Clinical profiles and outcomes of paediatric patients presenting with abdominal pain to the emergency medicine department of Muhimbili national hospital, Dar es salaam, Tanzania

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CLINICAL PROFILES AND OUTCOMES OF PAEDIATRIC PATIENTS PRESENTING WITH ABDOMINAL PAIN TO THE EMERGENCY MEDICINE DEPARTMENT OF MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM, TANZANIA

By

Francis Mussa Sakita

A dissertation / Thesis Submitted in (Partial) Fulfilment of the Requirement for the Degree of Master of Medicine (Emergency Medicine) of

Muhimbili University of Health and Allied Sciences
October, 2017

CERTIFICATION

The undersigned certify that he has read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation titled **"Clinical profiles and outcomes of paediatric patients presenting with abdominal pain to the Emergency Department of Muhimbili National Hospital Dar es salaam -Tanzania"** in (partial) fulfilment of the requirement for the degree of Masters of Medicine in Emergency Medicine of Muhimbili University of Health and Allied Sciences.

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Hendry R. Sawe, MD, MMed, MBA

(Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, **Francis Mussa Sakita**, declare that this **dissertation** is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award

Signature..... **Date**.....

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DEDICATION

To the beloved family of Mr and Mrs. Mussa Sakita for their love, prayers, guidance and encouragement over the years. Thank you for always being there in my triumphs and sorrows.

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ABSTRACT

Background: Abdominal pain in children can represent benign aetiologies and true life threatening emergencies. Aetiologies of paediatric abdominal pain vary geographically, and have not been studied in acute care settings in Tanzania.

Aim: To describe the clinical profiles and outcomes of paediatric patients presenting with abdominal pain to the EMD-MNH.

Methodology: This was a prospective cohort study of children aged 1mo-18yrs presenting with abdominal pain at the EMD-MNH. A case report form (CRF) was used to collect data on a convenience consecutive sample of patients from June to December 2016. The CRF included demographics, clinical presentation, management, diagnoses, disposition, and 24-hour, seven-day and three-month mortality. Data was summarised using descriptive statistics and analysed using counts, percentages, median; inter quartile range, relative risk, Mann-Whitney U test and logistic regression model was applied.

Results: Total of 1855 children were screened, of which 184 (9.9%) children meeting the inclusion criteria were enrolled. The median age was 3.5yrs (IQR 1.3-7.0 yrs). 124 (67.4%) were male. 138 (75.0%) were referred from peripheral hospitals. Top EMD diagnoses were hernia, intra-abdominal malignancy and sickle cell disease. Most common interventions provided at the EMD were intravenous fluids 57 (30.9%), antibiotics 55 (29.9%) and analgesia 43 (23.4%). From the EMD, 37 (20.1%) were discharged home, 83 (45.1%) were admitted to medical wards and 48 (26.1%) to the surgical wards. Overall, 16 (8.7%) of these children underwent an operation. 24-hour, 7-day and 3-month mortality were 1.1%, 6.5% and 14.4%, respectively. Overall in hospital mortality was 9.8%.

Conclusion & Recommendations: Abdominal pain is a common complaint amongst paediatric patients presenting to the EMD-MNH. This presentation was associated with significant morbidity and mortality as evidence by very high admission rate, need for surgical intervention and an overall mortality rate of nearly 10%. Further studies and quality improvement efforts should focus in identifying aetiologies, risk stratification, and appropriate interventions optimize outcomes.

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ABBREVIATIONS OF TERMS

ALT	Alanine Transferase
AST	Aspartate Transferase
AVPU	Alert, Verbal, Pain, Unconscious
BP	Blood Pressure
BS	Blood Slide for Malaria
CNS	Central Nervous System
CPL	Central Processing Laboratory
CT SCAN	Computed Tomography Scan
CVS	Cardiovascular System
EMD	Emergency Medicine Department
FAST	Focused Assessment with Sonography for Trauma
FBP	Full Blood Picture
GCS	Glasgow Coma Scale
HEENT	Head, Eyes, Ear, Nose and Throat
HIC	High Income Country
HR	Heart Rate
IRB	Institutional Review Board
LMIC	Low-and Middle-Income Countries
MNH	Muhimbili National Hospital
MRDT	Malaria Rapid Diagnostic Test

MUHAS	Muhimbili University of Health and Allied Sciences
NGT	Nasogastric Tube
POC	Point of Care
RBG	Random Blood Glucose
RR	Respiratory Rate
RS	Respiratory System
SSA	Sub-Saharan Africa
US	Ultrasound
VBG/ABG	Venous Blood Gas/Arterial Blood Gas
WBC	White Blood Cells

DEFINITION OF KEY TERMS

Acute abdominal pain is a sudden uncontrolled development of severe abdominal pain secondary to disease or injury (1).

Appendicitis is the inflammation or infection of the short thin blind-ended tube that is attached to the end of the caecum.

AVPU is a system of assessing the depth of unconsciousness A= alert; V= verbal responses present; P= pain responses present; U= unresponsive.

A child is defined by the Convention on the Rights of the Child (CRC) as every human being below the age of 18 years.

Emergency Medicine is a medical specialty with the principal mission of rapid evaluating, managing, treating and preventing unexpected illness and injury (1).

Glasgow Coma Scale (GCS) is a numerical system used to assess patient's level of consciousness.

Intussusception is a pathological process in which a segment of the intestine invaginates into the adjoining intestinal lumen, causing bowel obstruction.

Paediatrics is a sole discipline concerned with all aspects of well-being of children including their health; their physical, mental, and psychological growth and development; and their opportunity to achieve full potential as adults (2).

1.0 INTRODUCTION

1.1 Background

Globally, abdominal pain is one of the most common symptoms that results in paediatric patients presenting to Emergency Medicine Departments (EMDs) (3–8). Abdominal pain may be a result of underlying traumatic or non-traumatic pathology. Non-traumatic abdominal pain is associated with both medical and surgical conditions that range from benign to life-threatening (4). The burden of acute abdominal pain in EMDs in High Income Countries (HICs) is well documented and has a widely variable presentations and diagnoses, and generally good clinical outcomes (3,7–9). In Low- and Middle-Income Countries (LMICs) the burden remains largely under-documented and undocumented, but when reported, the outcomes include significant morbidity and mortality.

In HIC, acute abdominal pain accounts for approximately 8%, of all children presenting to EMDs (7,10). The majority of children with acute abdominal pain in HICs are found to have medical or non-specific diagnoses; and surgical conditions requiring intervention only account for 6.5 % of cases (11). There is no difference in outcomes by race among paediatric patients who presents with abdominal pain at EMDs in HICs (12). The mortality and case fatality of surgical conditions, such as intussusceptions, in HICs is less than 1% (13,14). So, these patients do quite well with efficient diagnosis and treatment in HICs.

However, beyond the clinical implications of abdominal pain, the financial impact of management is substantially high. Abdominal pain cost 2.6 billion dollars of hospital charges in 1997 in the United States of America (USA) and also contributing to over 1 million hospital days (5). In Sub-Saharan Africa (SSA), these figures are unknown.

The large costs and prolonged hospital courses for children with abdominal pain are largely due to the fact that in children abdominal pain management poses a unique challenge when compared to adults. Children with abdominal pain presenting to acute care can have variable associated symptoms such as vomiting, loss of appetite, diarrhoea, fever or cough that may mimic other disease processes (9). Children can also be challenging patients because communication can be difficult, and abdominal pain needs to

be investigated well as it can result from truly life-threatening aetiologies (15). Studies in HICs have shown that abdominal pain presentations can vary according to the age of the child, and can vary widely in severity. This ranges from minor self-limiting conditions (constipation), which can be managed in the outpatient setting after parent/guardian education, to life-threatening conditions such as acute appendicitis, intussusceptions, abdominal trauma (blunt or penetrating) or ovarian torsion which require immediate surgical intervention (8).

The challenges in caring for children with abdominal pain, are further complicated by the fact that abdominal pain may originate from a disease process outside of the abdomen (such as a pneumonia), or a systemic illness (such as malaria or diabetic ketoacidosis) (16). These are often misdiagnosed as intra-abdominal processes, missed completely, or dispositioned to inappropriate further care (9,10,17).

In Africa, there is a general paucity of data on the clinical presentation of abdominal pain in children to guide workup and care; however, several studies evaluating the burden of specific abdominal-related diagnoses have been conducted (18–21). Acute appendicitis, intussusceptions and intestinal obstruction are the most common diagnoses among children presenting to the hospital in different parts of SSA. The overall mortality from these conditions varies widely, but has been reported to be as high as 25 % (22). This is more than 25 times the mortality rate reported in HICs. This disparity has been attributed to various factors, such as delayed presentation to the hospital, delayed diagnosis, lack of resources, burden/severity of illness, and co-morbidities such as HIV (18,23,24). Several other factors, such as surgical aftercare further complicate the picture and understanding of this morbidity and mortality. For example, the most commonly identified complication after surgical intervention was wound sepsis (23). A deeper understanding of these challenges is needed to identify areas for improvement in the healthcare system that can benefit the healthcare of these children in Tanzania.

The few studies done on paediatric patients presenting with abdominal pain in Tanzania have shown that the mortality in patients undergoing surgical procedures for abdominal complaints ranges from 15 to 25 % with a hospital length of stay up to 7 days (18,22,23). There are no dedicated studies looking at the general presentation of patients with

abdominal pain presenting to emergency care areas, and/or with non-surgical causes of abdominal pain.

In recent years, Tanzania has witnessed major changes in the Emergency Medicine specialty, with the opening of the first full capacity public EMD at Muhimbili National Hospital (EMD-MNH) (25). This Department plays a major role in triaging, resuscitating, treating, stabilising and giving proper disposition to acutely ill patients (26). This creates a special opportunity for early recognition and management of patients with acute abdominal pain, with a potential to improve their clinical outcome.

We aim to characterise paediatric patients who present to the full-capacity EMD-MNH with the initial complaint of acute abdominal pain. This characterisation can improve providers' understanding of paediatric abdominal pain in emergency settings in Tanzania, thus, help to improve care of these patients.

1.2 Literature review

Abdominal pain is a common complaint in children presenting to EMDs worldwide (3,7,8). In Tintinalli's textbook of Emergency Medicine abdominal pain is classified as visceral, somatic/parietal or referred pain. Visceral pain is a result of distension of a viscus stimulating un-myelinated nerves and generally presents with a dull, poorly localised pain over the epigastric, periumbilical or suprapubic regions (11). Such pain results from a number of clinical conditions, including early appendicitis (27). In contrast to visceral pain, somatic pain is described as well-localised, intense or sharp pain and known to result from stimulation of somatic nerves in the parietal peritoneum , muscle or skin unilateral to the spinal cord level T6 to L1 example late appendicitis (4). Lastly, referred pain presents at a site distant from the diseased organ(s), and is characterised by either a sharp, localized sensation or a vague ache example acute ureteral obstruction is associated with testicular pain of the same side (11,27).

Abdominal pain in children presenting to EMDs varies with age worldwide. There is geographical variation in aetiology of abdominal pain across the world. For example, a study in Turkey has shown that children less than seven years of age were more likely to complain of abdominal pain when suffering from upper respiratory infections (pharyngitis and otitis media) as compared to children older than seven years who were more likely to have surgical conditions (appendicitis) (7). On the contrary, in China, younger children were more likely to have surgical conditions, such as incarcerated hernia and intussusceptions, and surgical conditions were infrequent in school-aged children (9). In Tanzania and its neighbouring countries, the age variation of children with abdominal pain presenting to the EMDs is unknown.

The overall burden of abdominal pain also varies across the world. Studies in HICs showed a prevalence of children with abdominal pain presenting to EMDs to be 5 to 8 % (7,10,28). Early recognition and treatment of various causes of acute abdominal pain in children in HICs led to a mortality and case fatality to be less than 1.1 % (8,13,14). Despite greater achievement in mortality reduction in HICs, abdominal-related disorders continued to increase the costs and number of days spent in hospitals (5). On the contrary, in SSA, mortality rate varies from one country to another and across individual causes of abdominal pain. For example, studies done on appendicitis in children in various countries

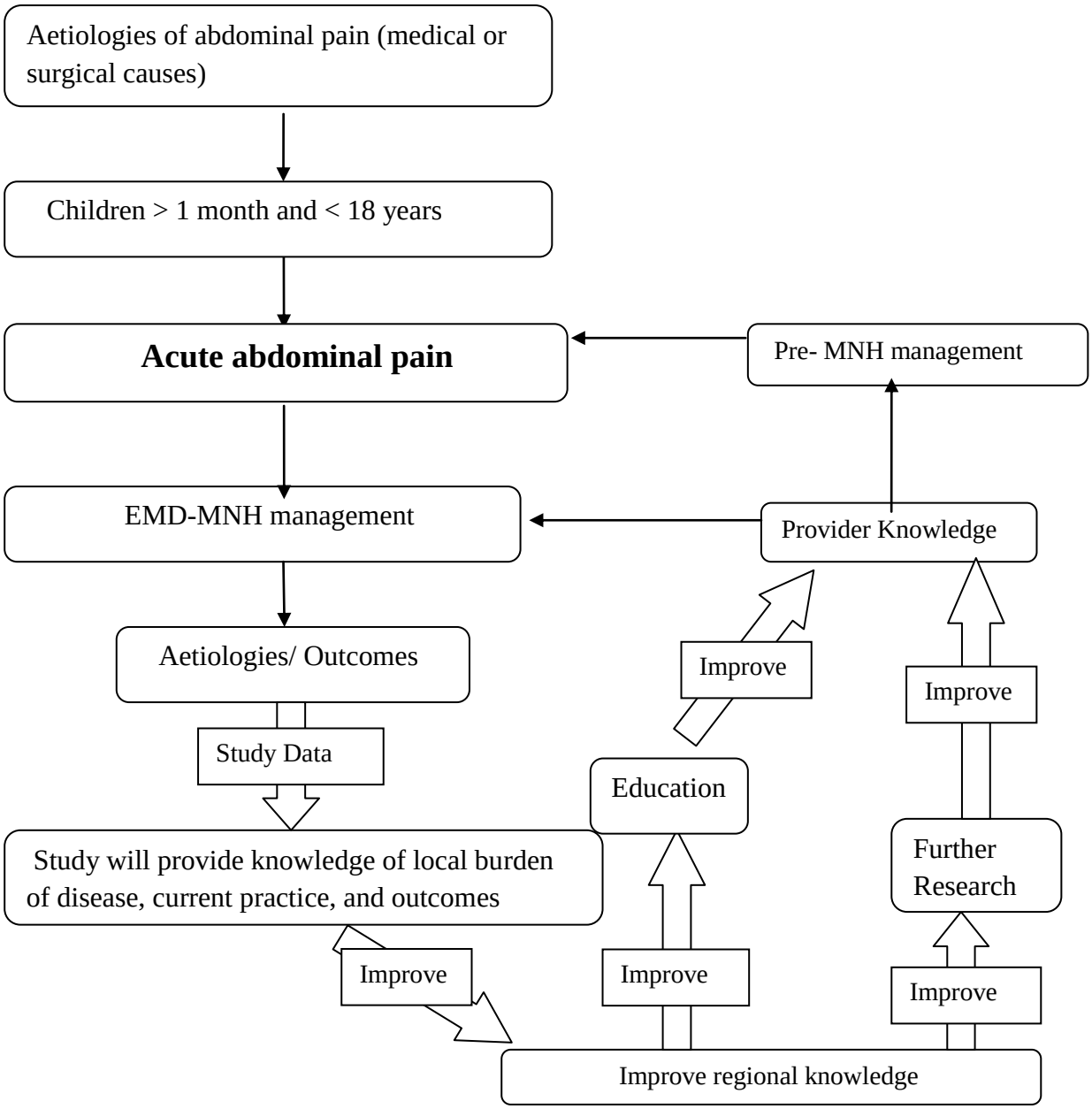
in SSA showed no associated mortality (19–21). However, in Tanzania mortality rate due to delay in presentation (> 3 days) of children with abdominal pain due to intussusception was found to range from 15 to 25 % (18,22).

Children presenting to the EMDs may have other symptoms and signs accompanied with abdominal pain which require careful evaluation. A study in the USA on evaluating clinical outcomes in children with abdominal pain, categorized the symptoms and signs to be originating either from abdominal or extra-abdominal processes (3,29). Abdominal symptoms and signs include decreased appetite, vomiting and abdominal tenderness, while the extra-abdominal symptoms are fever, headache, sore throat, cough, rhinorrhoea, irritability and increased urinary frequency (10,29).

Clinical presentation of children with abdominal pain to EMDs varies and so as the management. In the management of children presenting with abdominal pain, the role of EMDs is well established in most of the developed countries with full-capacity EMDs and Emergency Medicine programs (9,12). EMD management includes a combination of treating pain and nausea, intravenous (IV) fluids, radiological tests such as ultrasound, chest X-ray (CXR), plain abdominal X-rays (supine and erect)and standard laboratory tests including urinalysis, full blood picture (FBP), lipase, urinary pregnancy test and urine culture (8,9,11,30). In resource-limited settings, the completeness of the evaluation and treatment varies and may be limited by human resource, lack of infrastructure , and severity of disease (23).

The lack of dedicated EMDs in most of SSA countries makes it difficult to triage, resuscitate and stabilise paediatric patients who present with an acute abdominal pain. In Tanzania, Emergency Medicine is a new specialty which is less than 10 years since its establishment at MNH (25). EMD-MNH is an integral part of the hospital that receives up to 60,000 patients per year from different regions of Tanzania and offers emergency care by triaging, resuscitating and stabilising patients with acute and life-threatening conditions such as appendicitis (26,31). Among the patients presenting to the EMD, 25 % are children below the age of 18 years of age (32). However, the percentage of children presenting to the EMD-MNH with acute abdominal pain, its clinical presentation, management and mortality at 24 hours, 7 days and 3 months were previously unknown.

2.0 CONCEPTUAL FRAMEWORK



Conceptual Framework: Authors' own formulation (2017)

This Conceptual Framework describes the flow matrix of this study and its impact on the healthcare system.

3.0 PROBLEM STATEMENT

Abdominal pain is among the most common EMD complaints in children, and encompasses a broad number of diagnoses including medical and surgical problems. Abdominal pain in children can be a result of a simple self-limiting condition or a highly complex and life-threatening emergent condition that requires early diagnosis, resuscitation, stabilisation and definitive treatment (27). The management of children poses a unique challenge to providers across the world, due to the nature of the presentation and also, the inability of children to provide history and express localisation of symptoms (9). The aetiologies of abdominal pain in children vary geographically and understanding the common regional aetiologies helps providers in diagnosis and treatment efficiently. This is important because delayed recognition of intra-abdominal emergencies is associated with high mortality or lifelong morbidity (18,23).

Previous studies in East Africa have been carried out in hospital wards and largely describe individual causes of abdominal pain such as appendicitis and intussusception (18–21). Currently, there are no data on clinical presentation, aetiologies and outcomes of paediatric patients presenting with abdominal pain to acute care settings in Tanzania.

4.0 RATIONALE

The management and outcomes of paediatric patients presenting with abdominal pain can be improved with better understanding of regional aetiologies of abdominal pain in this group (10). Furthermore, improving the efficiency of recognition of serious emergent aetiologies of abdominal pain has been shown to decrease morbidity and mortality in paediatric patients (18,23).

Therefore, the information gathered from this study will be very useful to clinicians working in acute intake settings in Tanzania as it will characterise the burden of acute abdominal pain in paediatric patients. Also, it will help to guide management by identifying delays in presentation, recognition and improper management of these patients that may lead to poor outcomes. This will provide the opportunity to address the magnitude of the problem, educate parents on the importance of early presentation and train providers to efficiently recognize and treat the aetiologies of abdominal pain. Overall, the knowledge gained from this study has the potential to improve the healthcare system and thereby improving the outcomes of these patients.

5.0 RESEARCH QUESTION

What are the clinical profiles and outcomes of paediatric patients presenting with abdominal pain to the Emergency Medicine Department, Muhimbili National Hospital, Dar es Salaam?

6.0 OBJECTIVES

6.1 Broad Objective

To describe the clinical profiles and outcomes of paediatric patients presenting with abdominal pain to the EMD-MNH, Dar es Salaam, Tanzania.

6.2 Specific Objectives

i. To determine the proportion of paediatric patients presenting to the EMD-MNH with acute abdominal pain.
ii. To explore the pre-MNH course of illness and management given to paediatric patients presenting to the EMD-MNH with abdominal pain.
iii. To describe the clinical presentation, management strategies and final EMD diagnosis of paediatric patients presenting to the EMD-MNH with abdominal pain.
iv. To describe the outcomes (disposition, 24 hours, 7 days and 3 months mortality) of paediatric patients presenting to the EMD-MNH with abdominal pain.
v. To evaluate risk factors for mortality such as delay in presentation, severity of illness or delay in appropriate management of paediatric patients presenting to the EMD-MNH with abdominal pain.

7.0 METHODOLOGY

7.1 Study design

This was a descriptive prospective cohort study of paediatric patients older than 1 month and younger than 18 years presenting with abdominal pain at the EMD-MNH between June and December 2016.

7.2 Study Setting

The study was conducted at the EMD- MNH, Dar es Salaam. The hospital is situated in Ilala, one of the five districts of Dar es Salaam, Tanzania's commercial capital city. This is a tertiary teaching hospital which serves as a National referral hospital and has a capacity of 1500 beds with weekly admission of around 1,200 patients (33). The EMD-MNH was inaugurated in 2010 via a partnership between the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC), MNH and the Abbott Fund Tanzania (AFT). The department operates 24 hours and attends 150 to 200 patients each day. Approximately one-fourth of patients are children under the age of 18 years (25,31). The department is staffed by Emergency Medicine specialists who oversee the care provided by residents, registrars, intern doctors and undergraduate students. Critical care nurses supervise the nursing care of patients. There are special treatment and resuscitation rooms dedicated to paediatric patients' care; these rooms are under supervision of the specialists and critical care nurses.

7.3 Study population

Target population

Children older than 1 month and younger than 18 years presenting with abdominal pain to the acute intake areas of hospitals in Tanzania.

Accessible population

Children older than 1 month and younger than 18 years presenting with abdominal pain at the EMD-MNH in Dar es Salaam, Tanzania. Children younger than 1 month do not pass by the EMD for evaluation; instead they are admitted directly to the neonatology unit.

Study population

Children older than 1 month and younger than 18 years presenting with abdominal pain to the EMD-MNH during the study period and who were available when the researcher/research assistant(s) was present and whose parents consented to participate in the study.

7.4 Subjects

Inclusion criteria

All children older than 1 month and younger than 18 years of age presenting with abdominal pain and related complaints (inconsolability, drawing up of legs, passing currant jelly stool, distension or tenderness) in EMD-MNH.

Exclusion criteria

- Children who sustained burn injury on the abdomen.
- Children with acute abdominal pain who developed cardiac arrest in EMD-MNH before being enrolled in the study.

7.5 Variables of interest

INPUT (Predictive variables)

i. Demographics

- Age
- Sex

ii. Pre-MNH course of illness and treatment (treatment given to the patient at the peripheral health centre/hospital prior to the arrival EMD-MNH)

- Time to initial hospital presentation from onset of symptoms
- Alternative treatment used if any such as traditional healer medications
- History of admission and duration of time spent at a peripheral health centre/hospital
- IV fluids given at the peripheral health centre/hospital

- Prescribed antibiotics
- Analgesia used
- Antiemetic used
- Referral diagnosis and the reason for referral to MNH

iii. Clinical presentation of the patient at the EMD-MNH

- Associated symptoms that the patient has apart from the abdominal pain such as fever, vomiting, cough etc.
- Any accompanied co morbidity such as sickle cell disease, immunosuppression, malignancy etc.
- Vitals signs such as blood pressure, heart rate, respiratory rate, oxygen saturation and temperature
- Physical findings of the patients such as abdominal distension, tenderness, gloved finger stained with blood after digital rectal examination etc

iv. EMD management strategies (includes care that the patient received while at the EMD-MNH at the discretion of the attending doctor)

- IV fluids administered
- Antibiotics given
- Analgesia given
- Antiemetic medication given
- Diagnostic workup: Ultrasound, laboratory, X-rays, Urine dipstick, pregnancy test
- Consultation to other specialties such surgery according to the patient emergent condition

v. Provider's final diagnosis at the EMD

OUTCOMES OF INTEREST

i. Proportion of children with abdominal pain who presented to the EMD-MNH
ii. Surgical versus non-surgical management of various causes of abdominal pain
iii. Disposition such as operating theatre, medical or surgical wards and ICU
iv. Mortality: at 24 hours, 7 days and at 3 months

v. Final hospital diagnosis as reported in the file or discharge summary
vi. Cause of death as documented in the file of MNH

7.6 Study sampling

A consecutive convenience sampling method was used to enrol children between 1 month and 18 years of age who presented with the complaint of abdominal pain (as reported by the parent/guardian or the patient her/himself) to the EMD and whose parent or guardian consented to participate in the study. A research assistant screened every child who presented during the 12 hour shift and enrolled all patients with abdominal pain who met the inclusion criteria. No parents/guardians of children who met the inclusion criteria declined participation. There was no specific number of days or nights shifts allocated for data collection. However, data was collected on alternate days of the week for a period of 24 weeks.

7.7 Sample size

The sample size of this study was estimated from the formula below using the proportion of combined paediatric mortality rates of medical and surgical cases in Tanzania. Medical case mortality of 2015 was reported at 13.3% (Dr. M. Charles, Head of department of paediatrics MNH, personal quarterly data on mortality, March 2016 unreferenced). Mortality rates of children who were operated on due to acute abdomen in paediatric surgery ward was 11.3%(23). Therefore, the average mortality for medical and surgical cases that required surgical intervention was estimated to be 12.3%.

$N = [(Z^2P * (1-P)]/E^2$

Whereby,
N= Minimum sample size
Z = Standard normal deviate which is 1.96 for 95% confidence level
P = Combined mortality of medical cases in 2015 and mortality of children who were operated due to acute abdomen at the paediatric surgery department (12.3 %).
E = The margin of error (which is 0.05%)

Therefore,

N= [(1.96²*0.1232 (1-0.1232)]/0.05²

N= 166

NOTE: Assuming loss to follow-up rate of 10%, then

ADJUSTING FOR LOSS TO FOLLOW-UP = N * Adjusted factor

= 166* [100/ (100-10)]

=**184**

Therefore, the minimum required sample size is **184** children presenting at EMD-MNH

7.8 Data collection

Participants were enrolled in the study after meeting the inclusion criteria and consent was obtained. The principal investigator or the trained research assistant completed a written, case report form (*see appendix 14.3*) by recording information gathered from the Electronic Medical Record (EMR), Wellsoft information health system or directly from interviewing the parent or caregiver. Telephone numbers of the parent or guardian were obtained for follow-up at 24 hours, 7 days and 3 months. The principal investigator or the research assistant phoned the parent or guardian to find out if the child is still alive or died after 24 hours, 7 days and 3 months. A child was described as loss to follow up following the research assistant or the principal investigator failure to reach the parent or the guardian through the phone at least 3 times in different days of the week for two weeks.

7.9 Standardized data collection tool

Standardised case report form (*see appendix 14.3*) was used to collect information on;

- Demographics; age, sex, date of presentation, telephone number of the informant.
- Clinical presentation; history and physical examination findings.
- Pre –MNH management of children with acute abdominal pain (treatment prior to arrival at the EMD-MNH).
- EMD provisional diagnosis, management strategies and investigations.
- Mortality rate at 24 hours, 7 days and at 3 months.

7.10 Data Management and analysis

The collected data from the written questionnaire was transferred into Excel spreadsheet (Microsoft Corporation, Redmond, WA, USA) and then analysed. Data was cleaned and outliers checked. Median and interquartile range were calculated for skewed data. Proportion was obtained to determine the magnitude of children who presented with abdominal pain at the EMD during the study period, and to describe the study population. An online calculator for calculating confidence interval for proportions was used to obtain 95% confidence interval (CI) and relative risk (RR) for significance of various variables (34,35). The Mann-Whitney U test was used to determine the association of risk factors of mortality such as delayed presentation to the hospital. Also, logistic regression model calculated using STATA v 13 was used to assess the effect of specific variables on the study outcome. A p value of < 5% indicated statistical significance. Percentages were used to summarise categorical data.

7.11 Ethical considerations

Ethical clearance was sought from Muhimbili University of Health and Allied Sciences' Institutional Review Board (MUHAS-IRB), and permission to collect data was obtained from relevant authorities at MUHAS and MNH. Parents or guardian of patients were required to consent prior to enrolment in the study. Questionnaires were filled after parents or guardians of the participants signed the consent forms which were provided in both English and Swahili languages. Older children were required to assent before enrolment. If sensitive information such as rape is obtained from the child/parent/guardian, relevant authorities were notified. Data was coded to preserve patient's identities and stored on computer with a password known only by the researchers. The written consent forms were kept in a safe locker accessed by the researchers only.

8.0 RESULTS

8.1 Children who presented with abdominal pain prospective cohort flow chart

We screened 1855 children below 18 years during the study period, 184 (9.9%) children presented with the complaint of abdominal pain and all were consented to participate in the study. Among the 184 children, 37 (20.1%) were discharged home from the EMD, 83 (45.1%) were admitted to the medical ward, 48 (26.1%) were admitted to surgical ward and 16 (8.7%) of children had an operation at the EMD theatre before admission to the ward. Eleven children were lost to follow up. **(Figure 1)**

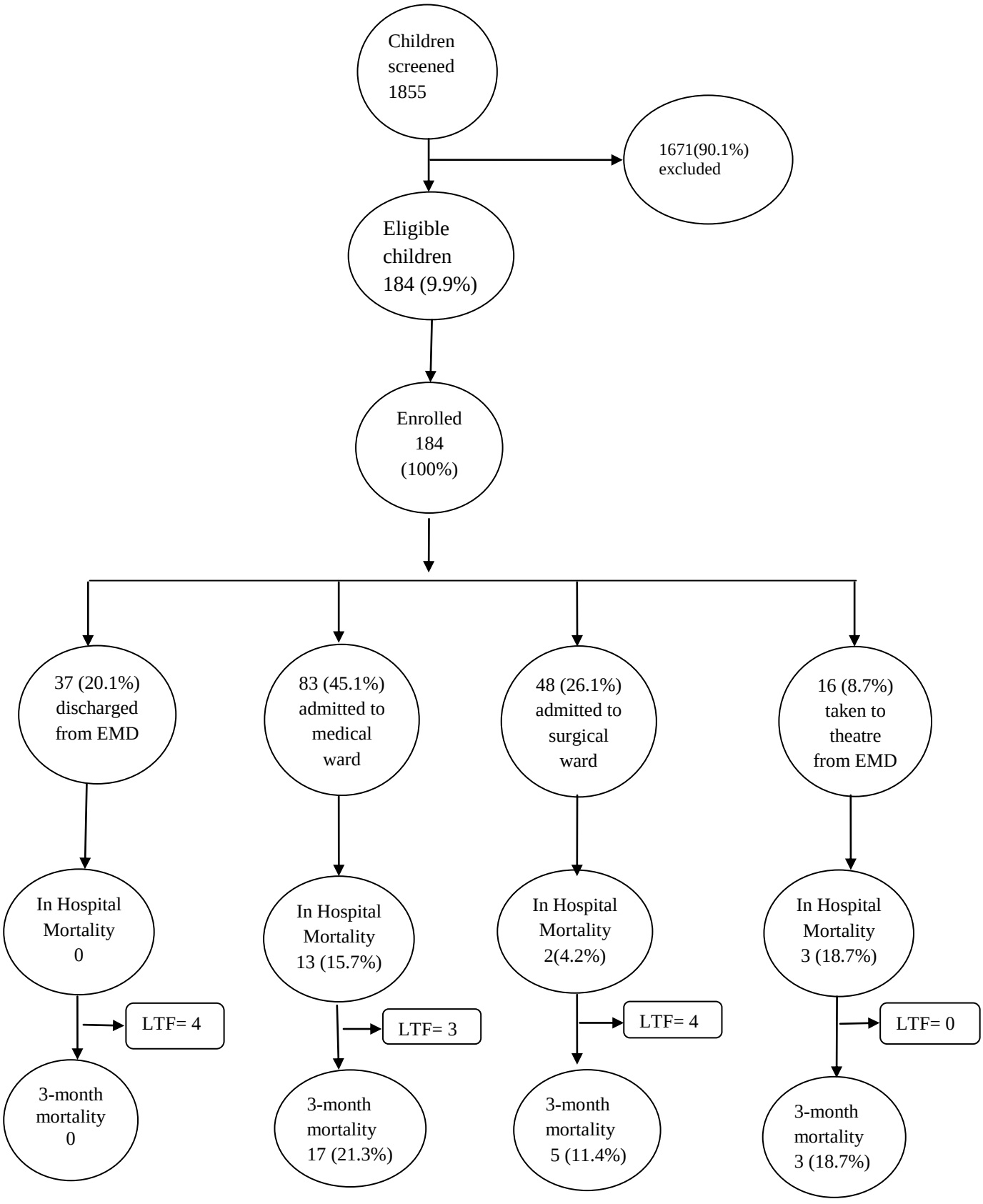


Figure 1: Screening, disposition and mortality of children presenting with abdominal pain.

8.2 Demographic characteristics

Of the 184 children enrolled, 124 (67.4%) were male and median age was 3.5 years (IQR 1.3-7.0). Male to female ratio was 2:1. Those reported to have abdominal pain for the first time were 111 (60.3%).Their median duration of current illness was 4 days (IQR 2.0-8.0).Overall, 138 (75%) children were referred from other peripheral hospitals. **(Table 1)**

Table 1: Demographic characteristics of children presenting with abdominal pain

Variable	**Overall**	**Died in hospital**	**Survived to discharge**	**P value**
	N=184	N=18	N=166	
	n (%)	n (%)	n (%)	
Duration of current illness (days) median (IQR)	4 (2.0-8.0)	6.5 (4.3-7.8)	4 (2.0-8.0)	0.14*
Time to presentation to any hospital, median (IQR)	2 (1.0-6.0)	2 (1.0-4.8)	2 (1.0-6.0)	0.66*
Age in years median (IQR)	3.5 (1.3-7.0)	2.8 (0.8-4.7)	3.6 (1.4-7.0)	0.17*
Male	124 (64.7)	10 (55.6)	114 (68.7)	
Referred from peripheral hospitals	138 (75.0)	16 (88.9)	122 (73.5)	
First time abdominal pain	111 (60.3)	14 (77.8)	97 (58.4)	
Comorbidities				
Sickle cell disease	15 (8.2)	1 (5.6)	14 (8.4)	
CHD	4 (4.1)	-	4 (2.4)	
Malnutrition	4 (4.1)	-	4 (2.4)	
Known HIV	2 (1.1)	-	2 (1.2)	
Malignancy	2 (1.1)	-	2 (1.2)	
Epilepsy	2 (1.1)	-	2 (1.2)	

Key: * Obtained through calculation using Mann-Whitney U test
HIV-Human Immunodeficiency Syndrome,
CHD- Congenital Heart Disease

8.3 Pre-MNH management given prior to arrival

Some of the children were managed prior to arrival at the department. The topmost leading management were antibiotics, 53 (38.4%), intravenous fluid administration 41 (29.7%) and antipyretics 28 (20.3%). Nasogastric tube was found in situ in 7 (5.1%) of all the children. **(Table 2)**

Table 2: The management given to children at the peripheral hospital

Variable	All N=138 n (%)	Died in the hospital N=18 n (%)	Survived to discharge N=166 n (%)
Antibiotics	53 (38.4)	8 (44.4)	45 (27.1)
Intravenous Fluids	41 (29.7)	7 (38.8)	34 (20.5)
Antipyretics	28 (20.3)	3 (16.7%)	25 (15.1)
Analgesia	28 (20.3)	3 (16.7)	25 (15.1)
Blood transfusion	13 (9.4)	2 (11.0)	11 (6.6)
Anti-malaria drugs	9 (6.5)	1 (5.6)	8 (4.8)
NGT placement	7 (5.1)	3 (16.7)	4 (2.4)

8.4 Vital signs, associated complaints, physical findings and outcomes

On arrival to EMD-MNH, 33 (18.1%) children had fever and 14 (14.6%) had increased respiratory rate. None of the children had hypoxia (SPO2 < 95%) or bradycardia. Among the most common reported symptoms were fever 93 (50.5%) and vomiting 77 (42.4%).

The most common abdominal findings identified by the providers were distension and obvious swelling/mass; 95 (51.6%) and 55 (29.9%) respectively. **(Table 3)**

Table 3: Vital signs, associated complaints, physical findings and outcomes

Variable	Overall n/N (%)	Died in Hospital n/N (%)	Survived to discharge n/N (%)	Relative Risk
Vitals signs				
Temperature > 37.5^{0}C	33/182*(18.1)	6/18 (33.3)	27/164 (16.5)	2.25
Tachypnoea**	14/184 (7.6)	6/18 (33.3)	8/166 (4.8)	6.07
Tachycardia **	18/184 (9.8)	3/18 (16.7)	15/166 (9.0)	1.84
Capillary refill > 2 sec	6/184 (3.3)	2/18 (11.1)	4/166 (2.4)	3.71
AVPU (abnormal)	9/184 (4.9)	3/18 (16.7)	6/166 (3.6)	3.89
Associated symptoms				
Fever	93/184(50.5)	14/18(77.8)	79/166(47.6)	3.42
Vomiting	77/184(42.4)	8/18(44.4)	71/166 (42.8)	1.06
Diarrhoea	25/184(13.6)	4/18(22.2)	21/166 (12.6)	1.81
Cough	37/184(20.1)	3/18(16.7)	34/166 (20.5)	0.79
Decreased appetite	17/184 (9.2)	-	17/166 (10.2)	0.25
Nausea	5/184 (2.7)	-	5/166 (3.0)	0.81
Weight loss	9/184 (4.9)	2/18 (11.1)	7/166 (4.2)	2.43
Abdominal findings				
Normal	33/184(17.9)	-	33/166 (19.9)	0.12
Distension	95/184(51.6)	18/18 (100)	77/166 (46.4)	34.69
Obvious mass/swelling	55/184(29.9)	4/18 (22.2)	51/166 (30.7)	0.67
Tenderness	55/184(29.9)	7/18 (38.9)	48/166 (28.9)	1.49
Decreased bowel sounds	12/184 (6.5)	1/18 (5.5)	11/166 (6.6)	0.84
Increased bowel sounds	11/184 (6.0)	1/18 (5.5)	10/166 (6.0)	0.92
DRE- blood	3/184 (1.0)	1/18 (5.5)	2/166 (1.2)	3.55

Key: AVPU- Alert, Verbal, Pain, Unresponsive, DRE-Digital Rectal Examination

*2 children were not checked temperature **Vital signs according to age (appendix IV)

8.5 Common investigations ordered and their outcome at the EMD

Random blood glucose (RBG) test found 11 (10.5%) children had hypoglycemia, malaria was positive in 10 (11.2%) children, POC iSTAT revealed elevated lactate 32 (43.8%) and hyponatremia 57 (70.4%) in all the children for whom tests were ordered. Overall, FBP showed an elevated WBC in 46 (46.9%) and haemoglobin of less than 10.9 g/dl was found in 77 (77.8%) children. None of the children had blood cultures or amylase/lipase tests done. Among the radiological investigations; 20 (10.9%) plain abdominal X-ray and 7 (3.8%) chest X-ray were ordered. None of the children had a CT scan of the abdomen ordered as part of investigation. This table is reflective of the results of children who underwent a particular investigation **(Table 4)**

Table 4: Results of commonly ordered investigations at the EMD

Variable	Overall n/N(%)	Died in the hospital n/N(%)	Survived to discharge n/N(%)	Relative Risk
Bedside investigation				
Hypoglycemia <3.5mmol/l	11/105 (10.5)	4/14 (28.6)	7/91 (7.7)	3.4
Hyperglycemia >6.9mmol/l	11/105 (10.5)	3/14 (21.4)	8/91 (14.3)	1.51
Malaria Positive	10/89 (11.2)	1/11 (5.5)	9/78 (5.4)	0.79
US (Abnormal)	12/21 (57.1)	5/5 (100)	7/16 (43.8)	8.46
Acidemia (< 7.35)	13/73 (17.8)	3/11 (27.3)	10/62 (16.1)	1.73
Alkalemia (>7.45)	17/73 (23.3)	3/11 (27.3)	14/62 (22.6)	1.23
Lactate level (>2mmol/L)	32/73 (43.8)	6/9 (66.7)	26/64 (40.6)	2.56
Hypokalemia*	14/81 (17.3)	3/13 (23.1)	11/68 (16.2)	1.44
Hyperkalemia*	1/81 (1.2)	0/13 (0)	1/68 (1.2)	1.5
Hyponatremia*	57/81 (70.4)	11/13(84.6)	46/68 (67.6)	2.32
Abnormal laboratory values				
White blood cells >11k/uL	46/98 (46.9)	5/13 (38.5)	41/85 (48.2)	0.71
Hemoglobin < 10.9g/dL	77/99 (77.8)	14/15(93.3)	63/84 (75.0)	4.0
Creatinine (>97umol/L)	3/50 (6.0)	1/10 (10.0)	2/49 (4.1)	2.07
Radiological investigations				
CXR	1/7 (14.3)	1/1 (100)	0/6 (0)	7.0
Abdominal X ray	13/20 (65.0)	2/2 (100)	11/18(61.1)	2.86
CT scan of the abdomen	-	-	-	-

Key: *Normal range values (36)

CXR-Chest X-ray US- Abdominal Ultrasound

8.6 EMD provider's final diagnoses and their outcome

This study found out that the most frequent EMD provider diagnoses among children presenting with abdominal pain in the department were hernia (inguinal and umbilical in origin) in 34 (18.5%), intra abdominal malignancy in 19 (10.3%) and sickle cell disease in 17 (9.2%). Moreover, only 3/184 (1.6%) had blunt abdominal injury, none presented with penetrating abdominal injury. **(Table 5)**

Table 5: Provider's common diagnoses and their outcome at the EMD

No.	Diagnosis	All N=184 n(%)	Died in hospital N=18 n(%)	Survived to discharge N=166 n(%)
1.	Hernia (with/out obstruction)	34 (18.5)	1(5.5)	33 (19.9)
2.	Intra abdominal malignancy	19 (10.3)	4 (22.2)	15 (9.0)
3.	Sickle cell disease	17 (9.2)	1 (5.5)	16 (9.6)
4.	Malaria	15 (8.2)	1 (5.5)	14 (8.4)
5.	Intestinal obstruction	12 (6.5)	1 (5.5)	11 (6.6)
6.	Viral intestinal infection, unspecified	9 (4.9)	-	9 (5.4)
7.	Abdominal pain of unknown origin	9 (4.9)	5 (27.8)	4 (2.4)
8.	Constipation	9 (4.9)	-	9 (5.4)
9.	Intussusceptions	7 (3.8)	2 (11.0)	5 (3.0)
10.	Appendicitis	5 (2.7)	-	5 (3.0)

8.7 Interventions provided to children with abdominal pain at the EMD

The most common interventions given to these children at the EMD were administration of intravenous fluids (Lactated Ringers/normal saline) in 57 (30.9%) patients, intravenous antibiotics in 55 (29.9%) and analgesia in 43 (23.4%) patients. None of the children received antiemetic or anti-spasmodic medications. **(Table 6)**

Table 6: Various interventions given to children with abdominal pain

Interventions	**Overall** **N=184** **n/N (%)**	**Died in hospital** **N=18** **n/N (%)**	**Survived to discharge** **N=166** **n/N (%)**
Intravenous fluids (RL/NS)	57 (30.9)	8 (44.4)	49 (29.5)
Antibiotics	55 (29.9)	7 (38.9)	48 (28.9)
Analgesia	43 (23.4)	4 (22.2)	39 (23.5)
Dextrose (5%, 10%)	24 (13.0)	4 (22.2)	20 (12.0)
Antipyretics	23 (12.5)	3 (16.7)	20 (12.0)
Intravenous KCL	7 (3.8)	2 (11.1)	5 (3.0)
Anti-malarial	3 (1.6)	-	3 (1.8)
Antiemetic	-	-	-
Anti-spasmodic	-	-	-

8.8 Disposition of children with abdominal pain

Approximately three-quarter of children were admitted to the hospital. None of the children died while at the EMD. However, the overall hospital mortality was 9.8%.**(Table 7)**

Table 7: EMD Disposition and outcome

Variable	Overall n/N (%)	Confidence Interval
Discharged from EMD	37/184 (20.1)	14.6-25.9 %
Taken to theatre from EMD	16/184 (8.7)	4.6-12.8 %
Admitted to the hospital	131/184 (71.2)	64.5-77.4 %
Died at the EMD	0	
Mortality at 24 hours	2/184 (1.1)	-0.4-2.6 %
Mortality at 7 days	12/184 (6.5)	2.9-10.0 %
Mortality at 3 months	25/173 (14.5)*	9.3-19.8 %
Overall in hospital mortality	18/184 (9.8)	5.5-14.1 %

* 11 children were lost to follow up

8.9 Characteristics of patients who died after discharge from the hospital at 90-day follow up

Children who died after being discharged from the hospital were diagnosed and treated for both acute and chronic illnesses.

Table 8: Characteristics of children who died at 90-day follow up

Patient	Age in years	Duration of current symptoms (days)	Time before hospital contact (days)	Final Hospital diagnosis
1	14	11	4	Bilateral hydronephrosis with CKD
2	0.08	14	2	Reducable Umbilical hernia
3	2	3	2	Liver failure
4	0.46	2	1	Post laparatomy due to Intussusception
5	0.29	8	8	Pyloric stenosis
6	10.42	19	4	Leukaemia
7	5	8	1	TB Peritonitis due to PAIDS

8.10 Profiles and outcome of children who had a surgical abdomen

Only 16 children were taken to the operating room from the EMD. Among these 3 died in the hospital. **(Table 9)**

Table 9: Characteristics of children who were operated

Age in years	Sex	Intra OP findings	Survival to discharge status
0.13	Female	Peritonitis	DIED
0.17	Male	Liver abscess	ALIVE
0.42	Female	Intussusception	ALIVE
0.46	Male	Intussusception	ALIVE
0.5	Male	Intussusception	DIED
0.58	Male	Intussusception	ALIVE
0.6	Female	Intussusception with gangrene	DIED
0.75	Male	Intussusception	ALIVE
0.8	Male	Incarcerated inguinal hernia	ALIVE
1.3	Male	Intussusception	ALIVE
1.33	Male	Intussusception	ALIVE
3	Male	Obstructed inguinal hernia	ALIVE
6	Male	Appendicitis	ALIVE
7	Female	Appendicitis	ALIVE
12	Female	Appendicitis	ALIVE
12	Female	Appendicitis	ALIVE

8.11 Multivariate analysis of factors that are associated with in-hospital mortality

In crude analysis significant factors associated with in-hospital mortality were age, abnormal abdominal ultrasound, hypoglycemia <3.5 mmol/l and abnormal AVPU. Children who were below 5 years had almost six times higher odds of dying as compared to children who were below 5 years (OR; 5.55(95% CI; 1.23-24.93). children who had abnormal abdominal ultrasound had 8 times higher odds of dying as compared to those children with normal abdominal ultrasound (OR;8.24 (95% CI;2.29-29.64). Children whose level of consciousness were abnormal had five times higher odds of dying as compared to children who were normal (OR; 5.33(95% CI;1.2-25.3).

In adjusted analysis after adjusting for other factors, age, sex and haemoglobin less than 10.9 g/dl were significant factors associated with in-hospital mortality.

Table 10: Factors associated with in-hospital mortality

Variable	Total N= (%)	Died n= (%)	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age in years						
Above 5	70(38.1)	2(2.9)	1		1	
Below 5	114(61.9)	16(14.0)	5.55(1.23-24.93)	0.025	6.80(1.25-37.06)	0.027
Sex						
Female	63(34.2)	8(12.7)	1.61(0.60-4.32)	0.340	3.63(1.09-12.04)	0.035
Male	121(65.8)	10(8.3)	1		1	
Referral status						
Walk in	47(25.5)	2(4.3)	1		1	
Referred	137(74.5)	16(11.7)	2.97(0.65-13.45)	0.157	3.17(0.54-18.42)	0.198
Haemoglobin*						
Above 10.9	22(11.9)	1(4.6)	1		1	
Below 10.9	77(41.9)	13(16.9)	4.26(0.52-34.58)	0.174	6.94(0.46-102.9)	0.046
Abdominal US						
Normal	9(4.9)	0(0.0)	1		1	
Abnormal	12(6.5)	5(41.6)	8.24(2.29-29.64)	0.001	5.06(1.02-24.88)	0.159
N/A	163(88.6)	13(7.9)	-	-	-	-
RBG						
Normal	93(50.5)	10(10.8)	1		1	
Abnormal	11(5.9)	4(36.4)	4.74(1.17-19.09)	0.028	3.24(0.52-20.26)	0.207
N/A	80(43.6)	4(5.0)	-	-	-	-
Cap refill<2 sec						
No	6(3.3)	2(33.3)	5.06(0.85-29.82)	0.073	1.68(0.16-17.49)	0.660
Yes	178(96.7)	16(8.9)	1		1	
AVPU						
Abnormal	9(4.9)	3(33.3)	5.33(1.20-23.51)	0.027	1.20(0.15-9.46)	0.860
Normal	175(95.1)	15(8.6)	1		1	

*Missing data- not all children had full blood picture test done.

OR: Odds ratio; RBG; Random Blood Glucose, AVPU; Alert, verbal, Pain, Unresponsive

9.0 DISCUSSION

To the best of our knowledge, this is the first study within our setting to highlight the burden of acute abdominal pain within the EMD in East Africa. We found that 9.9% of paediatric patients below 18 years who presented to the EMD-MNH had abdominal pain. Previous studies in Tanzania investigated individual causes of abdominal pain such as appendicitis and intussusceptions, but the overall burden of abdominal pain and most common diagnoses had not been studied (18,22,23). The proportion we found in this study is relatively higher than those reported from HICs, which have reported a burden of up to 8.1% (7,10,12).

In our study, three-quarters of children with abdominal pain were referred from other peripheral hospitals, this is similar to the percentage of all EMD-MNH patients that are referrals (25). The existence of a referral system in Tanzania requires a patient to be evaluated and managed by a lower level health facility before being transferred to the higher, more advanced facility with experts in different fields for further management (33,37). The nature of the referral system may result in higher acuity in the patients that are seen in our EMD and may lead to children being seen by us further into their course of illness than is seen in many HICs.

Prior to arrival at the EMD-MNH, the most common treatments received were intravenous fluids and antibiotics among children who were referred from peripheral hospitals. These were also the most common treatments provided in the EMD-MNH. Patients presenting to the EMD-MNH had symptoms that began a median of 4 days prior to their arrival at EMD-MNH, and a median of 2 days prior to seeking care at the various hospitals.

The most frequently reported associated symptoms with abdominal pain were fever and vomiting. Nausea was reported least often. The findings are similar in studies in HICs where these symptoms were observed in undifferentiated cases of abdominal pain (7,10). However, in SSA most studies which have been conducted studied on a single aetiology of abdominal pain found a symptom of abdominal distension (18,20). This finding highlighted the variability of symptoms that children with abdominal pain present with to hospitals. These symptoms could be due to both medical and surgical pathologies found in our cohort.

This lack of uniformity in presentation and reporting of symptoms in children with abdominal pain makes it difficult for providers in acute care settings to evaluate and treat these children (9).

The most frequent specific EMD providers' diagnoses in our study was abdominal wall hernia-with/out obstruction and intra-abdominal malignancy. This is somewhat surprising, as it is in contrast to similar studies in SSA. Specifically it does not align with a study in Central African Republic in which *Serengbe et al* found that appendicitis was the most common diagnosis found in children aged 2 -10 years presenting with acute abdominal pain in a paediatric hospital (38). This does not necessarily correlate with the most common symptoms of fever and vomiting that were found in the patients. We believe that because the diagnoses of hernia and intra-abdominal malignancies have specific examination findings, they are more likely to be specifically diagnosed in the EMD. Limited availability of CT scan due to cost and clinician preference on certain investigations over others may have resulted in less diagnostic specificity in these patients as over three-quarter of them seen at the EMD-MNH do not have health insurance. Furthermore, we believe the patient population in our study may have been largely influenced by the nature of the referrals MNH receives due to the presence of specialised paediatric surgical and oncologic services (33).

Three quarters of children with abdominal pain were admitted after evaluation at the EMD. This highlights the high acuity of illness among children in our cohort. This high acuity is also reflected in the in hospital mortality rate of these children. 9.8% of children with abdominal pain died. This is higher than 8.0%, the mortality rate of children observed from a previous study in Central Africa Republic (38), and much higher than mortality rates reported in HIC. In HIC, the mortality rate was remarkably low (1.1%) among the children who were hospitalized due to various aetiologies of abdominal pain (8,13,14).

The observed factors that were associated with in-hospital mortality in our cohort were age below five years, abnormal abdominal ultrasound, abnormal level of consciousness, hypoglycemia, sex and haemoglobin less than 10.9 g/dl. In our study, patients did not delay their presentation to hospitals. Previous studies observed delayed presentation to the hospital as an associating factor to mortality among children presenting with specific causes of abdominal pain (18,20,22).

The mortality rate increased significantly to 14.4% at three-months follow up. The final hospital diagnoses of the children who died after hospital discharge are found in *Table 8*. Given the diagnoses, these deaths were likely unexpected. To the best of our knowledge, this is the first study to document this outcome of children with acute abdominal pain in our setting and represents an area that requires further study since a significant number of children died after their hospital stay.

Overall, our study showed that abdominal pain is a common presentation amongst paediatric patients presenting to the EMD-MNH, and that those children have a high mortality rate. The disparity between the results in our setting and those in other settings highlights the opportunity for improvement in these outcomes through healthcare system improvement.

10.0 LIMITATIONS

i. This was a single centre study, however EMD-MNH receives referral from all over the country hence efforts were made to ensure appropriate sampling was done so as to maximise the inclusion of patients referred from different parts of the country.

ii. Relying on the informant's report on preverbal children i.e. children who could not explain themselves. This was mitigated by a careful history from the parent or guardian and physical examination done by the provider while evaluating the child.

iii. Many smaller groups within the sample, this was mitigated by using logistic regression model to find significant variables.

iv. There was missing information in the charts such as radiology, POC test results. However efforts were made to look for films and POC results and were documented accordingly. Also, doctors were encouraged to record results of the test(s) that they had performed/ordered.

11.0 CONCLUSION

Abdominal pain is a common complaint amongst paediatric patients presenting to the EMD-MNH. This presentation was associated with significant mortality as evidenced by a very high admission rate, need for surgical intervention and an overall mortality rate of nearly 10%. Further studies and quality improvement efforts should focus on identifying aetiologies, risk stratification, and appropriate interventions to optimise outcomes.

12.0 RECOMMENDATIONS

Providers in acute care settings should be trained to promptly recognise life threatening causes of abdominal pain and treat the reversible complications such as hypoglycemia.

Providers at peripheral hospitals should be trained to prompt recognize life threatening symptoms/signs and refer to the appropriate facility once a child with acute abdomen is identified.

Further research is needed to identify gaps in management of children with acute abdominal pain as the mortality is high.

REFERENCES

1. Martin E. Concise Medical Dictionary. Oxford University Press; 2015. 881 p.

2. Kliegman R, Nelson WE, editors. Nelson textbook of pediatrics. 19th ed. Philadelphia, PA: Elsevier/Saunders; 2011. 2610 p.

3. Reynolds SL, Jaffe DM. Diagnosing abdominal pain in a paediatric emergency department. Paeditric Emerg Care. 1992 Jul 1;8(3):3.

4. Han-Ping Wu W-CY. Etiology of non-traumatic acute abdomen in pediatric emergency departments. World J Clin Cases. 2013 Dec 16;1(9):10.

5. Guthery SL, Hutchings C, Michael Dean J, Hoff C. National estimates of hospital utilization by children with gastrointestinal disorders: analysis of the 1997 kids' inpatient database. J Pediatr. 2004 May;144(5):589–94.

6. Blanch AJ, Perel SB, Acworth JP. Paediatric intussusception: Epidemiology and outcome. Emerg Med Australas. 2007 Feb;19(1):45–50.

7. Erkan T, Cam H, Ozkan HC, Kiray E, Erginoz E, Kutlu T, et al. Clinical spectrum of acute abdominal pain in Turkish pediatric patients: A prospective study. Pediatr Int. 2004 Jun;46(3):325–9.

8. Tseng Y-C, Lee M-S, Chang Y-J, Wu H-P. Acute Abdomen in Pediatric Patients Admitted to the Pediatric Emergency Department. Pediatr Neonatol. 2008 Aug;49(4):126–34.

9. Reynolds SL, Jaffe DM. Children with abdominal pain:Evaluation in paediatric emergency department. Paeditric Emerg Care. 1990;6(1):5.

10. Scholer SJ, Pituch K, Orr DP, Dittus RS. Clinical outcomes of children with acute abdominal pain.

11. Tintinalli JE, Stapczynski JS, Cline DM. Acute abdominal pain. In: Tintinalli's Emergency Medicine Manual 7/E. 7 edition. New York: McGraw-Hill Education / Medical; 2012. p. chapter 74.

12. Caperell K, Pitetti R, Cross KP. Race and Acute Abdominal Pain in a Pediatric Emergency Department. PEDIATRICS. 2013 Jun 1;131(6):1098–106.

13. Jiang J, Jiang B, Parashar U, Nguyen T, Bines J, Patel MM. Childhood Intussusception: A Literature Review. PLoS ONE [Internet]. 2013 Jul 22 [cited 2016 Apr 6];8(7).

14. Intussusception Among Young Children in Europe: The Pediatric Infectious Disease Journal [Internet]. LWW. [cited 2016 Apr 5].

15. Van Heurn LWE, Pakarinen MP, Wester T. Contemporary management of abdominal surgical emergencies in infants and children: Abdominal surgical emergencies in infants and children. Br J Surg. 2014 Jan;101(1):e24–33.

16. Umpierrez G, Freire AX. Abdominal pain in patients with hyperglycemic crises. J Crit Care. 2002 Mar;17(1):63–7.

17. Jolanda M. Denham, MMR. Abdominal Pain in Children With Sickle Cell Disease. J Clin Gastroenterol. 2014 Feb;48(2):7.

18. Chalya PL, Kayange NM, Chandika AB. Childhood intussusceptions at a tertiary care hospital in northwestern Tanzania: a diagnostic and therapeutic challenge in resource-limited setting. Ital J Pediatr. 2014;40(28):8.

19. Azoz M, Elhaj M. Appendicitis in Children: Audit of outcome in Kosti-Teaching Hospital. Sudan J Med Sci [Internet]. 2010 Feb 12 [cited 2016 Feb 4];4(4).

20. Willmore WS, Hill AG. Acute appendicitis in a Kenya rural hospital. East Afr Med J. 2001 Jul 1;78(7):355.

21. Ademola TO, Oludayo SA, Samuel OA, Amarachukwu EC, Akinwunmi KO, Olusanya A. Clinicopathological review of 156 appendicectomies for acute appendicitis in children in Ile-Ife, Nigeria: a retrospective analysis. BMC Emerg Med [Internet]. 2015 Dec [cited 2016 Feb 5];15(1).

22. Carneiro P.M.R. Intussusception in children seen in Muhimbili National Hospital, Dar es Salaam. East Afr Med J. 2004 Sep;81(9):4.

23. Carneiro PM., Wella H. Children with acute abdomen requiring surgery at Muhimbili National Hospital Dar es Salaam. 2011;25(2):5.

24. St E, O O, Az M, M A. Intussusception in Kano: a 5-year analysis of pattern, morbidity and mortality. Niger J Med J Natl Assoc Resid Dr Niger. 2002 Dec;12(4):221–4.

25. Nicks BA, Sawe HR, Juma AM, Reynolds TA. The state of emergency medicine in the United Republic of Tanzania. Afr J Emerg Med. 2012 Sep 1;2(3):97–102.

26. Razzak J, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? Bull WHO. 2002;80(11):5.

27. LEUNG AKC. Acute Abdominal Pain in Children. Am Fam Physician. 2003;67:6.

28. Marin JR, Alpern ER. Abdominal Pain in Children. Emerg Med Clin North Am. 2011 May;29(2):401–28.

29. Tsalkidis A, Gardikis S, Cassimos D, Kambouri K, Tsalkidou E, Deftereos S, et al. Acute abdomen in children due to extra-abdominal causes. Pediatr Int. 2008 Jun;50(3):315–8.

30. Wai S, Ma L, Kim E, Adekunle-Ojo A. The Utility of the Emergency Department Observation Unit for Children With Abdominal Pain. Pediatr Emer Care. 2013;29:5.

31. Reynolds T, Sawe HR, Lobue N, Mwafongo V. 107 Most Frequent Adult and Pediatric Diagnoses Among 60,000 Patients Seen in a New Urban Emergency Department in Dar Es Salaam, Tanzania. Ann Emerg Med. 2012 Oct;60(4):S39.

32. Reynolds TA, Mfinanga JA, Sawe HR, Runyon MS, Mwafongo V. Emergency care capacity in Africa: A clinical and educational initiative in Tanzania. J Public Health Policy. 2012;33:S126–37.

33. About us - MUHIMBILI NATIONAL HOSPITAL [Internet]. [cited 2016 Feb 15].

34. Confidence Interval of a Proportion [Internet]. [cited 2017 Jun 17]. Available from: http://vassarstats.net/prop1.html

35. Schoonjans F. Relative risk calculator [Internet]. MedCalc. [cited 2017 Jun 17]. Available from: https://www.medcalc.org/calc/relative_risk.php

36. Gregory GA, Andropoulos DB, editors. Gregory's Pediatric Anesthesia: Andropoulos/Gregory's Pediatric Anesthesia [Internet]. Oxford, UK: Wiley-Blackwell; 2012 [cited 2017 May 22].

37. Referral system in tanzania - Google Search [Internet]. [cited 2017 Jun 2].

38. Serengbe BG, Gaudeuille A, Soumouk A, Gody JC, Yassibanda S, Mandaba JL. Acute abdominal pain in children at the Pediatric Hospital in Bangui (Central African Republic). Epidemiological, clinical, paraclinical, therapeutic and evolutive aspects. Arch Pediatr Organe Off Soc Francaise Pediatr. 2002;9(2):136–141.

39. Fleming S, Thompson M, Stevens R, Heneghan C, Plüddemann A, Maconochie I, et al. Normal ranges of heart rate and respiratory rate in children from birth to 18 years: a systematic review of observational studies. Lancet. 2011 Mar 19;377(9770):1011–8.

APPENDICES

Appendix I: Consent in participating in research: English version

STUDY TITLE: THE CLINICAL EPIDEMIOLOGICAL PROFILE AND OUTCOME OF PAEDIATRIC PATIENTS PRESENTING WITH ABDOMINAL PAIN IN EMERGENCY DEPARTMENT, MNH, DAR ES SALAAM, TANZANIA

Introduction

Greetings, my name is Dr Francis M. Sakita, a second-year resident in the Department of Emergency Medicine at Muhimbili University of Health and Allied Sciences (MUHAS).
I am conducting a study with the above title as part of my study program. I hereby request your participation and cooperation in my study once I or my research assistant approaches you. Your decision to or not to participate will have no effect on the care and management given to your child. Please ask questions if there is anything about this study you do not understand.

Aim of the study

The purpose of this study is to characterize and describe the outcome all children who present with a complaint of abdominal pain at the emergency department.

Benefits

There will be an overall benefit after knowing the results and its implication to the hospital. There will be no payment for participation in the study.

Risks

There is no risk in participating in this study.

What does this study involve?

This study involves the research assistant or principal investigator asking structured questions to the informant or patient and filling the responses in the prepared questionnaire. Also, information about the patient will be obtained from the patient's file.

Consent

Your participation in this study is completely voluntary and agreeable by signing the consent form. If you are not free you are allowed not to participate and this will not affect the care and management offered to you or the child you brought for treatment. You may choose to stop taking part in this study at any time for any reason.

Confidentiality

The information you provide is highly valued and will be kept strictly confidential. The study information will be stored in protected computer files and in paper records stored in locked filing cabinet. Only study staff will have access to the information.

Access of information

By signing this form, you allow the research team to use the information and give it to others involved in the research. The research team includes the researcher, facilitators plus others working on this study at MUHAS and MNH.

For further information, questions or queries, you can contact:

1. The Principal Investigator,
   Dr. Francis Mussa Sakita,
   Department of Emergency Medicine,
   MUHAS,
   P. O. Box 65001,
   Dar es Salaam, Tanzania.
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2. Dr. Hendry Sawe
   Department of Emergency Medicine,
   MUHAS/MNH,
   P. O. Box 6500,
   Dar es Salaam, Tanzania.
   Tel: +255 754 885658
   Email: hendry_sawe@yahoo.com

3. Prof. Said Aboud,
   Chairman of the Senate Research and Publications Committee,
   MUHAS,
   P.O. Box 65001,
   Dar es Salaam, Tanzania.
   Tel: 2152489.

Signature:

I (Initial letter of your names) _____ have read/been told the contents of this form. My questions have been answered. I agree to participate in this study.

Signature of participant _____

Date of signed consent _____

Appendix II: Consent in participating in research: Swahili version

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FOMU YA RIDHAA YA KUSHIRIKI KATIKA UTAFITI

Utangulizi

Jina langu naitwa Dkt. Francis Mussa Sakita, mwanafunzi wa udaktari bingwa wa magonjwa ya dharura (Emergency Medicine) katika Chuo Kikuu Cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Ninaomba ushiriki wako kwa niaba ya mwanao katika utafiti huu endapo mimi ama msaidizi wangu atakapokufuata ili kukuuliza taarifa muhimu za mgonjwa wako.

Madhumuni ya utafiti

Utafiti huu unalenga katika kujua aina, sababu na hatma ya watoto wanaokuja idara ya magonjwa ya dharura wakiwa na tatizo la kuumwa tumbo katika hospitali ya Taifa ya Muhimbili.

Ushiriki katika utafiti

Mtoto yeyote mwenye umri dhaidi ya mwezi 1 na chini ya miaka 18 aliyefika idara ya magonjwa ya dharura kwa lalamiko la kuumwa tumbo atajumuishwa katika utafiti huu baada ya mzazi ama mlezi kuridhia ushiriki.

Hatari

Hatutarajii kuwepo na athari/hatari yeyote itokanayo na ushiriki katika utafiti huu.

Faida za utafiti

Kwa kushiriki katika utafiti huu, tutaweza jua ni magonjwa gani ya tumbo yanayosumbua sana watoto wa eneo hili na pia kujua hatima yao baada ya kupewa matibabu. Matokeo ya utafiti huu yamtasaidia mtoa huduma atakayemwona mtoto anayeumwa tumbo kutoa huduma kwa haraka pasipo kucheleweshe.

Usiri

Taarifa zote zitakazokusanywa katika utafiti huu zitakuwa siri, hivyo ushiriki wako hautajulikana na mtu. Taarifa hizi zitajulikana kwenye timu ya watafiti tu.

Malipo

Kwa kushiriki kwenye utafiti huu, hautalipwa wala hautalipa chochote.

Ukiwa na swali au tatizo lolote, unaweza kuwasiliana na wafuatao:

1. Mkuu wa Utafiti
   Dr. Francis Mussa Sakita,
   Idara ya Magonjwa ya Dharura na Mahututi (Emergency Medicine),
   MUHAS,
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   Simu: +255 767 865 441
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   Tel: +255 754 885658
   Barua pepe: hendry_sawe@yahoo.com

3. Prof. Said Aboud
   Mwenyekiti wa kamati ya utafiti na machapisho
   MUHAS,
   S. L. P. 65001,
   Dar es Salaam, Tanzania
   Simu: 2152489.

Kuweka sahihi ya makubaliano:

Mimi(Herufi za mwanzo za majina yako) _____, nimesoma/nimesomewa maelezo yote yaliyomo kwenye fomu hii na nimeelewa. Maswali yangu yamejibiwa vizuri na niko tayari kushiriki.

Sahihi ya mshiriki _____

Sahihi ya Mtafiti _____Tarehe _____

Appendix III: Questionnaire

Inclusion criteria: Children older than 1 month and younger than 18 years of age presenting with traumatic or non-traumatic abdominal pain and related complaints (inconsolability, drawing up legs, distension, tenderness or passing currant jelly stool) in EMD-MNH

C.NO..... /16 **Date of presentation**.....

1. Demographics

Name ☐ Admission number ☐

Age (d/m/y) ☐ Estimated body weight (kg) ☐

Sex: Male ☐ Female ☐

Informant ☐

Telephone no. ☐ Time :(in 24 hours) ☐

2. Pre – MNH course of illness and management

i. When did the child fall sick? ☐ First episode? YES ☐ NO ☐

ii. When did you first take the child to the health centre? ☐

iii. Admission at peripheral health centre? YES ☐ NO ☐

iv. IF YES above, how many days? ☐

v. Use of traditional therapy? YES ☐ NO ☐ which one(s).....

vi. Name of the referring hospital.....

vii. Treatment given while admitted: Tick/fill the appropriate response

☐ IV fluids Type..... Amount.....

☐ Antibiotics Type1).....2).....

☐ Analgesia Type1).....2).....

☐ Nothing

☐ Don’t know

☐ Anti-malarial Type1).....

☐ Antiepileptic Type1).....

Others: 1).....2).....

vii. Referral diagnosis (es).....

viii. Reason for referral.....

3. History of presenting illness

Associated symptoms:

	Duration	Nature
☐ Vomiting	☐	.....
☐ Diarrhoea	☐	.....
☐ Fever	☐	.....
☐ Cough	☐	.....
☐ Sore throat	☐	.....
☐ Loss of appetite	☐	
☐ Nausea	☐	
☐ Weight loss	☐	
☐ Joint pain	☐	
☐ Headache		

Others:

a).....b).....

c).....

4. Co-morbidity/Chronic Illness (Tick the box infront for the appropriate response)

a. Malnutrition ☐ b. HIV ☐ c. Sickle cell disease ☐

d. Known malignancy ☐ e. Congenital heart disease ☐

f. OTHER (specify).....

5. Vital signs

i. BP: systolic ☐ Diastolic ☐ ii. HR ☐ iii. RR ☐ iv. Temp.☐

v. Oxygen Saturation ☐

vi. Capillary refill ≤ 2 sec YES ☐ NO ☐

6. Physical examination findings

6.1 Primary survey	Normal	Abnormal	IF Abnormal, specify
Airway	☐	☐	.....
Breathing	☐	☐	.....
Circulation	☐	☐	.....

Disability (AVPU/GCS) (record the actual level of consciousness).....

Exposure ☐ ☐

.....

6.2 Secondary survey

Per Abdomen examination

a. Distension ☐

b. Obvious mass/ swelling ☐

c. Obvious trauma ☐

d. Rebound tenderness ☐

e. Decreased bowel sounds ☐

f. Increased bowel sounds ☐

e. Gloved finger stained with blood ☐

	NORMAL	ABNORMAL	
HEENT	☐	☐	.....
NECK	☐	☐	.....
RS	☐	☐	.....
CVS	☐	☐	.....
CNS	☐	☐	.....
GENITALIA	☐	☐	.....
BACK			.....

7. EMD Provisional diagnosis (es)

i)..... ii).....

iii).....

8. Investigations ordered

A. POC RESULTS

☐ RBG .....

☐ RDT .....

☐ UPT ....

☐ VBG

pH.....PCO2.....K+.....Na+.....Hct.....

Lactate.....HCO3.....

☐ Urine dipstick .....

☐ Ultrasound/FAST .....

Others .....

☐ **B. CPL** RESULTS

FBP

WBC.....NEUT.....Hb.....PLT.....

.....

☐ Blood grouping .....

☐ Blood cross-matching .....

☐ Serum electrolytes .....

☐ Blood culture .....

☐ BS for Malaria .....

☐ Lipase .....

☐ Creatinine .....

☐ Urea .....

☐ AST .....

☐ ALT .....

Others .....

C. Radiology RESULTS

☐ Plain abdominal X-ray (erect)

- Multiple air fluid levels ☐
- Air under the right hemidiaphragm ☐
- Distended bowels ☐
- Empty rectum ☐
- ☐

☐ Plain abdominal X-ray (supine) .....

☐ Erect CXR .....

☐ Formal abdominal US .....

☐ CT scan .....

Others (such as MRI) .....

9. EMD Management

☐ IV fluids Type..... Amount (ml/L).....

☐ Analgesia Type1).....2).....

☐ Antibiotics Type1)..... 2).....

☐ NGT

Others: .....

10. Consultation done ☐ specify (which service?).....

Opinion.....

11. Disposition

Where was this child disposed to?

☐ Home

☐ Ward specify (which ward?).....

☐ Theatre Outcome.....

Intra-OP diagnosis.....

☐ ICU

☐ Died

☐ Transferred to another hospital specify.....

Reason for transfer.....

12. Outcome at 24 hours

Tick the appropriate response

☐ **Alive**
- ☐ at home discharged from EMD
- ☐ At home discharged from the ward ☐ pain FREE
- ☐ Ward ☐ have PAIN
- ☐ Intensive care unit (ICU)

☐ **Died**
- ☐ in ED
- ☐ At home
- ☐ Operating room
- ☐ In ICU
- ☐

In ward ☐ Pre-OP (died before operation could be done)

☐ Post-OP (died after the operation)

No plan for operation ☐

13. Outcome at 7 days

Tick the appropriate response

☐ **Alive** ☐ at home discharged from EMD

☐ At home discharged from the ward ☐ pain FREE

☐ Ward ☐ have PAIN

☐ Intensive care unit (ICU)

☐ Transferred to another hospital

☐ Died ☐ in ED

☐ At home

☐ Operating room

☐ In ICU

☐ In ward ☐ Pre-OP (died before operation could be done)

☐ Post-OP (died after the operation)

No plan for operation ☐

Cause of Death .....

14. Final Hospital diagnosis (es)

i. .....

ii. .....

iii. .....

15. Date of discharge from the hospital ☐

Appendix IV: List of normal range of paediatric vital signs (39)

Web Box 1: Existing reference ranges for respiratory rate and heart rate

Respiratory rate (breaths/minute)

Age Range (years)	APLS[1] / PHPLS[2]	PALS[3]	EPLS[4]	PHTLS[5]	ATLS[6]	WHO+[7]
Neonate	30 – 40	30 – 60	30 – 40	30 – 50*	<60	
0 – 1	30 – 40	30 – 60	30 – 40	20 – 30*	<60	<50+
1 – 2	25 – 35	24 – 40	26 – 34	20 – 30	<40	<40
2 – 3	25 – 30	24 – 40	24 – 30	20 – 30	<40	<40
3 – 4	25 – 30	24 – 40	24 – 30	20 – 30	<35	<40
4 – 5	25 – 30	22 – 34	24 – 30	20 – 30	<35	<40
5 – 6	20 – 25	22 – 34	20 – 24	20 – 30	<35	
6 – 12	20 – 25	18 – 30	20 – 24	(12 – 20) – 30	<30	
12 – 13	15 – 20	18 – 30	12 – 20	(12 – 20) – 30	<30	
13 – 18	15 – 20	12 – 16	12 – 20	12 – 20^	<30	

* PHTLS provides separate ranges for neonates up to six weeks, and for infants between seven weeks and one year of age.
^ PHTLS does not provide ranges for adolescents over 16 years of age.
+ WHO only provides ranges for children between two months and five years of age.

Heart rate (beats/minute)

Age Range (years)	APLS[1] / PHPLS[2]	PALS[3]*	EPLS[4]*	PHTLS[5]	ATLS[6]
Neonate	110 – 160	85 – 205^	85 – 205^	120 – 160+	<160
0 – 1	110 – 160	100 – 190^	100 – 180^	80 – 140+	<160
1 – 2	100 – 150	100 – 190	100 – 180	80 – 130	<150
2 – 3	95 – 140	60 – 140	60 – 140	80 – 120	<150
3 – 5	95 – 140	60 – 140	60 – 140	80 – 120	<140
5 – 6	80 – 120	60 – 140	60 – 140	80 – 120	<140
6 – 10	80 – 120	60 – 140	60 – 140	(60 – 80) – 100	<120
10 – 12	80 – 120	60 – 100	60 – 100	(60 – 80) – 100	<120
12 – 13	60 – 100	60 – 100	60 – 100	(60 – 80) – 100	<100
13 – 18	60 – 100	60 – 100	60 – 100	60 – 100~	<100

* PALS and EPLS provide multiple ranges – ranges for awake children are tabulated
^ PALS and EPLS provide separate ranges for infants up to three months, and for those between three months and two years of age.
+ PHTLS provides separate ranges for infants up to six weeks, and for those between seven weeks and one year of age.
~ PHTLS does not provide ranges for adolescents over 16 years of age.