STUDY REPORT

Magnitude, Major Causes and Factors Associated with Hospital Deaths among Children under Five Years of Age in the Lake Zone of Tanzania

April 2015

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Acronyms

AMMP	Adult Morbidity and Mortality Project
AWD	Acute Watery Diarrhea
CI	Confidence Interval
DIB	Difficulty in Breathing
DMO	District Medical Officer
Dx	Diagnosis
DSS	Demographic Surveillance Systems
HF	Health Facility
IRB	Institutional Review Board
Kg	Kilogram
LZERB	Lake Zone Ethical Review Board
MoHSW	Ministry of Health and Social Welfare
MWZ	Mwanza
NIMR	National Institute of Medical Research
OR	Odds Ratio
PI	Principal Investigator
QIA	Quality Improvement Advisor
RMO	Regional Medical Officer
SA	Severe Anemia
SAM	Severe Acute Malnutrition
SCD	Sickle Cell Disease
SD	Standard Deviation
SM	Severe Malaria
SP	Severe Pneumonia
TD	Technical Director
THP	Tibu Homa Project
U5	Under-five
UNICEF	United Nations Children's Emergency Fund
URC	University Research Co., LLC
USAID	United States Agency for International Development
UTI	Urinary Tract Infection
VA	Verbal Autopsy
WHO	World Health Organization

EXECUTIVE SUMMARY

While striving to achieve the Millennium Development Goals, Tanzania has made progress in reducing under-five morbidity and mortality by improving coverage of effective health interventions. However, children are continuing to die from preventable and treatable conditions, with an estimated under-five mortality rate of 81 per 1000 live births. Tanzania lacks accurate data on specific causes of death and associated factors. Like other developing countries, Tanzania relies on verbal autopsies to get information on causes of death. Few studies of hospital-based specific causes of death have been carried out in Tanzania.

The USAID Diagnosis and Management of Febrile Illness Program (Tibu Homa) is implementing a comprehensive program in the Lake Zone, focusing on improving diagnosis and management of childhood illnesses and improving data management. It is expected that with its increased efforts in correct diagnosis and monitoring of treatment outcomes and in improvements of data management, Tibu Homa will better inform the understanding and management of common causes of death among under-fives in project-assisted areas in the Lake Zone. With this background, USAID Tanzania encouraged the Tibu Homa Project to assess causes of hospital-based child deaths in the Lake Zone.

Objectives

This study sought to determine the major causes of hospital-based mortality and associated factors among children under five years of age in the Lake Zone of Tanzania.

Methodology

Tibu Homa conducted a cross-sectional, quantitative study in three regional and three district hospitals in the Lake Zone of Tanzania. The three regional hospitals were Kagera (Kagera), Sekou Toure (Mwanza) and Musoma (Mara). The three District Hospitals were Ngara (Kagera), Magu (Mwanza) and Tarime (Mara). The target population was children under five years of age who were hospitalized and discharged or died during the study period. Respondents were parents or caregivers of these children.

Data analyses were performed using Statistical Package for Social Sciences software. Statistical procedures included descriptive, bivariate analysis categorical variables which were assessed using Chi-square test and binary logistic regression analysis to estimate independent (adjusting for possible confounding effects) factors for under-five mortality. The significance level was set at p-value less than 0.05.

Findings

The study found 1,130 inpatient children (50.2% females and 49.8% males) aged between 2 and 59 months admitted into hospitals in the Lake Zone between September and November 2015 Diagnoses included malaria (555, 49%), anemia (420, 37.2%),

pneumonia (27%), diarrheal diseases (27%) and malnutrition (22.1%). These patients presented mainly with fever, vomiting, diarrhea, cough and convulsions. Of the three regions assessed in the Lake Zone, Mara Region showed the highest malaria positivity of 63.2% with Kagera showing 53.7% and Mwanza 47%. Anaemia was 41.3% mong under-fives in Mara, followed by 41.1% in Mwanza Region and Kagera 29%.

The mortality level among these hospitalized under-fives is slightly more than 1 in every 13 under-fives. The major causes of death of in-patient children aged between 2 to 59 months were severe anemia (29.8%), severe malaria (28.6%) and severe pneumonia (26.2%). Of the 84 children who died, there were significantly more female deaths than males (9.1% against 5.4%) relative to all under-fives admitted (p=0.02). More deaths occurred among children aged 2-11 months and those aged 48-59 months. Other factors that were found to affect under-five inpatient mortality were location of the hospital (Mwanza Region leading under-five mortality, p=0.01) and regional variations in causes of death. Under-fives brought for care after 24 hours of onset of illness were twice at risk of death than those presented within 24 hours of onset of illness. Under-five children under care of mothers with low or no education were 15-times more likely to die. More deaths occurred among under-fives with diagnoses of anemia, malnutrition, urinary tract infections and respiratory infections.

Conclusion

Despite improvements in the health delivery system put in place by the Government of Tanzania, children under five in the Lake Zone still suffer high morbidity and mortality. A key finding of this assessment is the geographical disparity of causes of under-five mortality and a strong correlation with mortality and delay in seeking care in the Lake Zone. This critical information suggests that geographically focused interventions rather than a generalized approach would be more effective in addressing the correct causes of mortality in under-fives. Furthermore, the Ministry of Health and Social Welfare needs to further assess the variations in causes of under-five deaths in the Lake Zone.

1.0 INTRODUCTION

The Government of Tanzania is striving to achieve the Millennium Development Goals which are part of the National Strategy for Growth and Reduction of Poverty. Progress has been made in the reduction of child mortality as a result of improved coverage of effective health interventions (Vitamin A supplementation, exclusive breast feeding, immunization coverage, Integrated Management of Childhood Illnesses and improved Malaria management) but despite progress made children, especially neonates continue to die from preventable and treatable conditions [1]. It is estimated that the current under-five mortality in Tanzania is 81 per 1,000 live births, infant mortality is 51 per 1,000 live births and new born mortality is 26 per 1,000 live births [2]. The Health Sector Strategic Plan 111 (2009-2015) in Tanzania indicates that diarrhea, malaria, malnutrition, measles, and pneumonia combined with malnutrition are contributing factors in all these conditions and cause more than 70% of child deaths. According to WHO-UNICEF estimates, in 2011 pneumonia caused 13% of child deaths, malaria 7% and diarrhea 9% [3].

Hospital-based under-five mortality study similar to the current study has been conducted elsewhere in Africa [4]. There are few hospital based studies in Tanzania that show regional variations in magnitude of hospitals deaths among children under five years of age. The Adult Morbidity Mortality Project (AMMP) in Tanzania reported that 60% of under-five childhood deaths in Dar es Salaam occurred in hospitals, while only 20% of deaths in the Morogoro Region occurred in hospitals [5].

However, like many countries, Tanzania relies on verbal autopsy (VA) to get data on causes of death. Tanzania has Demographic Surveillance Systems (DSS) in some districts (e.g., Rufiji DSS and Magu DSS) which use verbal autopsy to assess causes of deaths [6, 7]. In Magu DSS, VA interviews were conducted for 75% of all deaths between 1996 and 2001. An under-five child mortality study conducted in Bunda (2003) reported fever as a cause of death in 68.8% of cases and unknown causes of 11.1% [8]. In general, any available documents such as death certificates and prescriptions are used to obtain evidence about causes of death. However, more often such documents are not available. A case-series study was done in the Iganga/Mayuge Demographic Surveillance Site [5] (DSS) in Uganda where causes of death were assigned for 164 children. Pneumonia contributed to 27% of the deaths. Of the pneumonia deaths, half occurred in hospitals and one-third at home and the rest at lower health facilities or en route to health facilities. Findings are similar to a study on Cause specific causes of death in under-fives in Northern India [9].

Cause-specific mortality estimates obtained through VA are susceptible to bias due to misclassifications of cause of death that often require hospital-based specificity and sensitivity validation estimates which are not useful for populations with substantially different pattern of cause-specific mortality [10].

In Tanzania, accurate data on specific causes of death and associated factors for child mortality are limited. There are some particular concerns regarding poor disease management, health management information and registration systems in Tanzania. The Health Management Information System does not provide accurate, complete and timely information. Correct diagnosis, proper recording and transfer of data, especially on specific causes of mortality in under-fives, are often not accurate leading to unreliable morbidity and mortality estimates [11]. Nevertheless, these data are crucial for planning, monitoring and evaluation and prioritizing interventions.

There are programmatic interventions targeting reduction of under-five morbidity and mortality in the Lake Zone (Kagera, Mara, Mwanza, Geita and Shinyanga regions) and the Tibu Homa Project (THP) has been implementing a comprehensive program since December 2011 in 414 health facilities with coverage of 30% of health facilities. Tibu Homa has also carried out community mobilization work in eleven districts, focusing on improving diagnosis and management of childhood illnesses and data management for decision making. Tibu Homa has supported heath facilities to improve case management of under-fives by training health care workers to treat under-fives according to national policy; providing training in logistic mentorship to ensure availability of essential medicines and supplies; and providing training in comprehensive supportive supervision to improve performance and put in place (in intervention health facilities) a system to ensure complete documentation of patient information and timely data collection and in analysis and use of data for planning. Through these efforts of improving data management, correct diagnosis and monitoring treatment outcomes, the project has a good understand of the management of common causes of deaths in under-five children. Hospital records have provided information on causes of death.

With support from the United States Agency for International Development (USAID) Tanzania, THP studied the causes of hospital-based child deaths in the Lake Zone. Findings provide useful information on the relative contribution of major causes of hospital-based mortality among children less than five years of age and help monitor trends to assist planning and decision-making.

2.0 OBJECTIVE

The objective of this study was to determine the magnitude and major causes of hospital-based mortality among children under-five years of age in the Lake Zone of Tanzania.

2.1 Specific Objectives

i. Determine the magnitude of mortality among children under five years admitted to hospitals in the Lake Zone.

ii. Estimate the relative contribution of major causes of deaths among children under-five years admitted to hospitals by age, sex, body weight and length/height.

iii. Determine factors associated with causes of death in children under-five years of age admitted to hospitals in the Lake Zone.

3.0 METHODOLOGY

3.1 Study Design

This is a cross-sectional, hospital-based study involving a review of causes of deaths of children aged 2 to 59 months as they occur in randomly selected hospitals within the study area during the study period. Information about signs and symptoms were obtained from parent/relatives by trained study team members assembled among the hospital staff managing children during clinical assessment. Clinical progress was documented by the study team until death or recovery of the child.

3.2 Study Area

The study was conducted in three regional hospitals in the Lake Zone (Mwanza, Mara and Kagera) and three public district hospitals. These district hospitals were Magu (Mwanza Region), Tarime (Mara Region) and Ngara (Kagera Region). According to the Ministry of Health and Social Welfare (MoHSW), regional and district hospitals are facilities with referral medical services serving a large number of patients, especially under-fives. They are expected to have reliable services and more experienced medical staff, having advanced examination medical services (basic lab examinations and x-ray facilities) and improved pharmacies. Therefore, apart from handling referral cases from lower levels, hospitals (district and regional) were in a better position to correctly assess causes of deaths than lower health facilities.

3.3 Study Population

The target population was all hospitalized children aged below five years in the Lake Zone. Children aged between 2 and 59 months that were admitted in the hospitals during the study period were included in the sample. Excluding children below two months was based on the unavailability and inaccessibility of young infants, especially neonates in pediatric wards and complications of consenting mothers in obstetric wards.

3.4 Sample Size Estimation

Sample size was calculated using the following formula:

$n = z^2pq/\varepsilon^2$ where:

n = expected minimum sample size

z = standard value which corresponds to 1.96 for a desired 95% Confidence Interval (CI)

p = best estimate of under-five mortality rate, set at 81 per 1,000 live-births

q = 1-p

ε = maximum likely error, 2% (0.02)

Therefore the estimated minimum sample size was 1.96^2 x 0.081(1-0.081)/0.02^2 =715

To adjust for non-response, we added 10% making a minimum sample size of 787 children**.** This sample size was intended to estimate under-five mortality with 2% error, given under-five mortality of 10%. The remaining 90% of surviving children was enough to assess characteristics of the two groups.

3.5 Sampling Procedure

Kagera, Mara, and Mwanza regional hospitals and one random district hospital from each region were selected for this study, to make up a total of six hospitals. Simple random sampling was employed to select one district hospital among eight district hospitals in Mwanza Region, one among seven in Mara and one among seven in Kagera, all implementing improvement activities under the support of THP.

From the estimated minimum sample size, the study planned for equal allocation between six sites which gives a total of at least 131 under-fives per site.

3.5.1 Inclusion criteria

All children aged between 2 and 59 months reporting for admission in the pediatric wards during the period of September 15 to November 5, 2015.

3.5.2 Exclusion criteria

Children aged below two months and above five years.

3.6 Data Collection Instruments and Procedure

A structured questionnaire was developed in English and translated into Kiswahili, a language that is largely spoken and understood by most people in Tanzania. This tool consisted of three main sections: A) child's information, B) parent/caretaker and C) cause of death of the under-five.

The child sections captured information on child characteristics in section A1; section A2 included interview questions related to the child's main problems. Section A3 had questions related to past medical history, and A4 sought information related to diagnosis of presenting problems. Section B was for parent/caretaker demographic information and parent/caretaker information was obtained during detailed family history taking. Section C sought information on diagnoses and final cause of death, medical (present and past) and detailed family histories of all admitted children aged

between 2 and 59 months. The following information was transcribed from the patient records onto the study tool:

- Examination and laboratory investigations results
- Associated diagnoses
- Differential diagnoses
- Specific causes of deaths as ascertained by the principle investigators during death review of all under-five deaths occurring in the hospitals as observed in the patient's clinical notes and from diagnosis made on death certificates. Whenever there was no definite cause of death documented or disagreement between death auditors, the cause of death was termed "unknown".

At each study site, one study clinician (contracted as the coordinator of the study), two clinicians and a nurse were trained as research assistants. Trainings included an in-depth review of data collection tools, data collection and interviewing techniques, strategies for quality assurance and formulation of diagnoses and determination of causes of death. All study team members were trained on research ethics by the principal investigators. The study personnel were attached to pediatric wards and were identified from the facility and assigned the role of research assistants.

The main roles of these clinicians were to use a standardized hospital form to obtain and document a history of presenting complaints, past medical history, and examination results in order to make a diagnosis. They were trained to decide on treatment based on national standard protocols and reviewing patients' conditions during routine ward rounds. Findings were to be recorded and used to make decisions on further management. Clinicians were responsible for reviewing information on every child who died so they could make an immediate determination on immediate underlying causes of death and where possible the immediate cause of death. International Classification of Disease 10th Revision (ICD-10) was used as reference.

The nurse (sister in charge of pediatric ward), was responsible for looking after participants' files, ensuring availability of required forms in patients' files and making sure patients got recommended investigations on time. She/he collected laboratory results promptly and oversaw the securing of results in patient files and charts. She/he gave prompt and necessary information to the clinicians.

Pre- test: Pre testing and study tools were done at Sekou Toure hospital prior to commencement of study and modification was made accordingly.

3.7 Enrolment of Study Participants

Biological parents or legal caretakers were contacted at admission during initial assessment or soon after and consented but only enrolled at death or discharge

when information was collected on diagnosis and cause of death. Study information was drawn from case notes.

3.8 Variables

3.8.1 Dependent variable

The main outcome variable was the child survival status (survived between the study periods or died within the study period).

3.8.2 Independent variables

Explanatory variables included sex, age as well as weight, height/length (used to assess nutritional status of the children) and duration of illness which included time from the date of onset of symptoms until the date when medical care was sought. Other independent variables included characteristics of the parent(s) or care-taker. These characteristics included: Age, sex, religion; relationship to the child (parents or kin caretaker), education level attained by the parent/caretaker, marital status and occupation. Education level was categorized as "none/low" education status if the parent/caretaker had no formal education or the individual attended school up to primary seven, and "medium/high" educational level for those who had attained education beyond primary school Occupation was categorized as not employed, peasant, daily wage earner (casual worker) and employed-salaried or self-employed.

3.9 Data Processing and Analysis

Data on identified deaths and their causes were extracted from hospital records and transcribed onto data record forms. A statistician was contracted to enter, clean, ensure accuracy and completeness of all data entries in a standard tool. He performed data processing and analysis using Statistical Package for Social Science software. Descriptive procedures were performed to characterize study participants using frequencies and cross-tabulations. Associations between categorical variables were assessed using Chi-square test. Logistic regression was used to estimate odds ratios (OR) and 95% confidence intervals (CI) used to assess associations between variables.

3.10 Quality Control

All study staff were trained on research procedure before the study. The research team members were trained for competence when carrying out the study. The study coordinator at each site reviewed data files to identify deficiencies and make corrections promptly. Two Tibu Homa staff (both pediatricians); one being the Principal Investigator (PI) and the other the Co-Principal Investigator visited the study sites twice a month to check for coverage and consistency of the study

procedure. They met with the research teams at the sites to discuss study progress and to review patient files and death certificates to ascertain causes of death.

3.11 Ethical Considerations

Ethical clearance was obtained from the Lake Zone Ethical Review Board and the University Research Company, LLC (URC) Institutional Review Board (IRB) in Bethesda, Maryland, USA. Permission to conduct the study was sought from Regional and District Medical Officers (RMO, DMO respectively). Consent for children to participate was requested from the biological parents or legal guardians accompanying the child during hospitalization. The purpose of the study was described, and participants were invited to participate by the research assistant.

Requesting permission to access medical records and use of information obtained now or in the future was part of the process, and assurance was provided that the study team would not disclose information to anyone outside the study staff. Parent caretaker was informed that the child was being enrolled in the study. This included all necessary information to enable her/him to make an informed choice. The information was given to the parent at admission or soon after. Research assistants made it clear that participation was voluntary. Parents/caretakers were informed that they had the right of refusal to participate and such withdrawal was not associated in any way with provision of health/medical services offered to them. No incentives were provided for participation.

Parents/caretakers were provided with an opportunity to ask questions prior to consenting. Each parent/caretaker was asked whether they understood the study and their expectations and whether they were willing to participate in the study. Each parent/care-taker was requested to sign a consent form as an agreement for participating in the study. Illiterate participants used their thumb print to document informed consent. Parents/caretakers were given the contact information for the Principal Investigator as well as the Chief of Party of Tibu Homa and were encouraged to contact them with any questions or concerns regarding the study. Additionally, contact information for the IRB Chairperson in the Lake Zone was provided.

3.12 Confidentiality

Parents/care takers were assured of confidentiality. Confidentiality was strictly observed by the research team. Identification numbers were assigned to study questionnaires, and no identifying information was collected. All computerized forms could only be accessed with passwords known only to the PIs and statistician. All hard copies of the study forms and consent forms were stored in a locked cabinet only accessible by a site supervisor during data collection and by the PIs thereafter at the Tibu Homa head office in Mwanza.

4.0 RESULTS

4.1 Description of Enrolled Children

A total of 1,130 child-parent/caretaker pairs were recruited for the study. This was 44% higher than the estimated sample size (Table 1). The variability of enrolment was time-dependent on duration of data collection and health seeking behavior per site such that hospitals with longer time of enrolment had more under-fives enrolled than those that started later.

Table 1. Number of under-fives recruited per site (n=1130)

Name of study site	Number of under-five children (%)
Magu Hospital	329 (29.1)
Kagera (Bukoba) Hospital	221 (19.6)
Ngara Hospital	161 (14.2)
Sekou Toure Hospital	150 (13.3)
Musoma Hospital	141 (12.5)
Tarime Hospital	128 (11.3)
TOTAL	1,130 (100.0)

There were 552 (50.2%) females and 547 (49.8%) males. The majority, 1,066 (95.3%) were accompanied by one parent to the hospital and 936 children (84.6%) lived with both parents. The mean age of the study participants was 21.1 months (Table 2).

4.2 Description of Parents/Caretakers

The majority, 975 (91.9%) of those accompanying the children were females; 1,043 (95.7%) being biological parents and most, 803 (71.7%), having attained primary education level. The age of parents and caretakers ranged between 15 and 64 years with a median age of 28 years (Table 3).

4.3 Morbidities among Study Participants

Parents or caretakers reported on signs and symptoms that brought children to the hospitals. Indicated in Figure 1, the major signs and symptoms that were reported included fever 995 (88.1%), vomiting 518 (45.8%), diarrhea 397 (35.1%) and cough 384 (34.0%).

Table 2. Socio-demographic characteristics of study participants (n=1130)

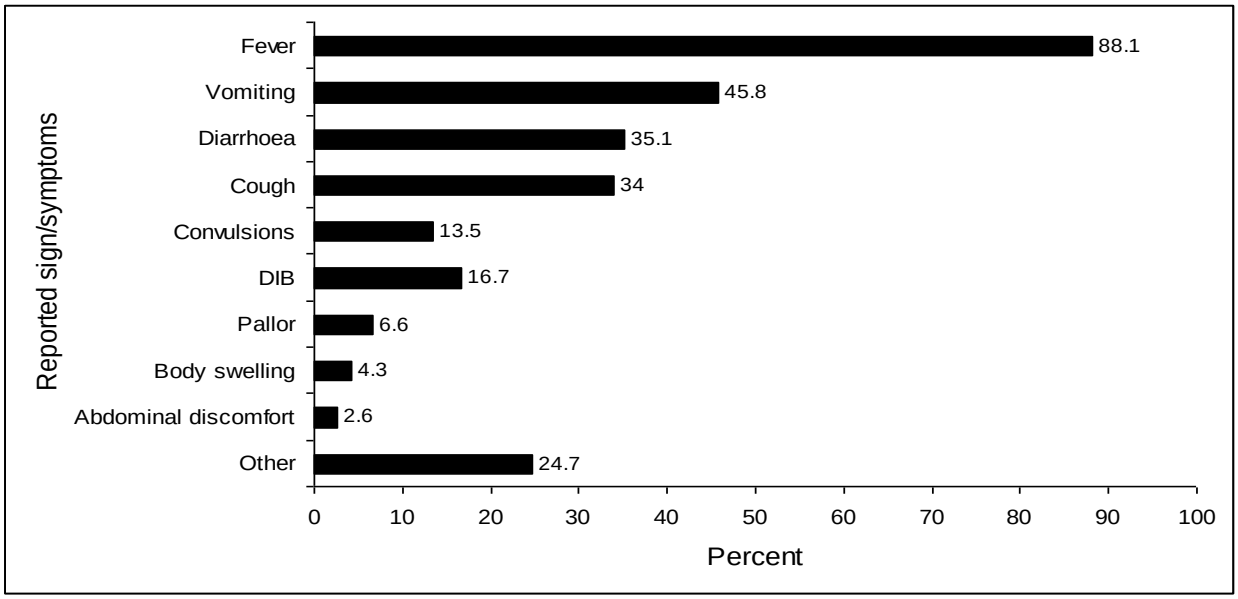
Characteristic	Number (%)*
Sex	
Male	552 (50.2)
Female	547 (49.8)
Accompanying person	
Parent	1,066 (95.3)
Relative	47 (4.2)
Other	5 (0.4)
Age (months)	
2 – 11	354 (31.3)
12 – 23	372 (32.9)
24 – 35	191 (16.9)
36 – 47	124 (11.0)
48 – 59	89 (7.9)
Regular caregiver	
Both parents	936 (84.6)
One parent	134 (12.1)
Other	36 (3.3)
Ever-born siblings	
None	226 (20.2)
1 – 2	468 (41.8)
3 – 4	248 (22.1)
5+	179 (16.0)
Alive siblings	
None	246 (21.9)
1 – 2	474 (42.2)
3 – 4	265 (23.6)
5+	139 (12.4)
Dead siblings	
None	938 (84.2)
1 – 2	155 (13.9)
3+	21 (1.9)

* Total responses do not add up to 1130 due to missing responses.

Table 3. Background information of parents/caretakers (n=1130)

Background characteristic	Number (%)
Sex	
Male	86 (8.1)
Female	975 (91.9)
Age (years)	
< 20	71 (6.4)
20 – 29	583 (52.5)
30 – 39	362 (32.6)
40 – 49	73 (6.6)
50+	21 (1.9)
Current marital status	
Unmarried	51 (4.6)
Married (monogamous)	827 (73.9)
Married (polygamous)	139 (12.4)
Cohabiting	10 (0.9)
Separated/divorce	80 (7.1)
Widow	12 (1.1)
Education status	
Never in school	166 (14.8)
Some primary	803 (71.7)
Above primary	151 (13.5)
Employment status	
Formal sector	778 (69.5)
Unemployed	213 (19.0)
Peasant	70 (6.3)
Self-employed	44 (3.9)
Wage earners	14 (1.3)
Relationship to the child	
Parent	1043 (95.7)
Kin	28 (2.6)
Other	19 (1.7)
Religion	
Christian	886 (83.8)
Muslim	137 (13.0)
Other	34 (3.2)

Figure 1. Reported signs and symptoms among inpatient children (2-59 months) admitted in hospitals (n=1130)



When asked about places where the child was taken before coming to the current hospital, 267 (43.3%), mentioned to have visited health facilities (including dispensaries), health centers or other hospitals. Otherwise, most children were taken to private pharmaceutical stores, home treatment or to traditional healers, etc. Very few 84 (7.6%), children were reported to have had a previous history of known medical condition in their lifetime. Among 541 under five children with records of whether they received any treatment and/or were referred elsewhere, 464 reported referral.

4.3.1 Morbidities by region

Following medical examinations, the main admissions diagnoses were malaria 555 (49.1%), anemia 420 (37.2%), diarrhea (27%) and pneumonia (27%). Other diagnoses are presented in Table 4. Of the 555 malaria cases, 253 (45.6%) were also anemic. Mara and Kagera had the highest proportion of under-fives with malaria at 170 (63.2%) and 205 (53.7%), respectively. Mara had 111 (41.3%) under-fives with anaemia followed closely by Mwanza Region 197 (41.1%) (Figure 2).

Figure 2 presents major diagnosis by region of study. Mara Region had the highest deaths rate resulting from severe malaria, severe anemia and malnutrition. Mwanza Region had the highest death rate from severe pneumonia but had the lowest death rate from malnutrition. In Kagera, both Acute Watery Diarrhea (AWD) and malnutrition were the major causes of hospital deaths but had the lowest severe malaria and severe anemia as underlying causes of hospital deaths as compared to other regions (Figure 3).

Figure 2. Distribution of major diagnoses by region of study (n=1130)

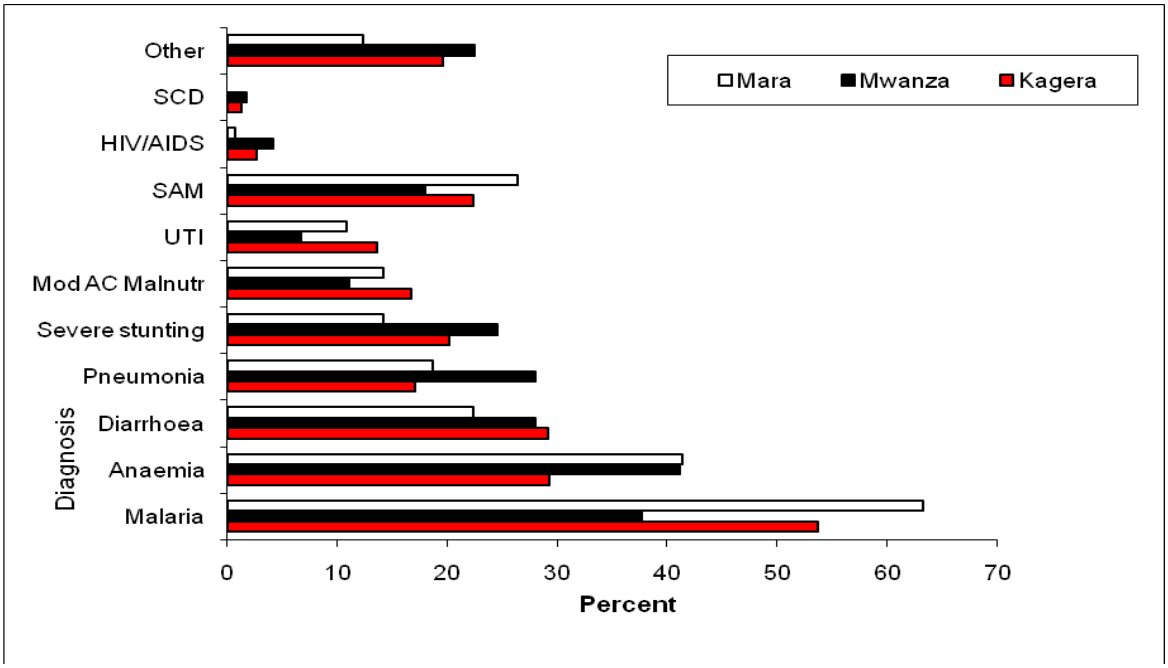


Figure 3. Underlying causes of hospital death by region of study (n=84)

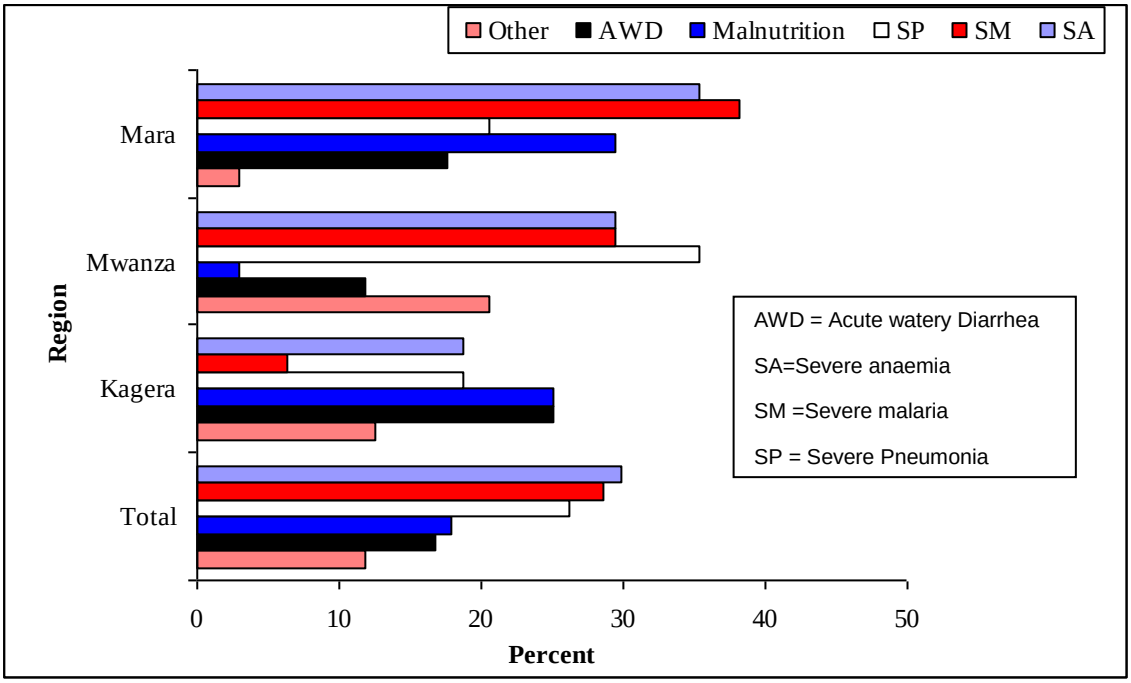


Table 4 presents diagnoses of under-fives at admission. Many under-fives were diagnosed to have malaria, 555 (49.1%), anemia 420 (37.2%), diarrhea 305 (27.0%), pneumonia 249 (22.0%) and severe stunting 219 (20.5%).

Table 4. Number (%) of inpatient children with corresponding diagnoses at admission (n=1130)

Diagnosis	Number (%)
Malaria	555 (49.1)
Anemia	420 (37.2)
Diarrhea	305 (27.0)
Pneumonia	249 (22.0)
Severe Stunting	219 (20.5)
Moderate Acute Malnutrition	150 (13.7)
Urinary Tract Infection	113 (10.0)
Severe Acute Malnutrition	92 (8.4)
HIV/AIDS	32 (2.8)
Sickle Cell Disease	13 (1.2)
Any other	216 (19.1)

4.4 Mortality among children aged 2 to 59 months

During the study period, 84 deaths were recorded giving an 'under-five' mortality of 74 (95% CI = 60.0, 91.6) deaths per 1,000 under-five admissions in the hospitals. Major underlying causes of mortality were severe anemia, 25 (29.8%), severe malaria 24 (28.6%) and severe pneumonia 22 (26.2%). Other underlying causes of deaths are presented in Table 5. Immediate/direct causes of deaths could not be ascertained due to inadequate patient monitoring during the cause of illness.

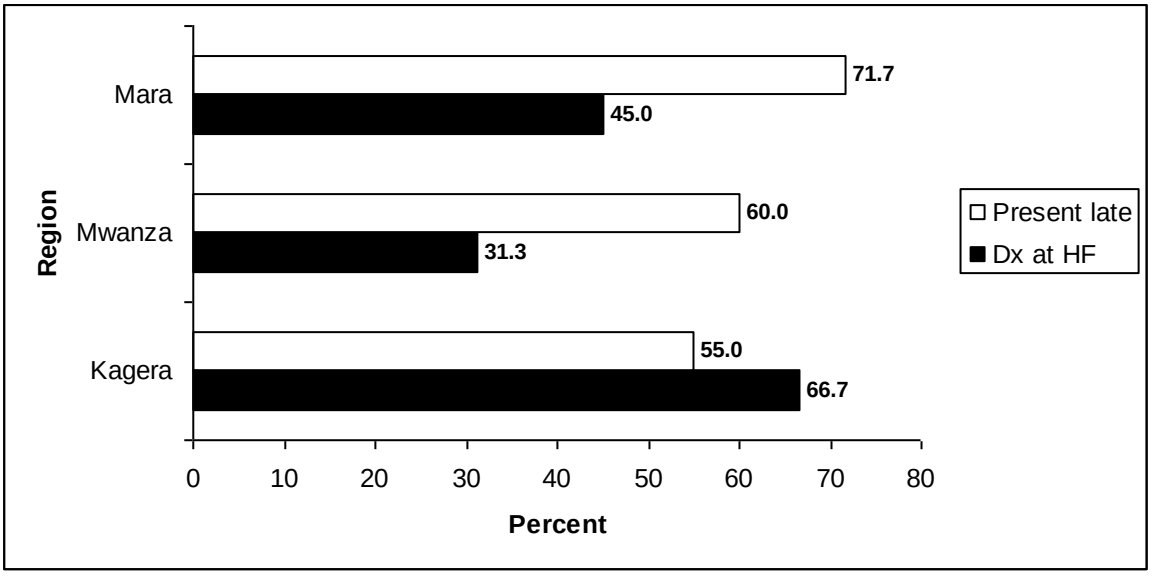
Table 5. Major underlying causes of death in under five children (n=84)

Cause	Number (%)
Severe anemia	25 (29.8)
Severe malaria	24 (28.6)
Severe pneumonia	22 (26.2)
Malnutrition	15 (17.9)
Acute watery diarrhea	14 (16.7)
Other	10 (11.9)

4.5 Health care-seeking behavior

We assessed among parents/caregivers the promptness of seeking health care from health facilities. Out of 617 under-fives with complete data, less than half, 267 (43.3%) visited established health facilities (dispensaries, health centres or other hospitals) before coming to the current hospital. Of the remaining 350 under-fives, 230 (67.7%) received medications from medical dispensing outlets (accredited drug dispensing outlets, and pharmacies) 45 (12.9%) had home treatments (self medication – 35/45 and traditional healers - 10/45) and the remaining 25 (7.1%) sought treatment from other sources, like traditional healers. The median duration between symptoms set and seeking treatment at health facility was 3 days. The majority of parents/caregivers, 685 (61.1%), reported presenting to health facilities more than 24 hours from onset of symptoms. Nevertheless, the median duration of seeking treatment among under-fives presenting at health facilities was slightly longer (4 days) than elsewhere (3 days). In Figure 4, Mara Region had the largest proportion of parents/caregivers presenting more than 24 hours from onset of symptoms and proportion of parents/caregivers presenting more than 24 hours from onset of symptoms to hospitals.

Figure 4. Proportion of caregivers coming to hospital more than 24 hours from onset of fever and who sought treatment to health facility by region of study



In contrast to Kagera Region, in hospitals from other regions (Mwanza and Mara) there were larger proportions of caregivers presenting their under-fives to hospitals more than 24 hours from onset of symptoms and fewer proportions seeking treatment at modern health facility (dispensary, health center) (Figure 4).

Among deaths with complete information, there were many more female deaths, 62.5%, than male 37.5%, and there were significantly more female deaths than males (9.1% against 5.4%) relative to all under-fives in the study (p=0.012).

Mortality by age was U-shaped, being almost equally high at both young and old ages and low in the middle age groups among study participants (Table 6).

Table 6. Main characteristics of inpatient deaths, Lake Zone, 2014 (n=1130)

Characteristic	Cases (%)	% of study population	p-value
Sex			0.012
Male	30 (37.5)	5.4	
Female	50 (62.5)	9.1	
Age (months)			
2 – 11	36 (31.0)	10.2	0.767
12 – 23	24 (28.6)	6.5	
24 – 35	14 (16.7)	7.3	
36 – 47	11 (13.1)	8.9	
48 – 59	9 (10.7)	10.1	

4.6 Factors Associated with Under-five In-patient Morbidity and Mortality

4.6.1 Bivariate analyses

In the bivariate analysis, under-five in-patient mortality was significantly ($p<0.05$) associated with region of study, sex of the child, maternal education and whether the child had been hospitalized before or not (Table 7). An attempt was taken to assess the association between child mortality and other variables, like caregivers' education, and marital status and number of ever born children, but there was no association.

In-patient under-fives admitted in Mwanza Health facilities were more than 3 times likely to die as compared to those in Kagera ($p<0.001$). And, although not significant, under-fives in Mara health facilities were almost twice as likely to die, as compared to those in Kagera ($p=0.07$). Female babies had significantly elevated risk of under-five mortality of almost twice as compared to males ($p=<0.001$). Similarly, the under-five mortality significantly decreased with increasing level of maternal education. Furthermore, under-five who were never hospitalized in the past prior to this illness had significantly increased odds of dying almost twice (OR=1.8, $p=0.026$) as compared to those who reported ever hospitalized (Table 7).

4.6.2 Multivariate analyses

In the adjusted analysis using logistic regression procedure, under-fives in Mwanza Region were almost three times as likely to die than those in Kagera Region (OR=2.9, $p< 0.001$) (Table 7). Similarly, though not significant, under-fives in Mara

Region have 70% increased risk of dying than those in Kagera (OR=1.5, p=0.209). Female babies were at 1.7 risk of dying than male births (OR=1.7, p<0.035). The risk of under-five mortality was significantly decreasing with increasing level of maternal education; significantly higher (OR=14.5, p=0.01) with not educated mothers and decreasing to (OR=11.5, p=0.017) for under-fives of mothers with some primary education as compared with under-fives of mothers with education above primary education (Table 8).

Table 7. Association between under-five mortality and selected characteristics among children admitted in Lake Zone Hospitals, 2014 (n=1130)

Characteristics	Deaths n (%)	Survivors n (%)	OR (95%CI)†	p-value
Region*				
Kagera	16 (4.2)	366 (95.8)	Reference	
Mara	34 (12.6)	235 (87.4)	1.7 (1.0, 3.2)	0.073
Mwanza	34 (7.1)	445 (92.9)	3.3 (1.8, 6.1)	< 0.001
Sex of the child*				
Male	30 (5.4)	522 (94.6)	Reference	
Female	50 (9.1)	497 (90.9)	1.8 (1.1, 2.8)	< 0.001
Child's custodian				
Both parents	65 (6.9)	871 (93.1)	Reference	
One/other	18 (10.6)	152 (89.4)	1.6 (0.9, 2.8)	0.100
Maternal education*				
No education	16 (9.6)	150 (90.4)	16.0 (2.1, 122.2)	0.008
Some primary	64 (8.0)	739 (92.0)	13.0 (1.8, 94.4)	0.011
Above primary	1 (0.7)	150 (99.3)	Reference	
Ever hospitalized*				
Yes	18 (4.9)	351 (95.1)	Reference	
Never	65 (8.6)	688 (91.4)	1.8 (1.1, 3.2)	0.026
Promptness to health facility				
Early (≤24 hours)				
Late (> 24 hours)	79 (7.2)	1014 (92.8)	Reference	
Child's age	5 (17.2)	24 (82.8)	2.7 (1.0, 7.2)	0.052
0 - 11				
12 – 23	26 (7.3)	328 (92.7)	Reference	
24 – 35	24 (6.5)	348 (93.5)	0.9 (0.5, 1.5)	0.635
36 – 47	14 (7.3)	177 (92.7)	1.0 (0.5, 2.0)	0.995
48 – 59	11 (8.9)	113 (91.1)	1.2 (0.6, 2.6)	0.585
Previous child death	9 (10.1)	80 (89.9)	1.4 (0.6, 3.1)	0.389
None				
At least one	75 (8.0)	863 (92.0)	Reference	
	9 (5.1)	167 (94.9)	6 (0.8, 3.5)	0.184

* = p-value < 0.05 using Chi-square test; †= Odds Ratio (95% Confidence Interval)

Table 8. Adjusted OR of under-five mortality among children admitted in Lake Zone Hospitals, 2014 (n=1130)

Characteristics	OR (95%CI)*	p-value
Region		
Kagera	Reference	-
Mara	1.5 (0.8, 2.8)	0.209
Mwanza	2.9 (1.5, 5.5)	0.001
Sex of the child		
Male	Reference	-
Female	1.7 (1.0, 2.7)	0.035
Child's custodian		
Both parents	Reference	-
One/other	1.5 (0.8, 2.6)	0.305
Maternal education		
No education	14.5 (1.9, 111.2)	0.010
Some primary	11.5 (1.6, 84.0)	0.017
Above primary	Reference	-
Ever hospitalized		
Yes	Reference	-
Never	1.6 (0.9, 2.8)	0.066
Promptness to health facility		
Early (≤24 hours)	Reference	-
Late (> 24 hours)	1.7 (1.0, 2.9)	0.053

* Odds Ratio (95% Confidence Interval)

4.6.3 Morbidity by survival status

On one hand, there were significantly more under-fives who died with major symptoms of difficulty in breathing (p=0.007) and convulsions (p=006) than among those surviving. On the other, with the exception of urinary tract infections (UTI), there were significantly more under-fives diagnosed with anemia (p<0.001), pneumonia (p=0.009) and malnutrition (p=0.006) among those who died than those who survived. But it was the reverse for UTI, whereby significantly more surviving under-fives were diagnosed with UTI than among those who died (p=0.005). Although there were more under-fives who survived diagnosed with malaria than

those who died, the difference was not statistically significant (Table 9). However malaria was significantly associated with anaemia such that among under-fives with malaria, there were more, 11 (45.8%) under-fives with anaemia than under-fives without malaria dying due to anaemia, 14 (23.3%). (p=0.042) (Table 10).

Table 9. Differences in morbidities by survival status among under-fives admitted in the Lake Zone Hospitals, 2014 (n=1130)

Symptoms and diagnoses	Survivors (%) n = 1046	Deaths (%) n = 84	Diference (p)*
Major symptoms			
Fever	923 (88.2)	72 (85.7)	0.295
Vomiting	486 (46.5)	32 (38.1)	0.085
Diarrhea	372 (35.6)	25 (29.8)	0.175
Cough	361 (34.5)	23 (27.4)	0.112
Difficulties in breathing (DIB)	166 (15.9)	23 (27.4)	0.007
Convulsions	133 (12.7)	20 (23.8)	0.006
Major diagnoses			
Malaria	517 (49.4)	38 (45.2)	0.460
Anemia	372 (35.6)	48 (57.1)	< 0.01
Diarrhoea	288 (27.5)	17 (20.2)	0.147
Pneumonia	221 (21.1)	28 (33.3)	0.009
Malnutrition	214 (20.5)	28 (33.3)	0.006
UTI	112 (10.7)	1 (1.2)	0.005
HIV	28 (2.7)	4 (4.8)	0.268
Other	194 (18.5)	22 (26.2)	0.087

* p-values based on Chi-square test

Table 10: The association between Malaria and Anaemia deaths in the Lake Zone

	Anaemia present	Anaemia absent	Total
Malaria	Number (%)	Number (%)	Number (%)
Positive	11 (45.8)	13 (54.2)	24 (100.0)
Negative	14 (23.3)	46 (76.7)	60 (100.0)
Total	25 (29.8)	59 (70.2)	84 (100.0)

Chi-square=4.15, p-value=0.042

5. 0 DISCUSSION AND CONCLUSIONS

5.1 Discussion

Overall under-five mortality in mainland Tanzania is estimated at 81 per 1000 live births and slightly higher in the Lake Zone (112 per 1000 live births) [2]. While the rest of the country has made progress in reducing malaria among those under-five, now with a prevalence of 10% from 18% in the 2008-2009 THMIS, prevalence in the Lake Zone has remained high (32% in Geita, 25.4% in Mara 18.6% in Mwanza and 8.3% in Kagera [12,13]. To support the Tanzania Government in reducing morbidity and mortality of under-fives in the Lake Zone, Tibu Homa is building the capacity of health care workers in case management by making use of the differential diagnosis protocols (the referral care manual) for major causes of severe febrile illness, treatment of malaria upon laboratory evidence, and improving the overall health systems. The study found a mortality rate of 74 deaths per 1000 children. Although the denominator is not live-births and the deaths exclude children aged less than two months, this level is lower than the previously reported data, suggesting a potential decline that might be partially attributed to Tibu Homa support in the region in addition to the government's efforts in reduction of deaths of under-fives.

This study aimed to quantify morbidity and mortality among under-fives admitted in three regions of the Lake Zone hospitals (Mwanza, Kagera and Mara) and assess factors associated with mortality in the area. The background characteristics of parents/caretakers of under-fives in this study sample were comparable with a recent study conducted in Central Tanzania [15].

The study found the major morbidities among under-fives in the Lake Zone to be malaria, anemia, diarrheal diseases, and respiratory problems. Malnutrition (severe stunting 20.5%, moderate acute malnutrition 13.7%, severe acute malnutrition 8.4%) featured high as a cause of morbidity in the three regions of the lake zone by contributing 42.6% of all causes of admission during the study period. In this study, the main presenting symptoms at admission were fever, vomiting, diarrhea and coughing quite consistent with the previous report in one of the districts in Tanzania [20]. The common diseases described have been previously reported as the leading causes of mortality among U5 children in developing countries and in Tanzania [15-17]. For the past five years, they have been leading contributions of hospital admissions and out-patient under-fives in Tanzania [15, 18, and 19]. However, the prevalence of morbidities among under-fives found in this study was lower than those reported in 2013 from Bugando Medical Centre [21]. While THIMS reported the prevalence of malaria in Kagera to range between 5.5% and 8.3%, this study reports a higher proportion of under-fives to have malaria in Kagera. Although this may partly be due to high malaria infection during the rainy season, but also it is because of hospital data that are more likely to over-estimate the prevalence. In this study, 43% visited established health facilities (dispensaries, health centres or other

hospitals) before coming to the current hospital. This means the remaining 57% received medications from medical dispensers, home treatment or traditional healers before going to the hospitals. This phenomenon is similar to a study on health-seeking behavior conducted in Rufiji [22]. Although there have been improvements in health care delivery in Tanzania, delays in seeking care especially among U5 children is a problem [14]. Data in this study shows under-fives present to hospitals after 24 hours of onset of illness are at increased mortality by about twice compared to those presenting early (OR=1.7, 95% CI=1.0, 2.9).

Although the mortality of 74 per 1,000 U5 inpatients found in this study appears lower than the projected figure of 84.6 that was used when calculating the sample size [2], the difference is not statistically significant (based on 95% CI). Furthermore, major underlying causes of in-patient deaths were severe anemia, severe malaria and pneumonia and malnutrition. In recent times, the same causes of mortality have been cited and discussed in rural Tanzania [23].

Mortality is associated with location and there is an increased risk of mortality among under-fives in Mwanza and Mara Regions relative to Kagera Region. Though not documented elsewhere, this association may be due to economic, social and cultural factors that have to be established. Factors such as public spending, immunization, health seeking behaviors, etc. may be associated with under-five mortality in selected regions. However, hospital related factors might also be responsible as they might lead to poor compliance to standard treatment guidelines as a result of poorly functioning quality improvement teams that were established by THP that work as change agents in improving case management a practice that have been shown to give results [24].

The study shows that females under-fives are at higher risk of inpatient mortality compared to male under-fives. Other studies in developed countries, have reported the risk of children dying is higher among males but not in developing countries [25, 26, 27]. The differences in mortality by sex between developed and developing countries has not been studied and the link between mortality and sex has not been fully established anywhere. However, a study from Ghana indicated that caregivers of females under-fives used alternative medications and caregivers of males under-five use public providers [29]. However, an assessment on gender conducted by THP (unpublished report) reported male and female children are not treated differently in seeking care in the region

In this study, a U-shaped pattern of under-five mortality by age was found with more deaths among the 2-11 months and 48-59 months age groups. Since maternal age and birth order are associated with U-shaped under-five mortality [28], these two variables may explain the U-shape mortality observed in this study. Further analysis on association of sex or delay in seeking care among different age groups did not support the U-shape mortality by age. [30].

The assessment also found children under-five who had never been hospitalized before having higher mortality than the previously hospitalized under-five. Previous hospitalization increases chances of survival and could be due the initial care received.

A high proportion (61%) of parents presented late to health facilities. Late care seeking among parents/caregivers of children under-five has been recently documented in Dodoma, Tanzania [31]. It is logical that presenting late to the health facility for treatment means a higher mortality risk. Parents/caregivers from the Mara Region are leading in reporting late to hospitals for treatment.

The study found major underlying causes of deaths to be severe anemia, severe malaria and severe pneumonia. Using verbal autopsies in Tanzania, the reported major causes of deaths are severe malaria, pneumonia, diarrheal diseases, and malnutrition and birth asphyxia [23, 31]. Therefore, although the major variation in underlying causes of deaths from this study was found to be severe anemia, there is a statistically significant difference between under-fives-dying from anaemia that is associated with malaria and anaemia that is not associated with malaria.

There are several potential limitations in this study. First, this hospital-based study clearly misses deaths that occur outside health facility settings. In low and middle income countries, many deaths occur in the community and information about causes are often unreliable. Second, results from this study cannot be generalized to other regions of Tanzania. Therefore, care must be observed when making inferences using the morbidity and mortality levels reported in this study.

Third, face-to-face interviews were used rather than a self-administered tool. In using this technique, it is possible to introduce information bias because respondents might have been offering socially desirable answers. Fourth, although the study tried to examine independent factors associated with under-five mortality, the selected factors were not exhaustive and missed several social factors such as socio-economic and cultural characteristics that may be related to mortality. Also, asking about past events of previous sickness relies on memory which may be flawed. Therefore, recall bias cannot be ruled out. By using well trained clinicians, this limitation was minimized. Moreover, the limitations of inaccurate and incomplete documentation and misclassification commonly observed in health facilities were decreased because Tibu Homa has increased the capacity of hospital health care workers in quality case and data management for the under-fives.

5.2 Conclusions

The critical information obtained in this study will not only help decision makers assess and act on the emerging needs of children under five years old in the Lake Zone Region but will also form a base for effectively monitoring the progress of the current programs targeting under-five years of ages in the Lake Zone and better plan future interventions. The study is believed to offer better quality data on hospital

diagnoses and deaths based on improved diagnoses and treatment of under-fives in the Lake Region.

Inpatients aged between 2 and 59 months admitted in hospitals in the Lake Zone suffer a number of diseases that include malaria, anemia, pneumonia, diarrheal diseases and malnutrition. Malaria remains a leading cause of admissions in hospitals among children under-five. Most of the under-fives admitted in hospitals presented with fever, vomiting, diarrhea, cough and convulsions.

The mortality level among children under-five is slightly more than 1 in 13. Factors associated with higher mortality are hospital location, the female sex, type of morbidities like anemia, malnutrition, UTI and respiratory infections. Major underlying causes of deaths are severe anemia, severe malaria and severe pneumonia. However, the majority of under-fives die from anemia, pneumonia and malnutrition. Nonetheless, without malaria, anaemia does not account for significant under-five mortality.

It has been found that the risk of mortality for children under five is elevated when caregivers present late for treatment. Most caregivers present their under-fives late for treatment. The Mara Region has more caregivers reporting late to hospitals than other regions. Furthermore, female under-fives in the study area have increased risk of mortality than their counterparts.

6.0 RECOMMENDATIONS

To avert deaths of children under-five admitted in hospitals, the Government of Tanzania needs to adopt a comprehensive package to improve case management of illnesses in children under five. The MoHSW in collaboration with other stakeholders like Tibu Homa should implement geographically focused interventions rather than generalized remedies for all conditions regardless of geographic variations. The Government needs to study causes of mortality disparities in the Lake Zone.

Tibu Homa has been addressing prompt health care-seeking behaviors among caregivers by training health care providers to relay these messages to the appropriate audience. The problem is persistent, especially in health facilities in the Mara Region. Therefore, we recommend that the government vigorously examine the promotion of early care-seeking behavior as part of the strategy in reducing child deaths in Tanzania. The government can scale up community health care workers to identify sick children, counsel on appropriate care seeking through an integrated Community Case Management (iCCM) approach and referral. Together with this strategy, efforts should be made towards improving health of female babies; whether it is through breaking cultural beliefs that discourage health promotion among this sex or anything that could increase the risk of female mortality.

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