during 2013. This group of patients had a mean CD4-count of 28*10^6/L. 7 patients in this group had CAP and

71 % of those had CRB-65 ≥ 1. Two of the six mortality cases were within this group of 13 newly diagnosed HIV-patients.

Educational level was similar between the sexes, with a small overrepresentation of females in the groups “No education” or “Primary education” compared to males, who had a slightly higher percentage in the groups “Secondary education” and “Collage/University”. The percent of subjects with no education was 13 % for females and 10 % for males. The education level differed when comparing different age-groups. In the youngest age-group all had some education, most had secondary. The subjects with university education were all in the age-groups “25-39 years” and “40-54 years”. All age-groups 25-69 years had a majority of subjects with “primary education”. The oldest age-group was dominated by “No education”, none of the cases in this group had secondary or university education. No CAP patients had university education, CRB-65 score was analyzed for the rest of the educational levels. Most patients with primary education had 0 points, the remaining two educational levels had most cases with score 1. 75 % of the subjects with university education were diagnosed with PTB, none with CAP. In the group with secondary education 70 % were diagnosed with CAP and 30 % with PTB.

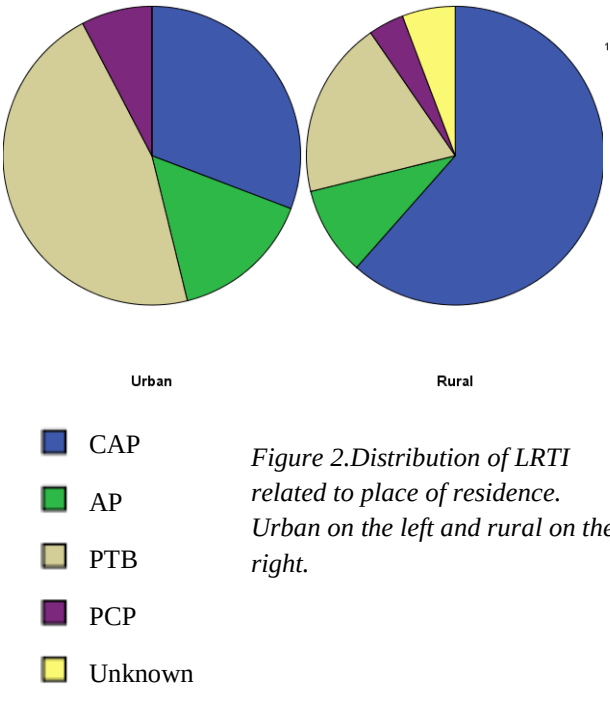


Figure 2.Distribution of LRTI related to place of residence. Urban on the left and rural on the right.

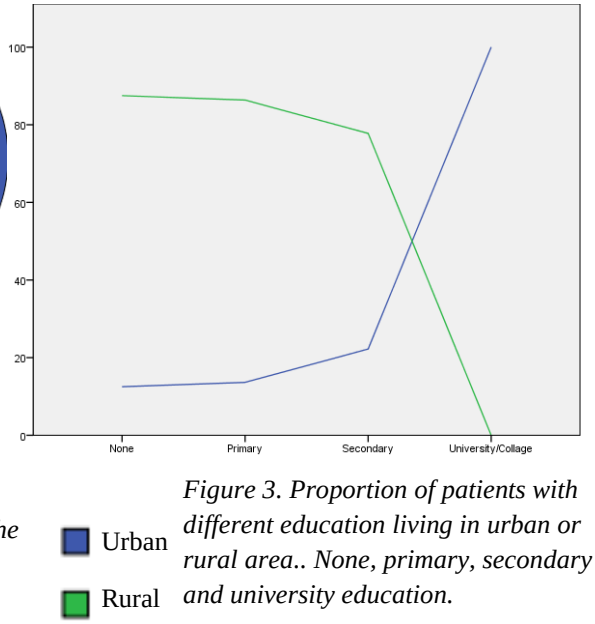


Figure 3. Proportion of patients with different education living in urban or rural area.. None, primary, secondary and university education.

The place of residence was answered as “urban” by 13 patients and “rural” by 52. Among the urban cases PTB dominated by 46 %, compared to 19 % in the rural group. Among the rural cases it was more common with CAP, 62 % compared to 31 % among the ones who answered “urban”. CRB-65 score (number of cases) for the CAP patients with urban residence was 0 (2) and 1 (2), compared to rural 0 (16), 1 (10) and 2 (6). Mean number of people sleeping in the same room as the patient was 2,00 in the urban group and 2,03 in the rural group. As can be seen in figure 3, the proportion of people living in the cities increased with increasing educational level, all patients who had gone to university had marked an urban residence. Among the other groups of educational level a majority lived in rural areas. No difference of consequence could be found when analyzing mean number of people sleeping in the same room to different types of LRTI.

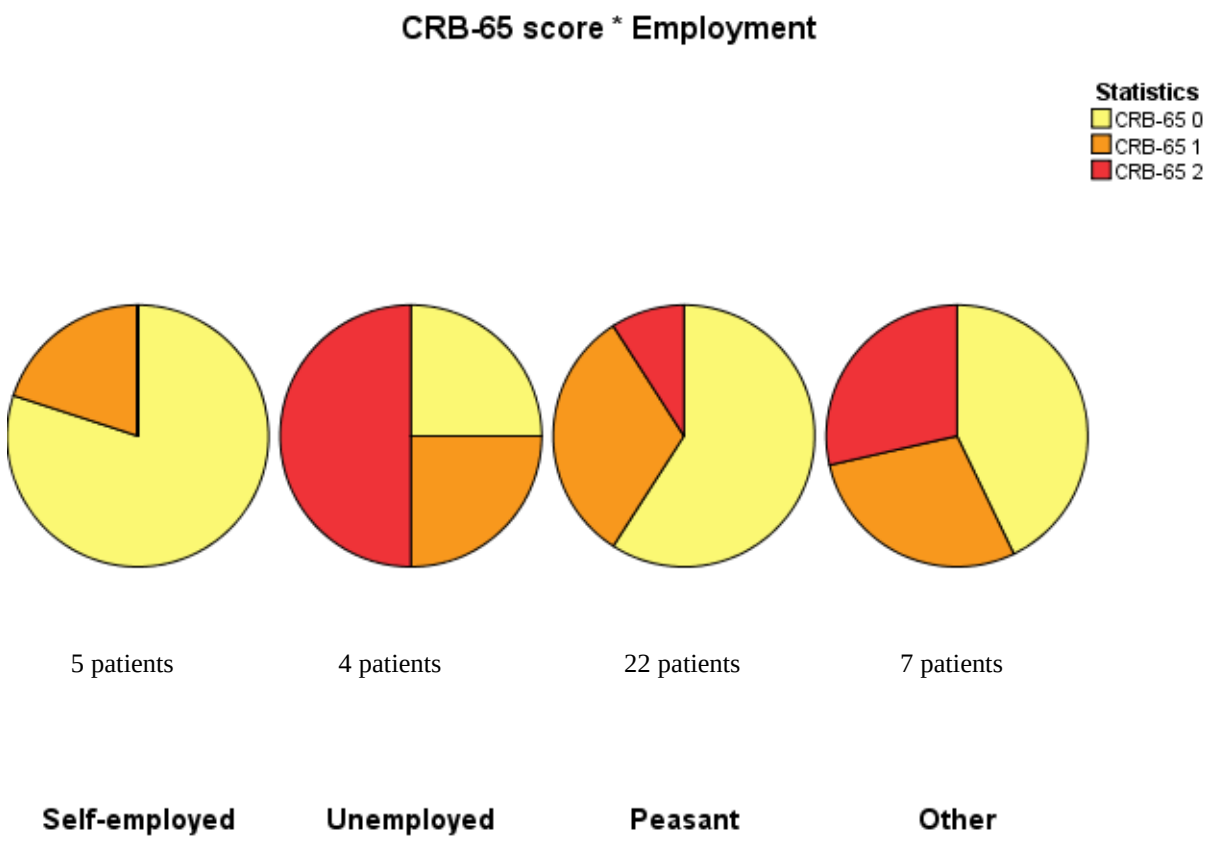


Figure 4. Occupation in relation to CRB-65 score. Figures are based on CAP-patients.

Concerning occupation 4 patients (6 %) reported to be "employed", 9 (13 %) "self-employed", 5 (7 %) "unemployed", 40 (57 %) "peasant" and 11 (16 %) "other". Of these 3 patients reported themselves as being both " peasants" and "self-employed". All PCP-patients were peasants. The other LRTI-types had similar distribution of the different employment groups but being peasant was less common among PTB-patients, 44,5 % compared to about 60 % in the other LRTI groups. PTB thereby had slightly larger proportions of the other types of occupation. 33 of the peasants lived in rural areas and 3 in urban. Among the CAP-patients CRB-65 score can be seen in figure 4. The group that stands out is the "Unemployed". 2/4 in this group had 2 points, compared to 0/5 in the "Self-employed" group, 2/22 among "Peasants" and 2/7 among "Others". There were no patients in the "Employed" group with CAP. Median number of days before coming to the hospital in the different groups were as

follows, for all LRTI-types (CAP only): employed 45 (-), self-employed 7 (7), unemployed 19 (7), peasant 7 (7), other 7 (7) and both self-employed and peasant 19 (30) days.

On examining the different types of LRTI with regard to alcohol consumption it was found that among the patients that drank alcohol once a week or more often had a higher incidence of aspiration pneumonia compared to the ones who never drank. No trends could be found comparing CRB-65 score for CAP- patients with different alcohol habits, nor any connection to mortality rate among all patients. Daily use of tobacco in the study population was 36 % among the male subjects and 10 % among the female. No type of LRTI or increased severity or mortality rate could be found linked to habits of smoking tobacco.

Source of energy * Type of LRTI Crosstabulation

		Probable type of LRTI					Total
		CAP	AP	PTB	PCP	Unknown	
Wood	Count	28	6	11	3	3	51
Electricity	Count	4	3	2	0	0	9
Kerosene	Count	2	0	1	0	0	3
Gas	Count	3	1	3	0	0	7
Charcoal	Count	7	0	2	0	0	9
Total	Count	37	7	16	3	3	66

Table 3. Source of energy used when cooking in relation to type of LRTI, based on cases. Some patients have answered with multiple responses. The total at the bottom row indicate how many cases of each diagnosis answered the question concerning source of energy.

The question concerning source of energy used when cooking was in some cases answered with multiple answers. As can be seen in "Table 3" the most common type of fuel was wood, followed by electricity and charcoal. The table also shows the relation to type of LRTI. All PCP cases used wood exclusively. 3/7 of the cases of AP used electricity, which was a much higher proportion than among the other types of LRTI. 3/7 of the patients who used gas had PTB. The frequency is the same for the patients with CAP but the proportion within the LRTI groups are higher for PTB than CAP. A larger proportion of those that had CAP used wood compared to PTB. A larger proportion of those that lived in a rural setting (88 %) used wood compared to those who lived in an urban area (31 %). No patients responded "other",

concerning type of fuel used. No trends could be spotted comparing CRB-values among CAP-patients who used different fuel, for any of the sexes. Of the cases that answered where the cooking took place 11 (18 %) stated indoors and 51 (82 %) outdoors. In the groups indoor/outdoor the percentage of LRTI who had CAP was 46/55 % and PTB 27/25 %. All the cases of PCP and AP, who answered this question, did their cooking outdoors. CRB-65 for CAP-patients, score (number of patients) for patients who cooked indoors were 0 (4) and 1 (1) and outdoor 0 (11), 1 (11) and 2 (6). The proportion of patients who cooked outdoors with score ≥1 compared to total in this group was higher for men compared to women, 80 % and 50% respectively.

To the question "Do you have access to clean water at home?" 73% answered that they did, 16 % that they did not, 3 % sometimes and 9 % did not answer. No major differences could be found between the ones with or without access in relation to type of LRTI. When looking at CRB-65 score for the CAP patients the ones with no access to clean water had higher score than the ones with access, 5/7 (71 %) had score ≥ 1 point compared to 12/29 (41 %) among the ones with access. No connection could be made between how often you eat a healthy meal and type of LRTI. Nor could such be found for CRB-65 score among CAP patients in relation to how often they ate healthy meals. The same was the case when examining the relation to different building materials used in the house the patients lived and the actions taken by the patient previous to admission.

The prevalence of comorbidities in the study population based on the cases where the information could be obtained, all except two, is shown in table 4. The most common ones were HIV/AIDS, disease of the lung other than chronic obstructive pulmonary disease (COPD), tuberculosis, hypertension and disease of the heart. The rest of the comorbidities were prevalent in less than 10 % of the cases in the study. Of the cases with comorbidities stroke or hypertension a majority of cases had aspiration pneumonia. Most comorbidities had

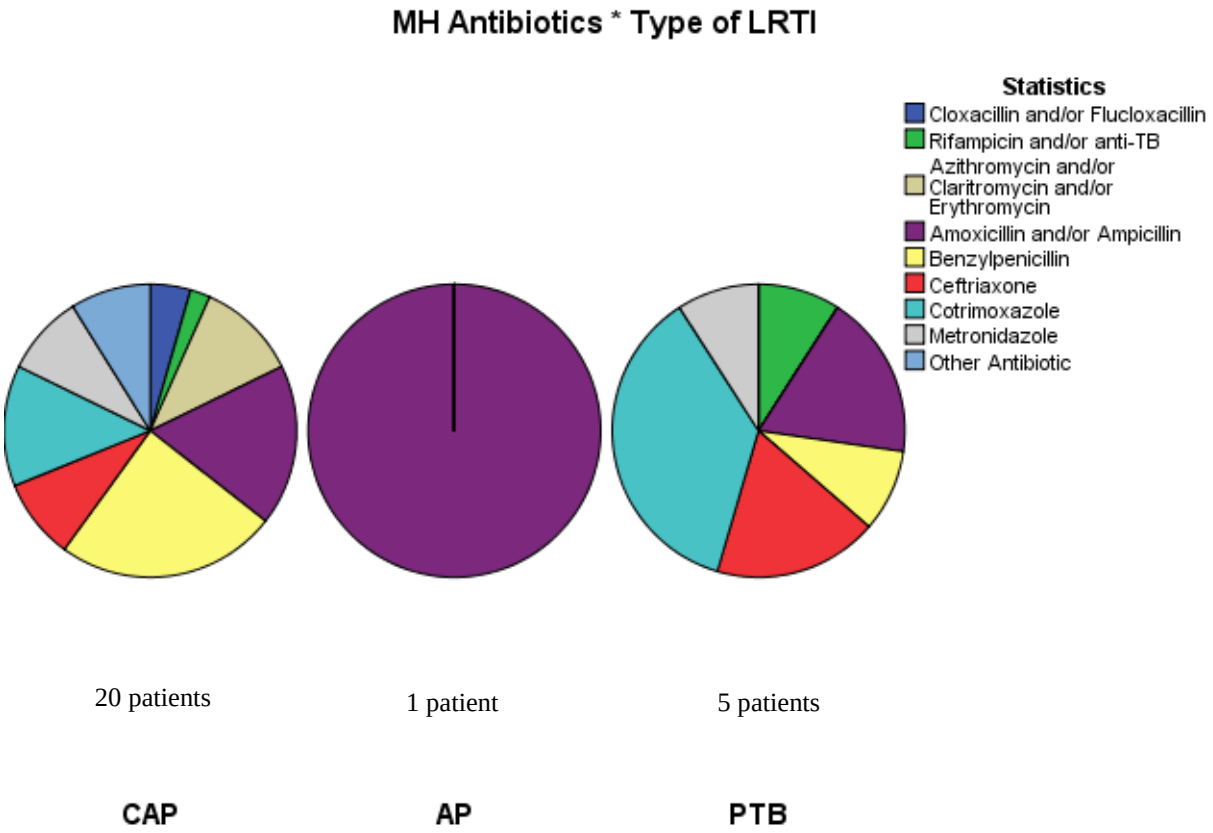
most percent of cases in the CAP group, tuberculosis naturally had more in PTB. The previously healthy had equal proportion in the CAP group and the PTB group. A majority of the CAP cases with HIV, disease of the heart or hypertension had CRB-65 score ≥ 1.

Comorbidity	Responses		Percent of Cases
	N	Percent	
Healthy	5	4,7%	7,4%
HIV positive/AIDS	33	31,1%	48,5%
TBC	13	12,3%	19,1%
COPD	5	4,7%	7,4%
Disease of the lung, other	22	20,8%	32,4%
Disease of the heart	7	6,6%	10,3%
Hypertension	9	8,5%	13,2%
Stroke	4	3,8%	5,9%
Diabetes	2	1,9%	2,9%
Other	6	5,7%	8,8%
Total	106	100,0%	155,9%

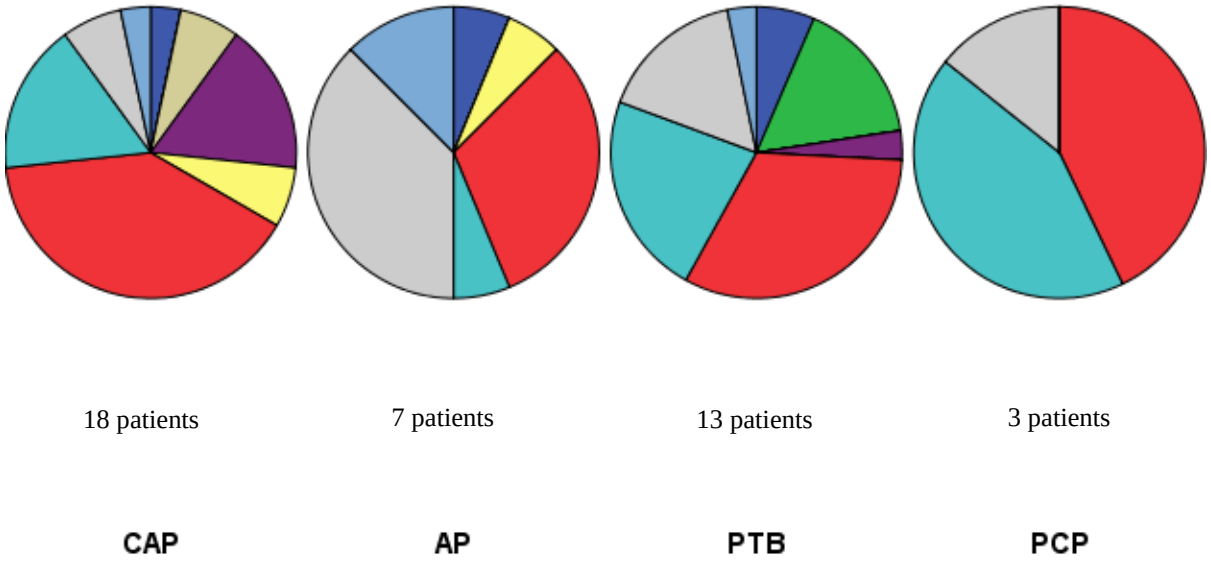
Table 4. Distribution of comorbidities among the study subjects where information about comorbidities could be obtained, 68 patients. Some had more than one comorbidity. Because of this reason the percentage of responses differ from the percentage of cases and the total percent of cases exceed 100 %.

Antimicrobials	Responses		Percent of Cases
	N	Percent	
Amoxicillin	8	4,6%	11,8%
Ampicillin	9	5,2%	13,2%
Azithromycin	3	1,7%	4,4%
Ceftriaxone	39	22,4%	57,4%
Chloramfenicol	1	0,6%	1,5%
Ciprofloxacin	3	1,7%	4,4%
Claritromycin	2	1,1%	2,9%
Clavulanic Acid	1	0,6%	1,5%
Cloxacillin	6	3,4%	8,8%
Cotrimoxazole	28	16,1%	41,2%
Doxycycline	1	0,6%	1,5%
Erythromycin	2	1,1%	2,9%
Flucloxacillin	1	0,6%	1,5%
Gentamycin	2	1,1%	2,9%
Itraconazole	1	0,6%	1,5%
Metronidazole	20	11,5%	29,4%
Rifampicin	1	0,6%	1,5%
Benzylpeniccilin	15	8,6%	22,1%
Acyclovir	1	0,6%	1,5%
Anti-TB	7	4,0%	10,3%
Fluconazole	23	13,2%	33,8%
Total	174	100,0%	255,9%

Table 5. Number and percent of responses and cases with various types of antimicrobials. Some patients had more than one drug. Because of this fact the percentage of cases exceed 100 %.



Figures 5 and 6. The Pie charts show the distribution of antibiotics related to type of LRTI at Mawenzi Hospital above and KCMC below Color labels apply for both figures. Antibiotics have been divided into groups of similar drugs. Note that these figures only include information of antibiotics, not all antimicrobials.



Among the study subjects 80 % had been ordinated multiple antimicrobials. The frequency of different drugs, among the cases where information concerning medicines were obtained, are shown in table 5. Distribution of antimicrobials related to type of LRTI, divided for the two hospitals, is shown in table 6, under "Appendices". The most common one was Ceftriaxone, followed by Cotrimoxazole, Fluconazole, Metronidazole and X-pen, a type of Benzylpenicillin. Comparing the different hospitals shows that Ceftriaxone was more common at KCMC compared to MH. At MH it was equally common to be treated with Amoxicillin as Ceftriaxone but the most common drug was Benzylpenicillin. Cotrimoxazole was used in similar proportion at the two hospitals. The most common combination of drugs among the cases at KCMC was Ceftriaxone, Cotrimoxazole, Metronidazole and Fluconazole in combination (4 cases) or Ceftriaxone as single treatment (4 cases). At MH the most common was single therapy of Benzylpenicillin, or a combination of Benzylpenicillin and Amoxicillin or Ceftriaxone, Cotrimoxazole and Fluconazole (2 cases each). The most common drugs used for CAP was: total Ceftriaxone, Benzylpenicillin and Cotrimoxazole, at KCMC Ceftriaxone, Cotrimoxazole and Ampicillin and at MH Benzylpenicillin, Cotrimoxazole and Amoxicillin. The most common for AP was: total and at KCMC Metronidazole, Ceftriaxone and Ciprofloxacin, at MH one case with Ampicillin. The most common for PTB and PCP was total, and for both hospitals, Ceftriaxone, Cotrimoxazole and Fluconazole. Of the 68 patients where information about treatment was found there were 21 different combinations of antimicrobial treatment.

10 Discussion with Conclusions and Implications

The number of cases of each sex were the same at KCMC but more women than men were enrolled at MH. This difference could be explained by the fact that more patients were admitted to the female medical ward than the male one during the data collecting period at MH. It could also be explained by the fact that more time was spent, by the researcher, at the

female ward because of the previous reason. Thereby enabling even more female cases to be found. There was a difference between the type of LRTI diagnosis between the sexes. This could be due to that the genders are exposed to different risk factors or that symptoms are interpreted differently depending on the sex of the patient.

Among the HIV-positive patients all the PCP patients were found, as expected, since PCP is an opportunistic infection. The proportion of PTB-patients was also higher in this group than in the total study population 33 % compared to 26 %. Since PTB is a common coinfection to HIV this was no surprise, the results were slightly lower than the numbers that had been estimated by WHO for seropositive in the country as a whole though, 39 %, 2012. Tanzania has a prevalence of tuberculosis of 176 per 100 000 in the population [26]. The size of the study population is unfortunately too limited to analyze the difference. PCP and tuberculosis has previously been found to be the most common cause of pulmonary disease among HIV-positive in Sub-Saharan Africa, but this group is also more susceptible to respiratory infections in general, in the present study it was more common with CAP [2][27]. It is also possible that some PTB-patients were misdiagnosed as having CAP, thereby lowering the count. This could be suspected mainly among the patients at MH, since the proportion of CAP-diagnoses were higher there than at KCMC.

When comparing different age-groups it seems that high age is a risk factor for aspiration pneumonia, as this type was increasingly common the older the patients were. This could mainly be explained by the increase of incidence of stroke with increasing age. It was more common to have a comorbidity of stroke among the patients diagnosed with aspiration pneumonia compared to the other types of pneumonia. Median days for duration of symptoms were highest for PTB and lowest for CAP, as can be expected since PTB is a chronic disease and CAP an acute one.

The means of evaluating the severity of CAP cases used in this study was the CRB-65 score. According to the score results, KCMC had more severe cases than MH. This could be explained by the fact that KCMC is a referral hospital, a hospital where other hospitals, among them MH, sends their most difficult cases. Although, the difference can also be explained by the fact that the journals at MH often lacked information concerning one or more of the factors used to calculate the score. All the information needed for calculating the score could be found in 33 % of the medical journals at KCMC compared to 10 % at MH. The factor most often missing was information if the patient was confused or not at admission, which is usually not negated when orientation is normal. The most common score among men at KCMC was 1 and among females 0. This could be due to different risk factors separating the genders. That no CAP patients had score 3 or 4, may be explained by the fact that a few patients who met the inclusion criteria were excluded because they were too ill to participate. Comparing the different age-groups with regard to CRB-65 showed that both the youngest patients and the oldest ones had proportionally more severe cases than the other groups. This could be interpreted as high age as well as being young are risk factors for more severe cases of CAP, previous studies have also found high age to be a risk factor for severity [11]. No explanation can be found for the youngest patients being more affected than the middle-aged. It is difficult to analyze the results due to there being so few cases in each group, the differences found could be a coincidence. Another way to measure the severity of cases could have been to measure the duration of the hospital stay. In the present study that information was collected but not used because of two reasons. First, some patients were admitted due to the respiratory infection and others because of another illness. Because of this inhomogeneity the number of days spent in the hospital would reflect the combined condition and not the respiratory infection exclusively. The same weakness sadly also apply to the use of CRB-65, since comorbidities other than respiratory tract infections also can alter the blood pressure,

respiratory rate and induce confusion. The second problem with using the number of days spent in hospital was that the count was incomplete in too many of the cases. Some of the patients were still admitted to the hospital wards when the data collecting period ended. No follow up was done to investigate the duration of the hospital stay for these patients. In other cases the patients was discharged from the wards but no information was found about which date this occurred or in what condition they were discharged.

Mortality rate: The six patients who were confirmed dead in the study were all admitted to medical wards at KCMC, none at MH. This could in part be explained, like the severity of cases, by the fact that KCMC is a referral hospital, which treats more advanced cases. It could also be a coincidence since there are so few cases of mortality. Half of the mortality cases were diagnosed with aspiration pneumonia, indicating that this type of LRTI is a risk factor for mortality. The study is too small to say for certain. The increased number of deaths in this group could also be due to comorbidities such as stroke and not be attributable to the LRTI at all. The death rate is equal to those found in similar previous studies, both from Africa and Europe [5][10]. It is possible that the present mortality rate is falsely low though. First, mortality was only recorded if it occurred during the hospital stay, more patients could have died shortly after being discharged. Second, some patients wasn´t included because they were in a too serious condition to be enrolled, this leads to a study population which reflect less severe cases than in reality. Third, some patients were transferred or discharged without the researcher being able to find sufficient information about which date or in what condition, it is possible that some of these patients died following the respiratory infection.

Differences between the proportion of types of LRTI between the hospitals could be explained by the fact that KCMC is a referral hospital and MH a regional hospital and that these different types of establishments handle slightly different cases. Another explanation

could be that MH is mainly staffed by Medical officers in opposition to at KCMC where there are more specialists. Physicians with different education may interpret symptoms differently.

HIV was much more common among the study population than in the population as a whole. This finding was similar to results in similar previous studies, in a Kenyan study among adults with acute pneumonia, 52 % were seropositive [5]. Among the patients in the present study, 47 % of the cases were HIV-positive. This number can be compared to the prevalence in Tanzania as a whole, 5,1 % in the age-group 15-49 years [28]. The difference is even greater when compared to the prevalence in the Kilimanjaro region, 3,8 % [29]. This can be interpreted as HIV being a strong risk factor for falling ill with respiratory tract infections. Especially for contracting a severe infection enough to be admitted to hospital, which all the subjects in the present study were. It would be interesting in future studies to investigate the difference between cases treated as in-patients compared to out-patients. It is also possible that more patients in the seropositive group were admitted compared to previously healthy just because of the fact that they had a comorbidity of HIV. HIV-prevalence was higher among the female patients than among the male. This reflects previous results among the Tanzanian population and may represent a higher true prevalence among women, a more frequent care-seeking behavior among women, but also that more women get tested [29][30]. The later reason is strengthened by the results found in the present study, where it was more common that the sero-status was unknown among men compared to women. Note that no conclusions can be made about any difference in the testing for HIV or hospital care between the sexes since most of the seropositive patients had a known status before the present admission and no note was taken of how many patients, or their gender, in the study was tested during this episode of illness. The finding that CRB-65 score was higher in the seropositive group and the unknown group compared to the seronegative group was interesting and can at least in the seropositive group be explained by the fact that these

patients, in the later stages of the infection have a compromised immune system, by definition. In the present study it is difficult to draw conclusions from these findings though since the study population is too small, only four patients represent the known seronegative population with CAP. Half of the mortality-cases were seropositive, which is close to the percentage of cases in the study with HIV, 47 %. This study could not show increased mortality among seropositive with respiratory infections, though the number of deaths are too low to draw any significant conclusions. This result is in line with previous findings [5]. A majority of the HIV-positive patients had a CD4-count below 250*10^6/L. This indicates, as could be expected, that being seropositive is mainly a risk factor for LRTI in the late stages of the HIV-infection. It could also imply that the sero-status is often unknown in the early stages of the infection, seropositive patients in the "unknown" group could plausibly have higher mean CD4-count than the cases in the "seropositive" group. Half of the HIV-positive cases in the present study had been diagnosed during the year of 2013. This group had a higher mortality, higher score on evaluating severity and a lower mean CD4-count than the rest of the seropositive patients. To prevent these severe cases and avoid some infections, it is very important to work towards an early diagnosis of HIV, so that treatment can be initiated in time.

The Tanzanian National Bureau of Statistics found that 10 % of females over the age of six never attended school, 4 % for males. In the present study the corresponding figures were 13 % and 10 % respectively[25]. That a larger proportion of cases in this study than in the general population never went to school could be seen as no education being a risk factor for LRTI, the study is too small to tell if the difference is significant though. The figures for the general population was also reached by examining a group with different age-criteria than the present study. If this was compensated for it is possible that the results of the studies would be the same. That 3/4 cases with university education were diagnosed with having PTB could be

seen as a sign that university education provides some kind of risk factor for contracting PTB. It is much more likely though that the result is just a coincidence considering only four patients had such high education. The result is further confounded by the fact that all the patients with university education had an urban residence. All of the patients who had gone to university also were HIV-positive, which present another strong confounding factor. No trends could be found that would indicate that successively more education shifts the cases from one type of LRTI to another. Neither could any trends be found comparing increasing level of education to CRB-65 score. A general limitation to the evaluation of education in this study was that no regard was taken to if the educational level in the answer had been completed or merely commenced.

That the most common type of LRTI among patients with an urban place of residence was PTB, in opposite to rural which was CAP, can be interpreted as there being a risk factor in the city that predisposes TB-infections, this factor could be crowding, in the home or generally. The only question in the questionnaire that concerned crowding was how many people who slept in the same room as the patient, with regard to the answers to this question no difference could be found between the urban and rural groups. There could plausibly also exist a factor in the rural areas which predisposes for CAP. The differences between the groups are quite large but there is a limitation to the factor since the question is subjective. Two neighbors could answer this question differently. At KCMC all questionnaires were filled in by an assistant which may have influenced the results, perhaps this is better for the conformity though, compared to MH, where the patients most often filled in the forms themselves.

The Kilimanjaro region statistics show that 47 % of the men and 42 % of the women, in the age 15-49 years, work within agriculture. This is a lower percentage compared to the study subjects [25]. Working within agriculture may be a risk factor for contracting LRTI. The results may also be a coincidence. That a smaller proportion of the peasants were diagnosed

with PTB than the other occupational groups is in line with the finding that PTB was less common among the rural population. A vast majority of the peasants reported to be living in rural areas. An interesting finding was that the unemployed with CAP on average had a higher score on CRB-65. Since there were only four patients in this group it is possible that this is a mere coincidence. But it could also imply that unemployment is a risk factor for more severe cases of CAP. In a previous Kenyan study unemployment was connected to a higher mortality rate [5]. It is plausible to think that a person who lack financial income is more likely to wait until he is really ill before seeking a doctor, thereby presenting a more severe case at admission. No connection to how many days with symptoms previous admission could be made, but this variable is probably more an indication of which type of LRTI it is, than how severe the cases are. The proportion of unemployed in the study population (7 %) was less than in the Kilimanjaro region as a whole, where 16 % of the men were unemployed and 23 % of the woman [25]. This finding supports the theory that the unemployed are less likely to come to the hospital if they are not feeling very ill. Due to financial reasons they may not come at all, regardless of the severity. Of course, on the contrary, this finding can also be interpreted as unemployment being a protective factor for falling ill with LRTI. It is important to remember that unemployed people in countries like Tanzania do not have the same benefits of social allowance from the government as in many western countries. "Unemployment" in low income countries is often equivalent to "inability to work" and dependence on family for financial support. This would imply that this group of patients may be ill with comorbidities to start with, leading to unemployment as well as contributing to these cases being more severe.

That more patients that drank alcohol often got aspiration pneumonia could be explained by the increased risk of aspirating when losing consciousness or dulling of the awareness. If this argument is to hold the patient would need to have a severe alcohol abuse though. Previous

studies have found several mechanisms by which alcohol has a negative effect on the immune system as well as affecting the oropharyngeal tone resulting in an increased risk for aspiration [6]. An important limitation to the interpretation of the results concerning alcohol is that no note was taken to what amount of alcohol that was being consumed, or what type, only how often it was taken. That this information was not asked for was due to the desire to keep the questionnaire from being too long. The Tanzanian adults (> 15 years) drank 6,8 liters per capita on average 2003-2005. That is a higher average than the entire African region, 6,2 liters. The patterns of drinking score found on the website of WHO indicate that the country have a medium risk pattern when evaluating the alcohol-attributable burden of disease [31].

During 2012 in Tanzania 23,0 % of the men and 1,3 % of the women smoked cigarettes daily [32]. These numbers are lower than for the present study where daily use of tobacco among men was 36 % and women 10 %. This could indicate that smoking tobacco daily is a risk factor for being admitted to hospital with LRTI. The numbers used for comparison was based on the entire Tanzanian population and may differ from the Kilimanjaro region though. Surprisingly no indication that groups in the study with different habits of smoking tobacco had any different outcomes could be found. This would have been expected since smoking is a known risk factor for CAP [7]. It is probable that a larger study would find a connection. The number of cigarettes smoked per day, as well as years of exposure, was asked but seldom answered in the questionnaire. Since this variable also is hard to quantify with only information about how often exposure occur no further conclusions can be made.

The results of which fuel is used for cooking can be compared with results from the entire Tanzanian mainland, there the proportion who used wood was 77 %, electricity 1 %, kerosene 2 %, gas 0,2 % and charcoal 19 % [25]. In this study the results were slightly less for wood and charcoal but higher for electricity, kerosene and gas. That could be interpreted that wood and charcoal are protective factors for LRTI or that the other fuels present risk factors. It is

more likely though that there is no real difference, that the results in the present study would be more like the whole mainland if the questionnaire had not allowed multiple responses. It is also possible that the Kilimanjaro region differs from the mainland in total. Concerning the distribution of source of energy used when cooking among different LRTI, the results concerning wood correlate with the results of place of residence. More patients that used wood had CAP, a larger proportion of those who lived in a rural area used wood and more of those that lived in a rural area had CAP. The finding that the CAP patients who did their cooking outdoors had a higher average CRB-65 score than the ones who did their cooking indoors was a result totally opposite the expected. One might suspect that cooking indoors would contribute more to the air pollution, which is a risk factor for pneumonia, at least among children [1]. When analyzing the genders separately it was found that the trend was strongest among the male subjects. That fact supports the idea that the finding might be coincidental. In Tanzania women traditionally do most of the cooking and are thereby more exposed to cooking fumes and should be considered more than the men when analyzing this variable.

A larger proportion of the study population (73 %) than of the population of the Tanzanian mainland (54 %), 2010, had access to clean water [25]. This could be interpreted as not having clean water is a protective factor for falling ill with LRTI. It is more likely though that there is no such connection. The answer to the question "Do you have access to clean water at home" is subjective and many patients may not know the answer. It was compared to data from the entire Tanzanian mainland, the access may be different in the Kilimanjaro region. The statistical data used for comparison had a more clear definition, in the question, and the data was based on "source of drinking water from an improved source" not "access to clean water at home" [25]. The study population without clean water had a higher CRB-65 score compared to the ones with. This can be seen as not having clean water at home being a risk

factor for more severe cases of CAP. To make certain this must be studied in a larger study with more clear definitions of clean water.

Concerning comorbidities, the high prevalence of HIV in the study population has already been discussed. The most surprising finding is the high prevalence of lung disease, other than COPD. This result is probably due to a misunderstanding of the questionnaire. It is possible that some patients agreed to this option because of the present LRTI. This was not the intension with the question. This suspicion is supported by the fact that patients with this option in the questionnaire seldom had any information about a lung disease in the medical file. That stroke is a risk factor for aspiration pneumonia can be explained by the loss of motor function and affected gag and swallowing reflexes [3]. That a majority of hypertension patients also were found among aspiration pneumonia cannot be explained by any such mechanism. Hypertension is a known risk factor for stroke though. Two of the five cases with aspiration pneumonia and hypertension also had stroke. Comorbidities among CAP patients in the present study that were connected to more severe cases were hypertension, disease of the heart and being HIV-positive. These diseases could be regarded as risk factors for more severe cases of CAP if the results are repeated in a larger study. Congestive heart failure has previously been found to be a risk factor for severity [11].

The percentage with multiple antimicrobials was surprisingly high. This might be explained by a discrepancy between what had been ordinated in the medical file, what was transferred to a drug sheet and what the patient actually received. This might be due to actual discrepancies or an insufficient understanding of the medical system by the researcher. The drugs shown in the results was also the total of antimicrobials ordinated, not exclusively for the indication of the present LRTI, since the indication was seldom noted. Many patients had other diagnoses being treated besides the LRTI. Of the most common drugs Ceftriaxone, Cotrimoxazole and Benzylpenicillin have pneumonia as one of the indications. Cotrimoxazole is also used as a

prophylaxis among HIV-patients. The high proportion of seropositive in the study population explain that it is a common drug in the study. Metronidazole is indicated to use for AP. Fluconazole does not have any type of LRTI as an indication. That Cotrimoxazole was used in similar proportion at KCMC and MH was as could be expected since the prevalence of HIV among the study subjects was similar at the two hospitals. KCMC followed their own treatment guidelines with regard to PCP and in part for CAP and AP. The most common treatment at MH was in line with national guidelines concerning CAP [15][16]. The results at KCMC may in part be explained by the fact that it is a referral hospital. More complicated cases are transferred there and it is more probable that the patients admitted there are treated for many conditions simultaneously. At KCMC a lot of Ceftriaxone was used which according to their own guidelines is first line treatment for hospital acquired pneumonia but not for other types of LRTI. A limitation to the present study is that it was not noted if the symptoms debuted more than 48 hours after admission. It is therefore possible that some of the cases categorized as CAP really were hospital acquired pneumonias. The proportion of these possible cases are estimated to be very low though. In general, at both hospitals, few patients received the same treatment. Overall it is difficult to analyze the results concerning drugs since it was not clear what the patients actually received.

Conclusions: To sum up, the following findings are what seem to be common among the subjects in the present study. Characteristics common among the CAP patients was to be female, to be admitted at MH, to have secondary education and to live in a rural area. The drug used most often to treat it was Ceftriaxone. For PTB it was to be male, to live in an urban setting and to be HIV positive. PTB was also common among those with university education. Ceftriaxone was the antimicrobial used most often. All PCP-patients were HIV positive, used wood for fuel when cooking and did their cooking outdoors. Also for this LRTI Ceftriaxone was the most commonly used drug. AP patients were often old, had a

comorbidity of stroke or hypertension, used more electricity for cooking and drank more alcohol. Main treatment was Metronidazole. KCMC used most Ceftriaxone and all deaths occurred there. MH had a larger proportion of CAP cases, more women and used Benzylpenicillin most.

More severe cases among CAP had characteristics such as unemployment, cooking outdoors, no access to clean water, seropositive patients, especially the newly diagnosed, disease of the heart and hypertension. Several of these are also markers of poverty. To be male at KCMC and to be in either the youngest or oldest age group was also connected to a higher CRB-65 score. Mortality was highest among AP cases and among the newly diagnosed HIV positive. No increased mortality rate could be found for the entire seropositive group. There was a higher proportion among the study subjects who were peasants, smoked daily and were seropositive, especially newly diagnosed, compared to previous statistics from the region. Male subjects smoked more, HIV was more common among women.

This study is broad, covering factors from comorbidities and socioeconomic and environmental factors to demographics. None of the areas have been penetrated in depth though. The findings above can be seen as an inspiration and guide in choosing topics for more extensive research in the future, one such area could be to investigate the risk factors for PTB in an urban setting.

Strengths of the study include that one single person collected information from all the medical files and one assistant interviewed all the patients at KCMC, adding to the conformity of the study. The study population was limited to inpatients which makes the group more homogeneous and suits a small study better. That only inpatients were used can also be seen as a limitation though, since this makes it more difficult to apply on the group of LRTI as a whole. It is probable that some risk factors predispose cases that do not get severe enough to

justify admission to hospital. The trends found in the present study can therefore only be applied to other groups of LRTI-inpatients. Even if the study population does not cover all the cases of LRTI, it does include all cases that were admitted to the medical wards with LRTI with very few exceptions. A lot of information could be gathered for every patient.

The main limitation to the study is that the study population is so limited. This was due to a major delay before the data collection could be commenced. Cultural differences may have led to misinterpretation of questions in questionnaire. There was no control group for comparison, this would have been valuable since the study population, found in one single area, probably differs from the populations found in the entire country or the Kilimanjaro region. These differences extend beyond what can be attributed to the LRTI. The setting, and mainly the fact that KCMC is a specialized referral hospital has probably led to an additional selection of the study population. Groups excluded are the patients that live in villages far away, the poorest who can not afford fees and transportation as well as the most ill patients, who die before reaching the hospital. This may lead to biased results. Because of this selection, only a small proportion of the patients with LRTI are captured by a study such as this one. Evaluation of the impact of LRTI in the population can therefore not be performed and generalization towards the Tanzanian population is limited. The results found may not resemble the reality. The assistant at KCMC as well as the medical student conducting the study may have influenced the study greatly by adding their personal interpretation of the questions answered and information found. The questions were often asked, by the nurse, in a multiple-bed-room which might affect the answers given by the patients. The questionnaire was first translated into Swahili and then the answers where translated back to English for interpretation and analysis. Vital information may have been lost or misinterpreted in this process of double translation. The months when the material was collected, October-November, was not ideal since there are few cases of pneumonia during this season. The data

collection procedures differed slightly between the two hospitals due to practical reasons. Severity was only evaluated for CAP patients. There is an uncertainty as to which drugs the patients actually received. The study consisted of patients predominantly from one region of the country. The results found in this population may not be applicable to Tanzania as a whole. The population in the Kilimanjaro region may differ from the rest of the country with regard to socioeconomic status, type of occupation, genetic predisposition and spectrum of comorbidity etc. The population in the Kilimanjaro region is in general better educated and less poor then the Tanzanian population as a whole [23][25].

LRTI is a major source of morbidity and mortality in the world. For such a common group of conditions little is known about some of the risk factors. More research is needed to find the best ways to limit the incidence of infections and prevent the most severe cases. Main focus should be on the risk factors. Actions needed include informing the population about the hazards of certain life style habits. To focus on information, detection and treatment of comorbidities, such as HIV. To improve sanitation. To limit the spreading of infections and to focus on child vaccination.

This study was too small and had too many limitations to have proper clinical relevance. The study can be seen as a pilot study for more extensive research done in the future though. Moshi, Tanzania is a good setting for further research in the field of respiratory infections.

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13 Populärvetenskaplig sammanfattning

Studien handlar om luftvägsinfektioner, när bakterier, virus eller svampar ger upphov till sjukdom i lungvävnaden. Den är speciellt inriktad på att undersöka de potentiella riskfaktorer som finns och de faktorer som är kopplade till mer allvarliga sjukdomsfall och död. Behandlingen på de två sjukhus där studien har genomförts har också undersökts och jämförts med de riktlinjer som finns i landet.

Luftvägsinfektioner ger upphov till stort lidande och många dödsfall i världen. Låginkomstländer, såsom Tanzania, är värst drabbade. Studien är genomförd i Moshi, en stad i norra delen av Tanzania. Underlaget till rapporten är taget från patientjournaler och från frågeformulär som delades ut till patienter, som var inlagda på sjukhusen, med luftvägsinfektioner.

70 patienter ingick i studien och de hade en medelålder på 48 år. 44 % var män, 56 % kvinnor. 6 patienter dog.

Studien är tyvärr alltför liten för att dra några konkreta slutsatser men resultaten visar att samsjuklighet med HIV-infektion är vanligare blad studiedeltagarna jämfört med i befolkningen, vilket skulle innebära att detta är en riskfaktor för att insjukna. Detta resultat stämmer också överens med vad tidigare studier visat. Resultaten lutar också mot att det kan finnas riskfaktorer i en stadsmiljö för att utveckla en viss typ av sjukdom, lungtuberkulos. Man vet sedan tidigare att spridningen av tuberkulos, som också kallas lungsot, ökar på platser där människor bor tätt ihop. Andra sjukdomar, bland patienterna, som till synes är kopplade till mer allvarliga fall av lunginflammation tycks vara att ha hjärtsjukdom, högt blodtryck eller HIV-infektion, den sistnämnda gör att immunförsvaret försvagas. Immunförsvaret har till huvuduppgift att skydda oss från sjukdomar orsakade av just bakterier, virus m.m.. Andra faktorer som verkar vara vanligare bland de allvarligaste fallen är att inte ha något arbete eller att inte ha tillgång till rent vatten. Det krävs dock större studier

för att bli säker på dessa resultat. Tre av de sex patienterna som dog hade en typ av luftvägsinfektion som beror på att man har fått ner magsäcksinnehåll i lungorna. Denna typ av lunginflammation drabbar vanligen äldre människor.

Eftersom Tanzania har så begränsade ekonomiska resurser så är det viktigt att fokusera på att bekämpa riskfaktorer för sjukdomar så att man kan undvika de mest allvarliga fallen samt förebygga så sjukdom inte uppstår. Luftvägsinfektioner är vanliga och mer kunskap inom området kan leda till att många liv räddas och att lidande begränsas.

14 Appendices

14.1 Questionnaire in English

14.2 Questionnaire in Swahili

14.3 Case record form

14.4 Table of antimicrobials related to type of LRTI, divided by hospital

Questionnaire concerning lower respiratory tract infection

Thank you for filling in this questionnaire. Please encircle the most accurate answer or write a comment yourself.

Patient number: ……

1. **Age**

   …….. years

2. **Gender**
   - Male
   - Female

3. **Occupation**
   - Employed
   - Self-employed
   - Unemployed
   - Peasant
   - Other……

4. **Source of income**

   ……..

5. **How much do you earn/month**

   …… Tanzanian Shilling

6. **Education**
   - None
   - Primary school
   - Secondary education
   - Collage/University

7. **Use of tobacco**
   - Never
   - Daily
   - In the past
   - Sometimes
   - Other family member smoking

   ……. cigarettes/day

   …… years

8. **Use of alcohol**
   - Never
   - 1-2 times/month

- 1-2 times/week
- Daily

9. Height

…… m

10. Weight

…… kg

11. Previous lower respiratory tract infections

- Yes
- Never
- Several
- 1-2

12. Days since first symptom, at admission

…….. days

13. Since you got ill, have you visited/done any of the following, before coming to the hospital

- Traditional healer
- Pharmacy
- Another doctor
- Praying
- Self-medicated / Home remedy

14. Place of residence

- Urban (city)
- Rural (countryside)

15. Comorbidity

- Healthy
- HIV positive /AIDS
- Tuberculosis
- Chronic obstructive pulmonary disease (COPD)
- Disease of the lung, other
- Disease of the heart
- Hypertension
- Stroke
- Diabetes mellitus
- Other:……..

16. Medications used regularly

……**……**

17. Source of energy used for cooking

- Wood
- Electricity

- Kerosene
- Gas
- Charcoal
- Other…….....

18. Number of people sleeping in the same room

……. Persons

19. Type of house, building material

- Mud
- Brick
- Wood
- Other……

20. Exposure to chemicals (agriculture-/construction-/industrial) or toxic fumes at work

- Yes
- No

21. Access to clean water

- Yes
- No
- Sometimes

22. Distance to clean water

…… km

23. Enough food to eat

- Always
- Sometimes
- Never

24. Healthy meal (protein, carbohydrates and fruit/vegetables) All categorys:

- Every day
- Sometimes
- Seldom

25. Distance to the hospital

…… km

Thank you for participating in this study.

Ms. Beatrice Svensson, medical student ,Sahlgrenska Academy, Gothenburg, Sweden

DODOSO KUHUSU A MAAMBUKIZI YA UGONJWA WA MAPAFU

Asante kwa kujaza dodoso hili.Naomba weka mduara kwenye jibu ambalo ni sahihi au andika maoni yako

26. Umri

Miaka ----------

27. Jinsia

1. Mme
2. Mke

28. Kazi

1. Nimeajiriwa
2. Nimejiajiri
3. Sina Kazi
4. Mkulima
5. Ingineyo ……..

29. Chanzo cha mapato

……

30. Kiasi gani kulipwa mwezi?

…… Shilingi

31. Elimu

1. Sijasoma
2. Darasa la (1-7)
3. Sekondari
4. Chuo

32. Je umewahi kuvuta sigara?

1. Hapana

2. Ndiyo , Kila siku (Pakiti ngapi kwa siku?-------- Miaka mingapi?----------
3. Je kuna anayevuta sigara kwenye familia yenu? Ndiyo/Hapana
4. Zamani
5. Muda mwingine

33. Je unakunywa pombe?

1. Hapana
2. Mara moja au mbili kwa wiki
3. Mara moja au mbili kwa mwezi
4. Ndiyo, Kila siku

34. Urefu

…… mita

35. Uzito

…… Kilo

36. Umewahi kuugua maambukizi ya mapafu?

1. Ndiyo
2. Hapana
3. Mara kwa Mara
4. Mara moja mpaka mbili

37. Kwa muda wa siku ngapi umeona dalili kabla hujaja hospitali ---------

38. Tangu umeanza kuumwa je ulishapata tiba mahali pengine kabla hujaja hapa? kama

1. Mganga wa kienyeji
2. Duka la dawa
3. Daktari mwingine
4. Kuombewa
5. Kunywa dawa za nyumbani

39. Mahali unapoishai

1. Mjini
2. Kijijini

40. Je unasumbuliwa na Magonjwa yafuatayo?

- Sina ugonjwa najisikia mwenye Afya
- Maambukizi ya Virusi vya Ukimwi (VVU)
- Kifua Kikuu (tb ya mapafu)
- Ugonjwa wa kudumu wa mapafu (COPD)

- Magonjwa mengine ya mapafu
- Ugonjwa wa moyo
- Shinikizo la damu
- Kiharusi
- Kisukari
- Mengineyo
- ----------

  ----

41. Dawa unazotumia mara kwa mara

----

42. Mnatumia nishati gani kupikia nyumbani?

1. Tunatumia kuni kupikia
2. Tunatumia Umeme
3. Tuanatumia jiko la mafuta ya taa
4. Tunatumia Gesi
5. Tunatumia mkaa
6. Ingineyo……..

43. Je mnapikia wapi?

1. Ndami ya nyumba ya kulala

2. Nje ya nyumba ya kulala

44. Je mnalala wangapi kwenye chumba kimoja? ----------

45. Aina ya nyumba unayoishi?

1. Ya udongo
2. Ya matofali
3. Ya mbao
4. Ingineyo……..

46. Umeshawahi kufanya kazi kwenye

1. Kiwanda cha madawa ya kilimo

2. Kiwanda cha kemikali yoyote ?

-Ndiyo

-Hapana

47. Nyumbani kuna maji safi na salama?

1. Ndiyo
2. Hapana
3. Si mara kwa mara

48. Umbali mpaka kwenye eneo lenye maji safi na salama

…… kilometa

49. Je Unapata chakula cha kutosha?

1. Ndiyo-kila siku
2. Ndiyo –si mara kwa mara
3. Hapana

50. Je unapata chakula chenye proteni, wanga, matunda na mboga

1. Kila siku
2. Mara ingine
3. Mara chache

51. Umbali mpaka hospitalini/kituo cha afya

Kilometa …….

Asante kwa ushirikiano wako

Ms. Beatrice Svensson, mwanafunzi daktari kutoka Swedeni

Case record form Pneumonia study

Patient No:……

1. Hospital: Mawenzi……..KCMC……

2. Age……..years

3. Heart rate …….. /min

4. Blood pressure …… / …… mmHg

5. Saturation …….. %

6. Respiratory rate …… /min

7. Temperature ……. C

8. Pulmonary x-ray
……
……

9. Pleural fluid yes / no

10. Weight …….. kg

11. Height ……. M

12. Blood samples:
Hb……Leucocytes…….CRP……
……

13. CD4-count ……..

14. Opportunistic infections / AIDS yes / no

……
……
15. Year of diagnosis, of HIV-infecion……..

16. Diagnosis (LRTI) based on:
……
……
……
……
……
……

17. Treatment:
……
……

……
……
……
……
……
……..

18. Death **Yes / No**

- Due to pneumonia **Yes / No**

- Secondary to other disease **Yes / No**

- Days after admission **……. days**

19. Total days in hospital **…… days**

20. Referred from:……..

21. Days at previous hospital:……

22. Examination findings……
……
……
……
……
……..

23. Confused: **Yes / No**

24. Type of pneumonia:

- **PTB**
- **Pneumonia**
- **PCP**
- **Aspiration**

25. Chief complaint:……
……
……
……
……
……

Antimicrobials * Type of LRTI								
Hospital								Total
			Community acquired	Aspiration	Pulmonary TB	PCP	Unknown	
KCMC	Amoxicillin	Count	1	0	0	0	0	1
		% within pneumoniatype	5,9%	0,0%	0,0%	0,0%	0,0%	
	Ampicillin	Count	4	0	1	0	0	5
		% within pneumoniatype	23,5%	0,0%	7,7%	0,0%	0,0%	
	Ceftriaxone	Count	12	5	10	3	2	32
		% within pneumoniatype	70,6%	83,3%	76,9%	100,0%	100,0%	
	Ciprofloxacin	Count	0	2	0	0	0	2
		% within pneumoniatype	0,0%	33,3%	0,0%	0,0%	0,0%	
	Claritromycin	Count	2	0	0	0	0	2
		% within pneumoniatype	11,8%	0,0%	0,0%	0,0%	0,0%	
	Cloxacillin	Count	1	1	2	0	1	5
		% within pneumoniatype	5,9%	16,7%	15,4%	0,0%	50,0%	
	Cotrimoxazole	Count	5	1	7	3	1	17
		% within pneumoniatype	29,4%	16,7%	53,8%	100,0%	50,0%	
	Gentamycin	Count	1	0	1	0	0	2
		% within pneumoniatype	5,9%	0,0%	7,7%	0,0%	0,0%	
	Itraconazole	Count	0	0	1	0	0	1
		% within pneumoniatype	0,0%	0,0%	7,7%	0,0%	0,0%	
	Metronidazole	Count	2	6	5	1	0	14
		% within pneumoniatype	11,8%	100,0%	38,5%	33,3%	0,0%	
	X-pen	Count	2	1	0	0	0	3
		% within pneumoniatype	11,8%	16,7%	0,0%	0,0%	0,0%	
	Acyclovir	Count	1	0	0	0	0	1
		% within pneumoniatype	5,9%	0,0%	0,0%	0,0%	0,0%	
	Anti-TB	Count	0	0	5	0	1	6

		% within pneumoniatype	0,0%	0,0%	38,5%	0,0%	50,0%	
	Fluconazole	Count	3	1	7	3	1	15
		% within pneumoniatype	17,6%	16,7%	53,8%	100,0%	50,0%	
	Total	Count	17	6	13	3	2	41
MH	Amoxicillin	Count	6	0	1		0	7
		% within pneumoniatype	30,0%	0,0%	20,0%		0,0%	
	Ampicillin	Count	2	1	1		0	4
		% within pneumoniatype	10,0%	100,0%	20,0%		0,0%	
	Azithromycin	Count	3	0	0		0	3
		% within pneumoniatype	15,0%	0,0%	0,0%		0,0%	
	Ceftriaxone	Count	4	0	2		1	7
		% within pneumoniatype	20,0%	0,0%	40,0%		100,0%	
	Chloramfenicol	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Ciprofloxacin	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Clavulanic Acid	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Cloxacillin	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Cotrimoxazole	Count	6	0	4		1	11
		% within pneumoniatype	30,0%	0,0%	80,0%		100,0%	
	Doxycycline	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Erythromycin	Count	2	0	0		0	2
		% within pneumoniatype	10,0%	0,0%	0,0%		0,0%	
	Flucloxacillin	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	

	Metronidazole	Count	4	0	1		1	6
		% within pneumoniatype	20,0%	0,0%	20,0%		100,0%	
	Rifampicin	Count	0	0	1		0	1
		% within pneumoniatype	0,0%	0,0%	20,0%		0,0%	
	X-pen	Count	11	0	1		0	12
		% within pneumoniatype	55,0%	0,0%	20,0%		0,0%	
	Anti-TB	Count	1	0	0		0	1
		% within pneumoniatype	5,0%	0,0%	0,0%		0,0%	
	Fluconazole	Count	5	0	2		1	8
		% within pneumoniatype	25,0%	0,0%	40,0%		100,0%	
	Total	Count	20	1	5		1	27

Table 6. Distribution of antimicrobials related to type of LRTI, divided by hospital. Percent are based on number of cases.