

**AETIOLOGIES AND OUTCOMES OF NON-TRAUMATIC  
ABDOMINAL SURGICAL EMERGENCIES IN CHILDREN AT  
MOI TEACHING AND REFERRAL HOSPITAL**

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**DECLARATION**

Declaration by Candidate:

“This thesis is my original work and has not been presented to any other University or institution”

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## **DEDICATION**

I dedicate this work to my dear parents Mr and Mrs Mohamedali Harunani for the immense effort and dedication in educating me and to all my teachers who over the years have modelled me to become a better person and doctor.

I also dedicate this work to my beloved wife Hawama Nathani, for her great support and encouragement and finally to my children.

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**DISCLOSURE**

The researcher did not receive any outside funding or grant in support for this study. Neither he nor a member of his immediate family receive payment or other benefits or commitment or agreement to provide such benefits from a commercial entity.

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**AETIOLOGIES AND OUTCOMES OF NON-TRAUMATIC ABDOMINAL  
SURGICAL EMERGENCIES IN CHILDREN AT MOI TEACHING AND  
REFERRAL HOSPITAL  
ABSTRACT**

**Background:** Childhood abdominal surgical emergencies are associated with high morbidity and mortality in developing countries. Non-traumatic childhood abdominal surgical emergencies (NTCASE) include acquired diseases like acute appendicitis, intussusception and congenital abdominal anomalies like gastroschisis. This study sought to identify the aetiologies and the outcomes of non-traumatic childhood abdominal surgical emergencies at Moi teaching and referral hospital (MTRH).

**Objective:** To describe the aetiologies and outcomes of non-traumatic childhood abdominal surgical emergencies at MTRH.

**Method:** This study was a hospital-based prospective descriptive study. It included 140 children (below 18 years based on WHO guidelines) who were operated on for non-traumatic abdominal surgical emergencies between January 2015 to January 2016. Patients were identified from the theatre register. Relevant data on clinical presentation, duration of onset of symptoms, intraoperative findings and definitive surgical procedure as per case notes were entered into the data collection sheet. The study end point was at discharge or in hospital death and at this point any complication reported in patients file was recorded together with duration of length of stay. The data was entered in Ms Access and later exported to SPSS version 20 for analysis. Bivariate analysis using Chi square and Fisher's exact test was used for correlation between variables and mortality.

**Results:** A total of 140 patients were studied. The age of the patients ranged from 1 day to 17 years old, with a median of 1.5 months. Neonates constituted 47.9 % (n=67) of the study participants. The male to female ratio was 2.1:1(n=95:45). Majority(70 %,n=98) of the patients presented to hospital more than 24 hours after the onset of symptoms. The four most common aetiologies were intussusception(17.9%,n=25), gastroschisis(17.9%,n=25), anorectal malformations(10.7%,n=15) and small bowel atresia(10.7%,n=15). The overall complication rate was 17.9%(n=25). The average length of hospitalization was  $8.6 \pm 7.6$  days. The in-hospital mortality was 20% (n=28). Factors that had significant co-relation with mortality included development of complications (P-value 0.0001), duration of illness presentation <24hours (P-value 0.0098), haemoglobin level >12g/dl (P-value 0.0127), neonatal age group (P-value 0.0017), ASA classification grade 3,4 (P-value 0.0003) and deranged potassium levels (P-value 0.0005).

**Conclusion:** The commonest aetiologies of NTCASE in MTRH are intussusception and gastroschisis. The mortality and morbidity rates from NTCASE are significantly high. The most important factors co-related with mortality in patients with NTCASE are development of complications, duration of illness presentation <24 hours, haemoglobin level >12g/dl, neonatal age group, deranged potassium level and ASA classification grade 3,4.

**Recommendation:** There is need to reduce the increased morbidity and mortality in children with non-traumatic abdominal surgical emergencies at MTRH by considering the factors associated with it.

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**LIST OF ABBREVIATIONS**

<b>ARM</b>	Anorectal malformation
<b>ASA</b>	American Society of Anaesthesiologists
<b>ASPS</b>	African society of paediatric surgeons
<b>GIT</b>	Gastrointestinal tract
<b>Hb</b>	Hemoglobin
<b>ICU</b>	Intensive care unit
<b>IH</b>	Inguinal hernia
<b>IHPS</b>	Infantile hypertrophic pyloric stenosis
<b>IREC</b>	Institutional research and ethics committee
<b>KNH</b>	Kenyatta National Hospital
<b>MTRH</b>	Moi Teaching and Referral Hospital
<b>NBU</b>	New born unit
<b>NEC</b>	Necrotizing enterocolitis
<b>NTCASE</b>	Non-traumatic childhood abdominal surgical emergencies
<b>WBC</b>	White blood cells
<b>WHO</b>	World health organization

## DEFINITION OF TERMS

**Surgery-** A branch of medicine that uses operative (cutting, abrading, suturing) and instrumental techniques on a patient to treat a pathological condition.

**Emergency-** A serious, unexpected and often life threatening disease/condition requiring immediate action.

**Non-traumatic abdominal surgical emergencies-** pathological conditions involving abdomen that require immediate operational treatment but exclude traumatic conditions.

**Children-** patients aged < 18 years.

**Management-** clinical evaluation, investigations and treatment given to patients.

**Outcome-** the eventual results of management of patients .

**Morbidity-** The frequency of appearance of complications following a surgical procedure or other treatment.

**Mortality-** death attributable to pathophysiological changes of the disease/condition.

**Length of stay-** interval between admission to hospital and the decision to discharge home.

**Intestinal obstruction-** presence (in a patient) of the following cardinal features in various combinations as identified (by a trained clinician) at presentation to hospital or at any point during hospital stay: Abdominal distension, constipation, vomiting and abdominal pain with or without supportive radiographic findings.

**Septicaemia-** Patient must exhibit at least two of the following symptoms: Body temperature above 38.3<sup>0</sup>C or below 36<sup>0</sup>C, Heart rate higher than the normal beats per

minute, Respiratory rate higher than normal breaths per minute and probable or confirmed infection.

**Surgical site/wound infection**-Infection within 30 days after the operation characterized by at least one of the following: 1) Purulent drainage with or without laboratory confirmation, 2) Organisms isolated from an aseptically obtained culture of fluid or tissue from the incision or 3) At least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.

## CHAPTER ONE

### INTRODUCTION

#### 1.1. Background Information

Non-traumatic childhood abdominal surgical emergencies are caused mainly by acquired gastrointestinal diseases such as acute appendicitis, intussusception and perforation peritonitis and congenital anomalies like anorectal malformations and gastroschisis. The main aetiologies of intestinal obstruction in children are anorectal malformations, intussusception, hirschsprung's disease, ascariasis, and intestinal atresias. Intussusception remains a common aetiology of bowel obstruction in children below 2 years and if not treated promptly, results in significant morbidity and mortality. Typhoid ileal perforation is common in many developing countries, with very high morbidity and mortality reported in children (Uba AF et al., 2007). Obstructed non reducible abdominal hernias and pyloric stenosis are also included in non-traumatic abdominal surgical emergencies.

Childhood abdominal surgical emergencies remain a challenge to surgeons and are associated with higher morbidity and mortality in developing countries. Several factors may be responsible for the high morbidity and mortality. Among the leading causes of high morbidity and mortality in developing countries are delayed presentation and poverty (Ademuyiwa Adesoji et al., 2012).

This study aims at elucidating the various aetiologies and immediate outcomes in children managed for non-traumatic abdominal surgical emergencies at the MTRH and the various factors involved.

The information generated will hopefully be useful not only to MTRH in its quest to improve patient care but also contribute to the body of knowledge in management of these common surgical emergencies.

## **1.2. Research Question**

What are the aetiologies and outcomes of non-traumatic childhood abdominal surgical emergencies at MTRH?

## **1.3. Problem Statement**

Childhood abdominal surgical emergencies are part of the deadly pathologies that contributes greatly to paediatric surgical morbidity and mortality. The outcomes in these patients vary from centre to centre. Data from MTRH registry revealed a mortality of about 40% in 2014.

MTRH is the only hospital in Western and Rift valley region with a specialized paediatric surgery unit. It therefore receives a lot of referrals of children with abdominal surgical emergencies. Patients are often brought late and in a debilitated state and this might be a contributing factor to morbidity and mortality.

Management of NTCASE remains a challenge to clinicians. The fact that children are unable to explain nature of symptoms and co-operate during physical examination facilitates the need to make prompt and accurate diagnosis with limited diagnostic tools.

Non-traumatic childhood abdominal surgical emergencies is not yet fully understood to date. Efforts have been made to educate the public at large about these emergencies but despite that the morbidity and mortality is still increasing.

## **1.4. Justification**

NTCASE contribute to a sizeable proportion of all children admitted at MTRH. However there is paucity of data at MTRH and in Kenya regarding non-traumatic childhood abdominal surgical emergencies hence this study will act as a backbone in comparing the data from MTRH and various other institutions.



Children constitute more than 40% of the population in most developing countries and they therefore deserve a fair share of robust surgical care by planning surgical services to reduce mortalities associated with these abdominal emergencies. This study will describe aetiologies and the morbidity and mortality rates and compare these results with other studies and eventually guide us in making protocols and improving management so as to practise evidence based medicine.

It is also a baseline study hence further studies can be done on the particular aetiologies of non-traumatic abdominal surgical emergencies in children.

## **1.5. Objectives**

### **1.5.1. Broad Objective**

To describe the aetiologies and outcomes of non-traumatic abdominal surgical emergencies in children at MTRH.

### **1.5.2. Specific Objectives**

- 1) To describe the demographic characteristics of non-traumatic childhood abdominal surgical emergencies at MTRH.
- 2) To describe the common aetiologies associated with non-traumatic childhood abdominal surgical emergencies at MTRH.
- 3) To determine the morbidity and mortality rates associated with non-traumatic childhood abdominal surgical emergencies at MTRH.
- 4) To co-relate factors with outcome of non-traumatic abdominal surgical emergencies in children at MTRH.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1. Epidemiology

In many countries, the paediatric age group constitutes a precious 30-40% of the total population (National Family Health Survey., 1999). In Kenya, it comprises 42% of the total population (Kenya population data sheet., 2011). Surgical patients comprise of 6-12 % of all childhood admissions. The incidence of non-trauma related childhood abdominal emergency surgeries (NTCASE) is reported to be between 2-5% ( Bickler S.W & Rode H ., 2002). The incidence in Kenya is not yet known as no study has been carried out to determine this aspect.

In a study in Gambia, surgical patients accounted for 11.3% of all paediatric admissions. Trauma, congenital anomalies and surgical infections accounted for about 90% of paediatric surgical admissions (Bickler SW, Sanno-Duanda B ., 2000).

At the Ahmadu Bello University Teaching Hospital in Northern Nigeria, paediatric surgery accounted for 6.6% of the total paediatric workload and 9.6% of all operative procedures. The most common operations performed in this hospital were for congenital anomalies (40%), infections (22%) and traumas (21%) (Ameh EA, Chirdan LB ., 2001).

A study in Lagos, Nigeria reported intestinal obstruction aetiologies as the commonest cause of non-trauma related pediatric surgery emergency accounting for 58.9% followed by acute appendicitis (10.1%) and anterior abdominal wall defects (ruptured omphaloceles and gastroschisis) (7.0%) (Ademuyiwa Adesoji et al., 2012).

Acute appendicitis (58%) was reported as the commonest aetiology of gastrointestinal emergencies requiring surgery in children in a study at Indira Gandhi Government Medical College and Hospital, Nagpur, India. Other aetiologies included intestinal

obstruction (32%) and perforation peritonitis (7%). Necrotising enterocolitis without perforation was found in only 1% (Pujari Amit et al., 2008).

## **2.2. Aetiologies and Pathogenesis**

The aetiologies of NTCASE include anorectal malformations, gastroschisis, intussusception, hirschsprung's disease, ascariasis, obstructed hernias, intestinal atresias and many others. In developing countries, peritonitis secondary to typhoid perforations and perforated appendicitis have greatly increased (Uba AF et al., 2007). In older children, acute appendicitis remains the commonest abdominal surgical emergency (Pujari Amit et al., 2008).

In our set up, among the commonest non-traumatic childhood abdominal surgical emergencies are obstructed hernias, intussusception, anorectal malformations, gastroschisis and appendicitis although no study has been carried out hence the aetiologies are rough estimates (from unpublished evidence) of what is encountered at MTRH.

### **2.2.1. Intussusception**

Intussusception is the invagination of one segment of the intestine within a more distal segment (Bines JE et al., 2004). Infantile intussusception occurs usually between 4 and 10 months of age and is the most common cause of bowel obstruction in infants (WHO., 2002).

Majority (90%) are idiopathic with ileocaecal region being the commonest site (>90%) of involvement. In about 30–50% of cases, a preceding viral illness is implicated. A pathological lead point should be suspected in older children and is found in 2 to 12% of the cases (Hesse Afua et al., 2010).

The mean incidence of intussusception in children < 1 year of age is 74 per 100,000 (range: 9–328). In 2013, a higher incidence was observed in some populations

including: Australia, Hong Kong, Japan , Israel , Vietnam and South Korea while lower incidence(<20 per 100,000)was observed in some populations from Finland, India, Malaysia and Bangladesh. Higher case-fatality was reported in Africa (9%) compared to other regions (<1%)( Jiang James et al., 2013).

Ultrasound is helpful in diagnosis however diagnosis remains a challenge and delay in diagnosis is associated with poor outcomes.

Treatment incudes both operative and non-operative methods. The non-operative methods include ultrasound-guided hydrostatic reduction, ultrasound-guided pneumatic reduction, fluoroscopic-guided hydrostatic reduction with barium and fluoroscopic-guided pneumatic reduction (air enema).Operative procedure involves laparotomy (manual reduction, segmental bowel resection for gangrene and anastomosis, hemicolectomy, creation of stoma) (Mensah Yaw Boateng et al., 2011).

The vascular supply of the bowel may be compromised if the intussusception is not relieved, resulting in intestinal ischemia and possibly perforation. Untreated intussusception is fatal if not relieved.

### **2.2.2. Congenital anorectal malformation**

Congenital anorectal malformation (ARM) is a condition of the digestive tract in which the anus and rectum do not develop normally. In some cases it may involve the urinary and genital tract.

It occurs in 1 in 4000-5000 births and boys are affected more than girls (Buedeker Nikki et al., 2013). The VACTERL (vertebral, anorectal, cardiac, tracheoesophageal, renal and limb abnormalities) group of anomalies is common and found in about 20-80% of patients (Moore S.W et al., 2005).Low birth weight, delay in access to paediatric surgeon, septicaemia, gut perforation in combination with associated anomalies have an adverse impact on the prognosis.

In the past, the mortality encountered in patients with ARM was remarkably high due to lack of understanding of the nature and anatomy of these malformations along with problems of associated anomalies and risk of anaesthesia. The mortality rate is now reduced and lies between 1.4% and 30% as a result of advancements in diagnostic, therapeutic modalities, and development of better intensive care units (Bhargava P et al 2006). However, in developing countries, the benefits of these advances have not been realised because of poverty and poor access to quality health care.

A temporary colostomy is made to relieve the obstruction while definite surgical procedures like posterior or anterior sagittal anorectoplasty are planned later.

### **2.2.3. Acute appendicitis**

Acute appendicitis is the most common cause of acute abdomen requiring surgery. The peak incidence is in teens and twenties but is less common throughout early childhood. Between birth and the age of 4 years, the incidence is reported to be 1 to 2 cases per 10,000 children per year (Ohmann C et al., 2002).

Evaluation of suspected acute appendicitis can be done using the Alvarado score, the Ohmann score or Paediatric appendicitis score. Diagnosis is particularly difficult in very young, obese patients. Delay in diagnosis can lead to perforation, which increases both the morbidity and mortality (Awan Muhammad Younus et al., 2013) .

The gold standard for the diagnosis of appendicitis is ultrasound however it becomes less specific if the appendix ruptures (Brisighelli Giulia et al., 2012). In our set up, clinical examination is still the gold standard to identify which children should undergo surgical exploration.

Appendectomy remains the standard treatment for non-perforated appendicitis. The annual incidence of appendectomy in the United States has been reported as 26 per 10,000 (Barlow Andrew et al., 2013). A high degree of suspicion and a higher diagnostic accuracy rate heavily determine the outcome.

#### **2.2.4. Abdominal hernias**

A hernia is defined as a protrusion of a portion of an organ or tissue through an abnormal opening (defect) in the cavity containing it. Inguinal hernias form a large part of the general paediatric surgical practice.

Majority of inguinal hernias (IHs) in infants and children are congenital. As a result of the presence of a patent processus vaginalis (PPV), in more than 99% of cases IHs are indirect (Abantanga Francis A, Kokila Lakhoo ., 2010).

About 0.8–4.4% of all children will develop IH therefore consultations for IHs are among the most frequent reasons for a paediatric surgery referral (Snyder CL ., 2010). Majority of the children present with a groin bulge on straining, discovered by the parents or a paediatrician and undergo elective repair in trained hands achieving good results with minimal complications.

Incarceration of the herniating abdominal viscera, with or without features of intestinal obstruction is common with complicated IHs. Strangulation predominates if not attended to early and leads to increased morbidity and mortality of an otherwise straightforward condition (Nah SA et al., 2011). Infants particularly those under 6 months and the premature, unfortunately have higher risk of incarceration (Lau ST et al., 2007). This is due to herniating loops of bowel being easily trapped in smaller and tighter internal ring and inguinal canal.

The prevalence of inguinal hernias in Africa is reported to be higher than other continents (Ohene-Yeboah M, Abantanga F.A., 2011). The incidence of paediatric

hernias is reported to be 1-5% and the rate of incarceration ranges between 3-18% with higher incidence among infants (Lau ST et al., 2007).

Umbilical hernia is the commonest of the childhood hernias. It is estimated that one out of every six children has umbilical hernia (Katz D., 2001). Male to female ratio is 1:1 are equally affected and black premature babies are more affected. Infants with weight of less than 1.5 kg are affected in 75% of cases.

Umbilical hernia occurs due to an imperfect closure or inherent weakness of the umbilical ring. Majority of umbilical hernias close spontaneously. Only 18 cases of spontaneous rupture with evisceration in children have been reported worldwide and the outcome was poor (Ameh EA et al., 2003).

Hernias generally have good outcomes worldwide however strangulated hernias especially in developing countries are an exception (Nah SA et al., 2003).

### **2.2.5. Gastroschisis**

Gastroschisis is a congenital abdominal wall defect usually located to the right of the umbilical cord in which intestines, and occasionally other abdominal contents, herniate through (Insinga V et al., 2014).

It occurs in about 1 out of every 2,300 live births (Shivaleela C et al., 2014). Predisposing factors include young maternal age and interaction between smoking and gene polymorphisms (Osman M Ali et al., 2014). A tenfold increase in risk of gastroschisis occurrence in mothers between 15 and 19 years of age was reported by Torfs et al in 1994.

The etiology of gastroschisis remains unknown though it is thought to be the result of a combination of genetic and non-genetic factors. Vascular aberration of umbilical and omphalomesenteric veins, interfering with the development of the somatopleure at the junction with the body stalk or a solution of continuity that is formed later than the

development of the abdominal wall have been focused as the etiology in recent hypotheses. Alternatively, an early vascular accident involving the omphalomesenteric arteries can cause gastroschisis (Insinga V et al., 2014).

Ultrasound done between the 18th and 20th week of gestation, suggesting the presence of irregularities of abdominal wall, hyperechoic loops, protruding in lateral position can be diagnostic (Insinga V et al., 2014).

Surgery is considered as the definitive treatment. The degree of intestinal inflammation, size of the defect and the newborn's general condition influence the timing and technique for surgical closure (Lund CH et al., 2007). Gradual reduction with silo is necessary if there is viscerο-abdominal disproportion to avoid complications. Between 6 and 10 days of extrauterine life, surgical repair should then be performed (Shivaleela C et al., 2014).

### **2.3. Embryology in relation to pathology**

#### **a) Congenital hypertrophic pyloric Stenosis**

Males are more affected (1 in every 150 newborn males). Hypertrophy of circular and, to some extent, the longitudinal muscles in the pylorus occurs resulting in marked muscular thickening of the pylorus. Eventually severe stenosis of the pyloric canal occurs causing gastric outlet obstruction. The body of stomach becomes markedly distended and the infant expels the stomach's contents with considerable force (projectile vomiting).

Treatment is by surgical relief of the pyloric obstruction (pyloromyotomy). The etiology of congenital pyloric stenosis is unknown, but genetic factors may be involved due to the high rate of concordance in monozygotic twins (Moore Keith L, Persuad T.V.N., 2006).



b) Duodenal atresia

During the development of the duodenum, the lumen becomes completely obliterated as a result of high proliferation rate of the lining cells. Later, the gut becomes recanalized due to degeneration of these cells. Failure of recanalization leads to atresia or stenosis (Snell Richard S., 2010).

c) Stenosis and atresia of the intestine

The ileum is mostly affected (50%). These anomalies occur during 10<sup>th</sup> week of intrauterine life due to failure of an adequate number of vacuoles to form during recanalization of the intestine. Also stenosis or atresia occurs when a transverse septum or web is formed. Interruption of the blood supply to a loop of fetal intestine resulting from a fetal vascular accident caused by impaired microcirculation can also cause stenosis or atresia. As a result, necrosis of the bowel and development of a fibrous cord occurs (Snell Richard S., 2010).

d) Ileal diverticulum and other omphaloenteric remnants

An ileal diverticulum appears 40 to 50 cm from the ileocecal junction as a fingerlike pouch from the antimesenteric border of the ileum and is the remnant of the proximal part of the omphaloenteric duct (yolk stalk). It is approximately 3 to 6 cm long. In about 2% to 4% of children, a congenital ileal diverticulum (meckel diverticulum) occurs and is three to five times more prevalent in males than females (Sadler T., 2012). The wall of the diverticulum contains all layers of the ileum and may contain small patches of gastric and pancreatic tissues. Acid is secreted by this ectopic gastric mucosa, leading to ulceration and bleeding. An ileal diverticulum may be connected to the umbilicus by a fibrous cord (leading to intestinal obstruction as the intestine can wrap around this cord) or causing an omphaloenteric fistula (omphalomesenteric duct) (Sadler T., 2012).

e) Congenital megacolon or hirschsprung disease

Congenital megacolon occurs due to a malformation in the pelvic parasympathetic system resulting in the absence of ganglion cells in Auerbach's plexus of a segment of distal colon. A defect in the migration of neural crest cells, which are the embryonic precursors of the intestinal ganglion cell is thought to cause Hirschsprung disease however the etiology is still incompletely understood. Normally, the neural crest cells migrate into the intestine from cephalad to caudad. The migration of neural crest cells from mid transverse colon to anus takes 4 weeks during which the fetus is most vulnerable to defects in migration of neural crest cells. This explains why most cases of aganglionosis involve the rectum and rectosigmoid. About one in 5000 newborns are affected and male to female ratio is 4:1 ( Brunicardi Charles F ., 2006).

f) Imperforate anus and anorectal anomalies

The hindgut separates into the urogenital sinus and the anorectum at 4 to 6 weeks' gestation. Anorectum then undergoes canalisation. The distal third of the anus develops from ectoderm and becomes the anal pit, whereas the proximal portion of the anal canal is derived from mesoderm. Until the 8<sup>th</sup> week gestation, the canal is covered by anal membrane which then perforates and becomes a patent anus. If this sequence of events occurs improperly, imperforate anus occurs (Sidler Daniel et al., 2010).

g) Congenital inguinal hernia

A persistent processus vaginalis exists if the communication between the tunica vaginalis and the peritoneal cavity fails to close resulting in herniation of a loop of intestine into the scrotum. Males are much more commonly affected, especially when there are undescended testes (Chung Kyung Won , Chung Harold M ., 2008) .

#### h) Intestinal malrotation

Intestinal malrotation (IM) refers to all the abnormalities of intestinal position and attachment (Smith SD., 2006). Normally during the sixth week, there is rapid growth of midgut and umbilical herniation occurs. The gut begins its 270° counter-clockwise rotation about the superior mesenteric artery axis during the 10<sup>th</sup> week and re-enters the abdomen. Fixation occurs by 12<sup>th</sup> week. If this sequence of events occurs improperly, malrotation occurs. The incidence is about 1 in 6000 live births (Pierro A, Ong EG., 2004).

### **2.4. Anatomy in relation to pathology**

#### A) Appendicitis

##### i. Variability of position of the appendix

When attempting to diagnose appendicitis, the inconstancy of the position of the appendix should be borne in mind. It may be difficult to elicit tenderness on palpation in the right iliac region in the case of a retrocecal appendix as it may lie behind a caecum distended with gas. The patient keeps the right hip joint flexed due to irritation of the psoas muscle. Absent abdominal tenderness in the right lower quadrant, but deep tenderness may be experienced just above the symphysis pubis if an appendix is hanging down in the pelvis. During rectal or vaginal examination, tenderness in the pelvis on the right side is elicited (Snell Richard S., 2010).

##### ii. Pain of appendicitis

Distension of the appendix lumen or spasm of its muscle causes visceral pain. A vague referred pain is felt in the region of the umbilicus as the afferent pain fibers enter the spinal cord at the level of the 10th thoracic segment. Later, the inflamed appendix irritates the parietal peritoneum and the pain is precise, severe and localized to where the inflamed appendix is (Snell Richard S., 2010).

## B) Inguinal hernia

### I. Inguinal canal

The inguinal canal is a slit-like passage lying just above and parallel to the lower half of the inguinal ligament. It begins at the deep inguinal ring and extends in a downward and medial direction for approximately 4 cm, ending at the superficial inguinal ring.

#### Walls of the inguinal canal

Anterior wall: external oblique aponeurosis, and laterally it is reinforced by the origin of the internal oblique from the inguinal ligament.

Posterior wall: conjoint tendon medially, fascia transversalis laterally.

Roof or superior wall: fibers of the internal oblique and transverses abdominis muscles.

Floor or inferior wall: the inguinal ligament and at its medial end, the lacunar ligament.

### II. Mechanics of the Inguinal Canal

- In the lower part of the anterior abdominal wall, the inguinal canal is a site of potential weakness in both sexes.
- The canal is an oblique passage except in the newborn. The weakest areas are the superficial and deep rings, lying some distance apart.
- The arching lowest fibers of the internal oblique and transverses abdominis muscles contract during coughing and straining, flattening out the arched roof so that it is lowered toward the floor. The contents of the canal are compressed against the floor virtually closing the canal.
- During defecation and parturition, the hip joints are flexed, and the anterior surfaces of the thighs are brought up against the anterior abdominal wall (squatting position) hence protecting the lower part of the anterior abdominal wall (Drake Richard L et al., 2007).

## **2.5. Clinical presentation**

Majority of children with NTCASE present with abdominal pain, abdominal distention and vomiting. Distinction needs to be made between billious and non billious vomiting so as to differentiate various aetiologies. There is a big challenge in examining children due to their poor localisation of pain therefore a high degree of suspicion is required with appropriate imaging diagnostic techniques. Also these symptoms are so common and non specific leading to missed diagnosis and therefore delayed appropriate treatment (Ademuyiwa Adesoji et al., 2012). However some aetiologies have straight forward presentation for example gastroschisis presents with protrusion of abdominal organs (mainly intestines) through the defect.

## **2.6. Investigations**

Nothing can replace the clinical acumen of the clinicians and a high index of suspicion in the management of acute abdomen in children. However some imaging techniques are required to assist in the diagnosis. When intestinal obstruction or perforation of viscus is the concern, plain radiographs of abdomen in erect position are most useful. Ultrasound of abdomen and pelvis can provide specific diagnosis in majority of the cases of acute abdomen in children (Aviral I et al., 2005). In the modern era of technologies, computed tomography (CT) scan, magnetic resonance imaging (MRI) and laparoscopy are also advocated for the diagnosis of acute abdomen in children (Tseng YC et al., 2008). However these imaging techniques are not affordable in developing countries due to challenges of infrastructure and sedation.

## **2.7. Treatment**

Supportive treatment includes intravenous fluid administration, electrolyte imbalance correction, blood transfusion, antibiotics and analgesics administration.

Surgery is the mainstay of treatment and it depends on the suspected aetiology. Many aetiologies of intestinal obstruction like intussusception would require a laparotomy while inguinal hernias can be sorted by herniotomy alone. Definite surgical techniques of some of the aetiologies have been discussed above.

## **2.8. Outcome**

NTCASE are associated with higher morbidity and mortality in developing countries, ranging from 5-34% in various regions. In a Nigerian study, the mean hospital stay was 10.8 days and mortality rate was 10.1%. In a study in Ghana, mortality rate was 8.7% while in Tanzania, it was 34% (Ademuyiwa Adesoji et al., 2012).

## CHAPTER THREE

### METHODOLOGY

#### 3.1. Study Design

A prospective cross-sectional study of children aged below 18 years who presented with non-trauma related abdominal emergencies at MTRH between January 15<sup>th</sup> 2015 to January 15<sup>th</sup> 2016 was carried out.

#### 3.2. Study Area and Site

This study was carried out at the MTRH in Eldoret, Kenya. This is located in Uasin Gishu County, in the North Rift region of Western Kenya. This is about 310 kilometers Northwest of Nairobi, the capital city of Kenya. The study was conducted in the surgical wards and newborn unit. The MTRH is the second largest referral hospital in Kenya. It serves the greater western Kenya region representing about 40% (approximately 16.2 million people) of the country's population. It also serves eastern Uganda and parts of Southern Sudan. It accommodates about 50 paediatric surgeries per month (electives and emergencies).

#### 3.3. Study Population

The study included all children below 18 years operated on for non-trauma related abdominal emergencies at MTRH between January 15<sup>th</sup> 2015 to January 15<sup>th</sup> 2016 who met the inclusion criteria and whose guardians gave informed consent to participate in the study.

#### 3.4. Sample Size Determination

The sample size was determined by the use of Fisher *et al* statistical formula:

$$n = \frac{Z^2 pq}{d^2}$$

where:

$n$  = desired sample size (when population is greater than 10,000).

$Z$  = The standard normal deviate set at 1.96 which correspond to 95% confidence level.

$p$  = Characteristic of the study population (10.1% mortality rate from previous data<sup>2</sup>).

$q = 1 - p$  (in this case  $q=1.0-0.101$ ).

$d$  = the degree of accuracy desired, which is here set at 5% or 0.05 corresponding to the 1.96.

Therefore in substitution:

$$\begin{aligned} &= \frac{(1.96)^2 \times 0.101 \times 0.899}{(0.05)^2} \\ &= 140 \end{aligned}$$

### **3.5. Subject Selection**

#### **3.5.1. Inclusion Criteria:**

- Children operated on for non-traumatic abdominal surgical emergencies at the MTRH.

#### **3.5.2. Exclusion Criteria:**

- Patient who had been operated elsewhere and then referred to MTRH.
- Patients with obvious co-morbidities were excluded from the study.



### **3.6. Data Collection**

The starting point of data collection was in the surgical wards and NBU after patients were identified from the theatre register. Patients who met the inclusion criteria were consecutively enrolled in the study. Data collection was conducted by the investigator and entailed filling of a data sheet of variables under investigation. Relevant data on factors, clinical presentation, duration of onset of symptoms, intraoperative findings and definitive procedure as per case notes were entered into the data collection sheet . Outcome evaluation parameters were in terms of complications, hospital stay and death. The study end point was at discharge or in hospital death and at this point any complication reported in patients file was recorded together with duration of length of stay. All filled questionnaires were checked for completeness and coded accordingly. Data was entered into access database and exported to SPSS version 20.0 statistical software for analysis.

### **3.7. Data Analysis**

#### **3.7.1. Descriptive Statistics**

Continuous data was analysed using means and SD and medians and IQR

Categorical data was presented in the form of frequency tables and charts.

#### **3.7.2. Inferential Statistics**

For continuous data, Student T- test was used to compare means.

For binary data, Chi-square test and Fishers exact test was used for analysis.

### **3.8. Limitations**

- It being a facility based study, its findings are not generalizable to the whole country and therefore may not give the burden in the community at large.
- Insufficiency of paediatric blood pressure machines and urethral catheters to monitor pre and post-operative blood pressure and urine output respectively

might have played a role in the management outcomes and also co-relation of blood pressure with mortality could not be achieved.

### **3.9. Ethical Issues**

1. Informed consent to conduct the study was sought:

- From an adult guardian/parent for their children together with assent from all children older than 7 years of age.
- Consenting took place in private consultation rooms.

2. No added cost on investigation or otherwise was added to the patients' bill.

3. Information gathered was confidential and used only for the purpose of this study.

4. No patient names or other identifying characteristics were used in the course of the study; instead, patient hospital numbers and initials were used.

5. All participants were free to withdraw from the study at any point in time as they wished and without need to seek prior authorization to do so and without any consequences whatsoever for so doing.

6. The proposal was submitted for review and approval by Institutional Research and Ethics Committee of Moi University and conditions complied with before the study commenced. Approval from the MTRH was also sought and granted.

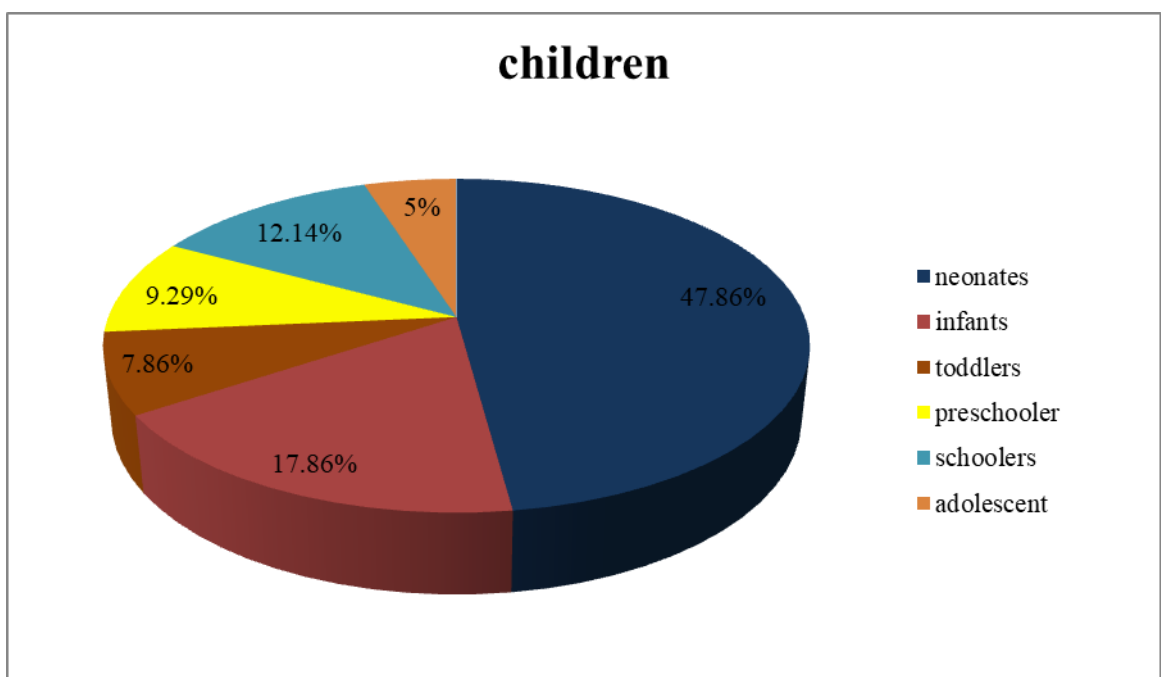
7. I declare no conflicts of interest in this study.

## CHAPTER FOUR

### RESULTS

#### 4.1. Demographics

The age of the patients ranged from 1 day to 17 years old, with a mean of 3.0 and SD of  $\pm 2.9$  years and median of 1.5 months, IQR 1-2 months. The male to female ratio was 2.1:1 (n=95:45). Figure 1 below illustrates the demographic features of the study subjects.



**Figure 1. Demography of children**

Neonates –less than 1 month old

Infants-1 month to 1 year old

Toddlers-1 year to 3 year old

Pre-schoolers-3 year to 6 year old

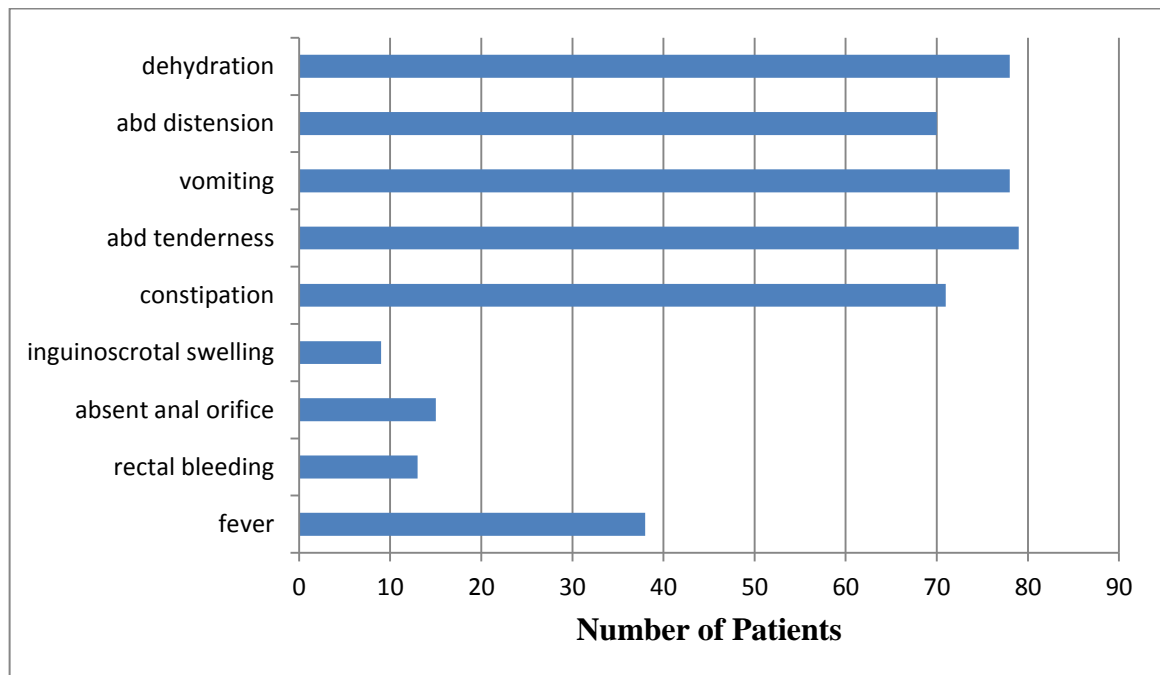
Schoolers-6 year to 12 year old

Adolescent-12 year to 17 year old

## 4.2. Clinical presentation and aetiologies of NTCASE

### 4.2.1. Dominant signs and symptoms

Patients who were diagnosed with NTCASE presented with diverse symptoms. Figure 1 below shows the dominant signs and symptoms that the patients presented with at the time of admission.



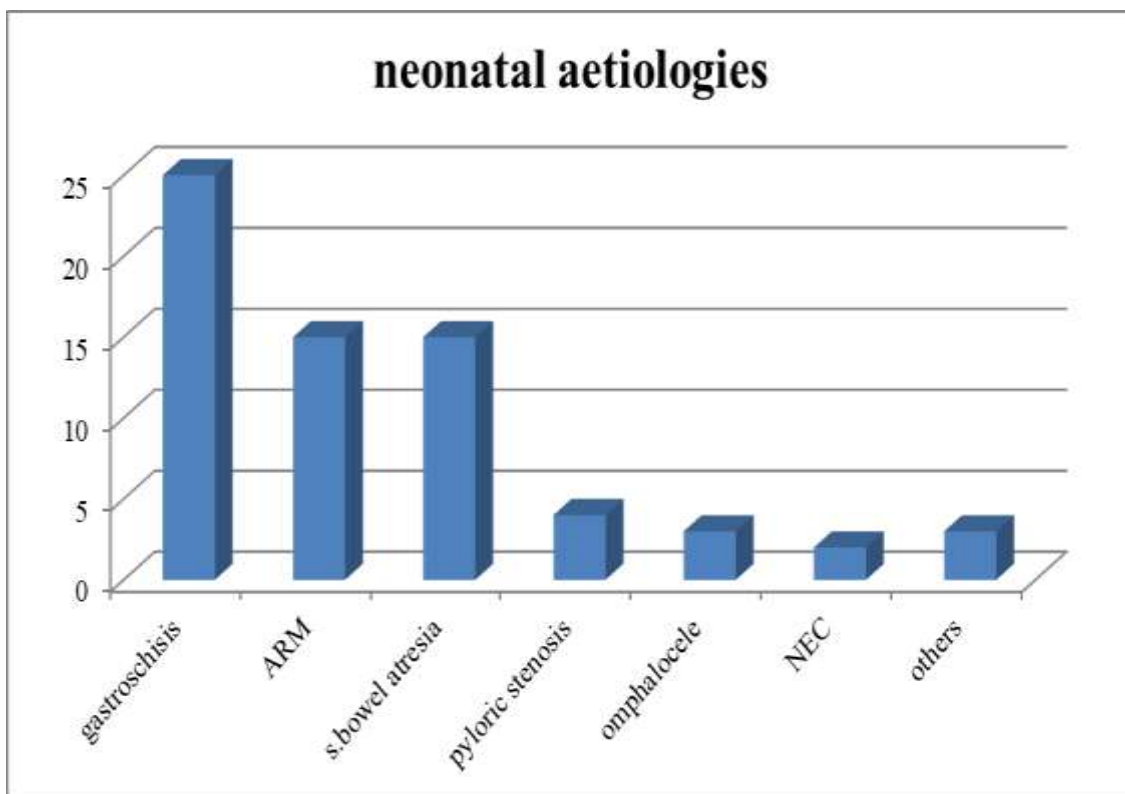
### Figure 2 .Dominant Signs and Symptoms

As shown in figure 2 above, majority of the patients presented with vomiting (78 patients, 55.7%). On examination, majority of patients were found to be dehydrated (78 patients, 55.7%) and had abdominal tenderness (79 patients, 56.4%).

### 4.2.2. Aetiologies of NTCASE

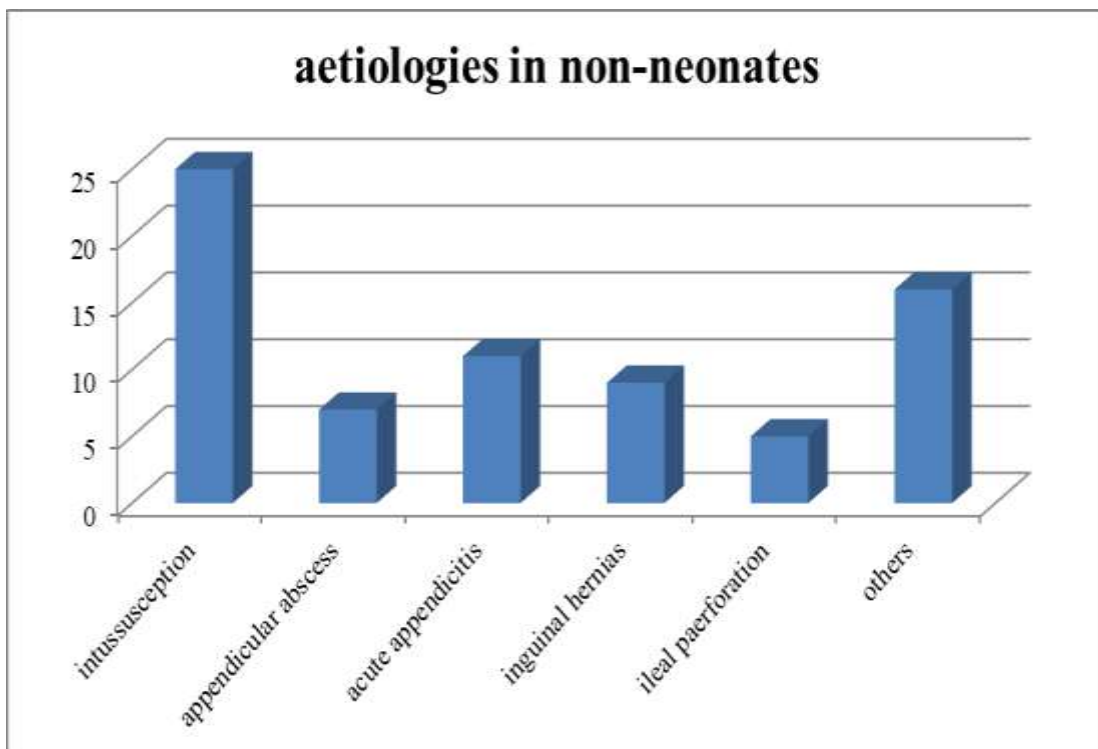
The aetiologies of NTCASE among the patients studied were diverse. These aetiologies are shown in figure 3 and 4 below.

Overall, intussusception (17.9%) and gastroschisis(17.9%) were the leading aetiologies of NTCASE followed by small bowel atresia(10.7%) and ARM(10.7%).



**Figure 3. Aetiologies in neonates**

Others include colon atresia (n=1), gastric perforation (n=1) and malrotation (n=1)



**Figure 4. Aetiologies in non-neonates**

Others include umbilical hernia (n=2), hirschsprungs disease (n=4), ascariasis (n=2), volvulus (n=2), colon tumor (n=2).

### 4.3. Outcome of NTCASE

#### 4.3.1. Complications

The overall complication rate was 17.9% (n=25) with neonates being the majority (n=19). The specific medical and surgical complications identified among the patients treated for NTCASE at the MTRH are as depicted in table 1 below.

**Table 1. Complications**

Complication	Frequency (%)
Septicaemia	19 (76%)
Wound dehiscense	2 (8%)
Burst abdomen	1 (4%)
Electrolytes derrangement	1 (4%)
Prolapsed stoma	1 (4%)
Enterocutaneous fistula	1 (4%)
Total	25 (100)

Septicaemia was the commonest complication encountered among the study subjects as depicted in the table above. Twelve out of 25 patients (48 %) with complications died.

#### **4.3.2. Morbidity: Length of stay**

The average length of hospitalization and SD was about  $8.6 \pm 7.6$  days. The range was 1 day to 35 days. Those who developed complications took longer in the hospital (11.6 days) than those who did not have complications (8.3 days). Also patients with gastroschisis had a longer stay (12 days) compared to the rest of aetiologies.

#### **4.3.3. Hospital mortality**

The overall in-hospital mortality recorded in this study was 20 % (28 patients) with neonates being the majority (n=24). Twelve out of the 28 patients who died had complications while in the other 16, the cause of death was not ascertained.

The case-specific mortality rates are represented in table 2 below.

**Table 2. Case-specific mortality**

Aetiology of NTCASE	Case fatality Frequency (Rate, %)
Gastroschisis	11(44%)
ARM	5(33.3%)
Small bowel atresia	5(33.3%)
Ileal perforations	3(60%)
Colon atresia	1(100%)
NEC	1(50%)
Intussusception	2(8%)
Total	28(20%)

#### **4.4. Factors co-related with morbidity and mortality**

##### **4.4.1. Duration of illness and referral status**

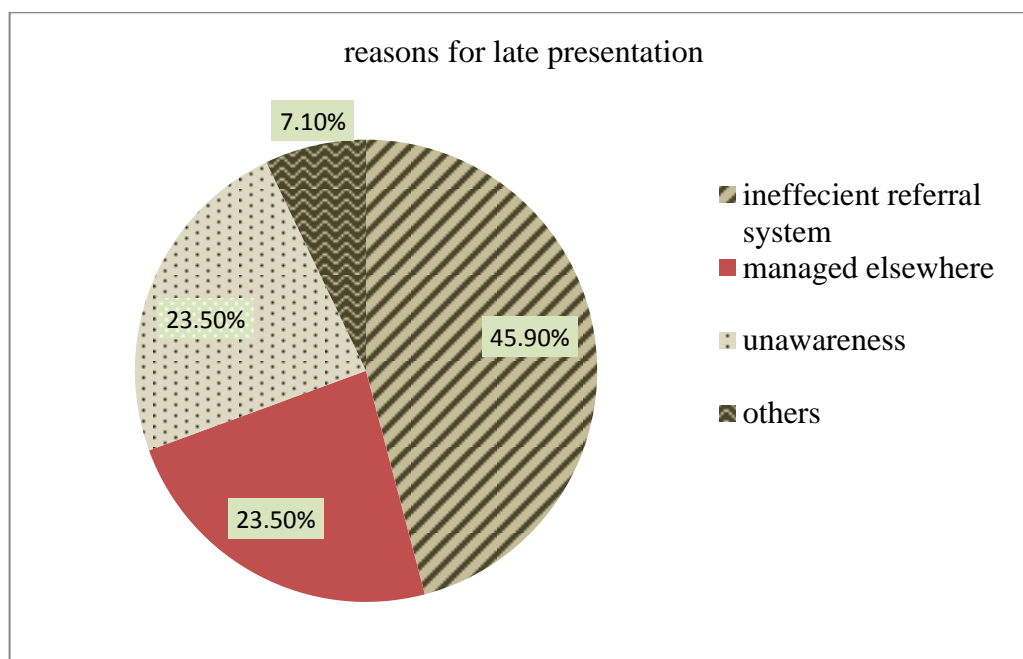
The duration of illness presentation ranged from 2 hours to 14 days with a mean and SD of  $66.0 \pm 54.4$  hours. Majority (70 %, n=98) of the patients presented to hospital more than 24 hours after the onset of symptoms.

Majority (92 patients, 65.7%) of the patients presented to MTRH were referrals while 48(34.3%) presented directly from home.

Among those who came straight from home, 72.9% (35 patients out of 48) took more than 24 hours after the onset of the symptoms while 68.5 % (63 patients out of 92) of those who were referrals from other health facilities took more than 24 hours to present at MTRH.



The reasons for late presentation (>24 hours) are shown in the figure 5 below.



**Figure 5. Reasons for late presentation**

#### **4.4.2. Investigations Done**

The laboratory tests done in these patients at admission were complete blood count (136 patients, 97.1%) and urea, electrolyte and creatinine (140 patients, 100%), largely to assess the physiological derangements and serve as a theatre requirement. Low Hb was found in 48 patients (34.3%), abnormal WBC in 63 patients (46.3%), 42 patients (30%) had deranged potassium level, 34 patients (24.3%) had deranged sodium levels and only 4 patients (2.9%) had elevated urea and creatinine.

#### **4.4.3. Treatment of NTCASE patients at MTRH**

##### **4.4.3.1. Supportive treatment: fluid resuscitation**

Among the patients with NTCASE, only 1.4% (2 patients) did not receive any fluids in the pre-operative period. Ringers lactate was the IV fluid of choice (52.9%, n=74). The choice and volume of IV fluid given was made by the clinician who first saw the patient.

#### 4.4.3.2. Use of antimicrobials

Out of the 140 patients, 123 patients (87.86%) were given antimicrobials pre-operatively. Majority (69.92%, n=86) of these 123 patients received ceftriaxone. Post-operatively, all of them received parenteral antimicrobials. The choice of antimicrobials given was made by the attending surgical team largely based on the suspected organisms being targeted. Other antibiotics used were penicillin, gentamycin, metronidazole and meropenem, mostly used as combination with the other.

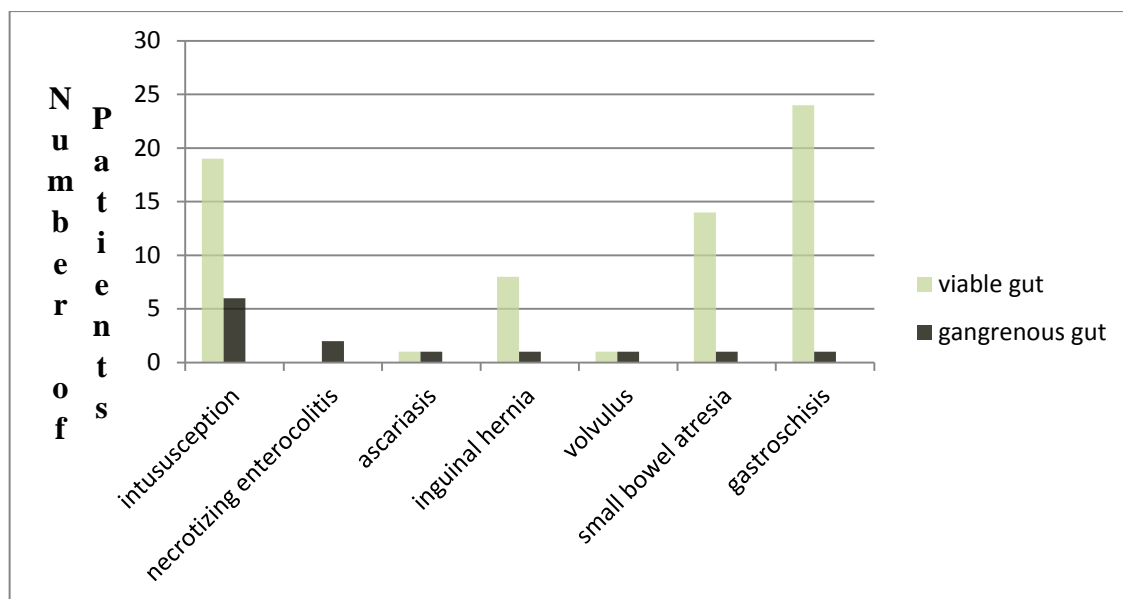
**Table 3. Co-relation between antimicrobial use and development of septicaemia or wound infection**

		Presence of either wound infection or sepsis		Total (%)
		No (%)	Yes (%)	
Antibiotic use	Yes	102(82.9%)	21 (17.1%)	123(100%)
	No	15 (88.2%)	2(11.8%)	17 (100%)
Total		117 (83.6%)	23 (16.4%)	140 (100%)

There was no significant association between antimicrobial use and development of either wound sepsis or septicaemia ( $\chi^2 (1) = 1, p=0.581$ ).

#### 4.4.4. Bowel strangulation

Majority (127 patients, 90.7%) of the patients who underwent surgery had viable bowels (not gangrenous) while the remaining 13 patients (9.3%) had gangrenous bowel. The figure below shows the diagnoses among the patients who had gangrenous bowel.



**Figure 6 .Aetiology of NTCASE among patients with bowel gangrene**

From the figure above, intussusception and necrotizing enterocolitis were the commonest aetiologies of NTCASE among the patients with gangrenous bowel.

#### 4.4.5. ASA Classification

More than half (55 %) of the patients were classified as ASA II as depicted in table 4 below.

**Table 4: ASA classification**

ASA classification	No. of patients	% of patients
I	40	28.58%
II	77	55.0%
III	22	15.71%
IV	1	0.71%

#### 4.4.6. Factors co-related with complications

**Table 5. Co-relation between various variables and complication development**

		Complication development		p-value
		No (%)	Yes (%)	
Temperature at admission	Normal	87 (84.5%)	16 (15.6%)	0.232
	High (>37.5°C)	28 (75.7%)	9(24.3%)	
WBC	Normal	64 (87.7%)	9 (12.3%)	0.111
	Abnormal	49 (77.8%)	14(22.2%)	
	Not done	2	2	
Duration of illness	<24hours	32 (76.2%)	10 (23.8%)	0.229
	>24hours	83 (84.7%)	15(15.3%)	
Gut viability	viable	108(85%)	19(15%)	0.005
	Gangrenous	7(53.8%)	6(46.2%)	

Bivariate analysis using chi-square test was used to co-relate complications with the above variables and presence of gangrene (p-value 0.005) was found to have a positive co-relation with complication development.

#### 4.4.7. Factors co-related with mortality

Various factors were evaluated for their capability to predict mortality in NTCASE patients as shown in table 6 below. Development of complications, duration of illness(<24 hours), ASA classification(grade 3,4), deranged potassium levels, normal haemoglobin levels(>12g/dl) and neonates had significant co-relation with mortality.

**Table 6.Co-relation between various variables and eventual outcome (Alive /Dead)**

		<b>Outcome</b>		<b>p-value</b>
		Alive (%)	Dead (%)	
<b>Presence of complications</b>	No	99 (86.1%)	16 (13.9%)	0.0001
	Yes	13 (52%)	12 (48%)	
<b>Sex</b>	Male	78 (82.1%)	17 (17.9%)	0.373
	Female	34 (75.6%)	11(24.4%)	
<b>Any antibiotic given</b>	Yes	98 (79.7%)	25 (20.3%)	0.794
	No	14 (82.4%)	3 (17.6%)	
<b>WBC</b>	Normal	59 (80.8%)	14(19.2%)	0.576
	Abnormal	49 (77.8%)	14 (22.2%)	
<b>Temperatures at admission</b>	Normal	79 (70.5%)	23 (29.5%)	0.217
	High	33 (86.8%)	5 (13.2%)	
<b>Gut viability</b>	viable	102 (80.3%)	25 (19.7%)	0.771
	gangrene	10 (76.9%)	3 (23.1%)	
<b>ASA classification</b>	1,2	100 (85.5%)	17 (14.5%)	0.0003
	3,4	12 (52.2%)	11 (47.8%)	
<b>Duration of illness</b>	<24hours	28(66.7%)	14(33.3%)	0.0098
	>24hours	84(85.7%)	14(14.3%)	
<b>Referral status</b>	Referrals	71(77.2%)	21(22.8%)	0.247
	Home	41(85.4%)	7(14.6%)	
<b>Potassium level</b>	normal	86(87.8%)	12(12.2%)	0.0005
	Abnormal	26(61.9%)	16(38.1%)	
<b>Sodium level</b>	normal	85(80.2%)	21(19.8%)	0.921
	Abnormal	27(79.4%)	7(20.6%)	
<b>Heamoglobin level</b>	Normal	68(73.9%)	24(26.1%)	0.0127
	Abnormal	44(91.7%)	4(8.3%)	
<b>Pulse rate</b>	Normal	86(82.7%)	18(17.3%)	0.176
	Abnormal	26( 72.2%)	10( 27.8%)	
<b>Age group</b>	<1 month	43(64.2%)	24(35.8%)	0.0001
	>1 month	69(94.5%)	4(5.5%)	

## CHAPTER FIVE

### DISCUSSION

#### 5.1. Demography of the patients

Male to female ratio in this study is similar to what was found in other studies. In a study in India, the male to female ratio was found out to be 2.22:1. However mean age of presentation was 7.09 years and 73% of patients were above 3 years of age which varies greatly with findings in this study (Pujari Amit et al., 2008). In a study in North central Nigeria, the mean age was 4.6 years and the male-to-female ratio was 2.5: 1 (Lukman Olajide et al., 2012). Another study from Lagos, Nigeria reported median age of 5 months which differs from this study (Ademuyiwa Adesoji et al., 2012). This signifies that mean and median age of presentation and male to female ratio varies with different geographical locations. The higher number of neonates and infants is likely due to regionalization of paediatric surgical services at MTRH thus indicating that other hospitals in the region may not be in a position to offer better health services to the very young and therefore being referred to MTRH. The increased male to female ratio is probably due to the variation in anatomy leaving male more susceptible to pathologies. Also many aetiologies have shown a male preponderance according to literature.

#### 5.2. Clinical presentation and aetiologies of NTCASE

The results on clinical presentation are similar to what F.A. Abatanga et al found in Ghana. Children present with common and non-specific symptoms and signs that recognition of abdominal surgical emergencies is frequently delayed or missed altogether.

Also examination of children especially those with abdominal pain is inherently difficult (Maureen McCollough et al., 2003). Therefore a high index of suspicion is

needed and correlation with investigations in order to manage these patients appropriately.

With the various aetiologies and the decreased percentage frequency of each aetiology, it is noted that NTCASE has no specific presentation form.

The aetiologies found in this study differ from studies elsewhere. In a study in Ghana, the leading aetiologies of surgical abdominal emergencies in children were typhoid perforation of the gastrointestinal tract (GIT), 68% and acute appendicitis, 16% (Abantanga F.A et al., 2009).

Another study done in Kashmir stated that the causes of intestinal obstruction in children included ascariasis (63.2%), adhesion (11.1%), intussusception (10.1%), obstructed hernia (8.2%), and volvulus (5.3%) (Shiekh KA et al., 2010) while in this study intussusception was the commonest.

In a study in Nigeria, acute appendicitis occurred in 15% of cases, typhoid ileal perforation (TIP) (22%), anorectal malformation (ARM)(11%) and intussusception occurred in 15% of cases (Lukman Olajide et al., 2012). In this study, only 3.57% patients presented with ileal perforations that were thought to be typhoid related.

These results show that aetiologies of NTCASE vary from region to region and therefore no aetiology can be taken for granted. High index of suspicion is required to reach a diagnosis. The tertiary nature of services offered may explain the difference in aetiologies and age when compared to studies from similar economic regions. Referrals from various regions also contribute to the various and common aetiologies found at MTRH.

Lack of folate supplements and poor food security may be the reason for the increased prevalence of congenital anomalies like gastroschisis. Also, there is need to focus on congenital anomalies as recent research has indicated that there is a global rise.

### **5.3. Outcomes of NTCASE at MTRH**

#### **5.3.1. Complications**

The overall complication rate was higher than in India (12%) (Rajendra K. Ghritlaharey et al., 2011) and Nigeria (10.1%) (Ademuyiwa Adesoji et al., 2012). The most common complication found by Lukman Olajide et al (2012) in Nigeria was wound infection (71%), which in this study comprised of only 12%.

Presence of gangrene in bowel had a positive association with complications. The positive association of gangrene in bowel with complications determines the rate of infection hence addressing to the need of early detection and management of pathology.

#### **5.3.2 Length of stay**

The average length of hospitalization in this study is comparable to what was found in a study in Nigeria by Sebastian Ekenze in 2010.

Patients who developed complications stayed significantly longer in the hospital. This could be due to patients with surgical complications undergoing another operation to solve the complication or prolonged antibiotic therapy for some complications like septicemia. Similar results have been reported by other authors (Chalya PL et al., 2014).

Also patients with gastroschisis stayed longer in the hospital due to having staged procedures in theatre at different times.

#### **5.3.3 Mortality**

The in-hospital mortality rate is twice that of Adesoji O. Ademuyiwa(10.1%) et al in Nigeria but lower than that of Mhando in Tanzania (34%) (Ademuyiwa Adesoji et al., 2012).



The highest mortality was among neonates. This is in agreement with Jumbi who noted that mortality was highest at extremes of ages (Jumbi G., 2014). This is likely due to low immunity and physiological body reserves in children particularly the newborns and infants. In addition, MTRH lacks total parenteral nutrition and paediatric ICU facilities and this may compound the problem among the very young patients who may need these facilities.

Colon atresia and ileal perforations had the highest case-specific mortality rates but their numbers were too low to suggest any valid reason for their high case specific mortality.

#### **5.4. Co-relation of factors with mortality**

##### **5.4.1. Duration of patient presentation**

Duration of presentation is almost similar to what was found in Rwanda by M.Nyundo et al. In Rwanda, the duration of symptoms on admission ranged from 1 hour to 10 days (mean = 3.6 days). The majority (64.2%) of the patients presented to the hospital more than 48 hours after the onset of symptoms (Nyundo M et al., 2013).

Various studies have reported early presentation as a positive factor in preventing morbidity and mortality in children (Ademuyiwa Adesoji et al., 2012). However in this study, duration of presentation < 24 hours has a positive co-relation with mortality contrary to other studies. This might be due to the low number of patients presenting before 24 hours and the rush to operate on them without sufficient resuscitation and also may be due to poor monitoring of these patients with the assumption that their vital signs and electrolytes had been normal prior to surgery. Also this might be due to severity of pathology and its presentation necessitating early presentation both by referrals and self presentation by the guardians.

### **5.4.2. Referral Status**

Inefficient referral system was the reason for delayed presentation in 45.9 % of those who presented after 24 hours of onset of symptoms. The referral process in most cases follows the chain of hierarchy according to the hospital level leading to delays, during which time the patient's condition may deteriorate, leading to increased operative risk and mortality (Bickler S.W , Rode H ., 2002). However in this study, the referral system had no co-relation with mortality.

### **5.4.3. Investigations**

Elevated WBC may signify bacterial translocation into the blood stream with attendant systemic inflammatory response or sepsis, elevated urea signify dehydration (Jackson PG et al., 2011) and deranged electrolytes may signify severity of the pathology. These tests are non-specific and they largely play a complimentary role in these patients with NTCASE (Kahi CJ, Rex DK., 2012) to assess the pathophysiological changes. Abnormality in WBC count had no co-relation with development of complications (p-value 0.111) or mortality (p-value 0.576) contrary to what might be expected with significant bacterial translocation. Despite correction of the deranged potassium levels (both high and low) before theatre, it had a positive co-relation with mortality (p-value 0.0005 ).The fact that stabilization of electrolytes before taking patient to theatre is a worldwide basic regulation, emphasis should be made on early presentation of patient to avoid severe electrolyte derangements and aggressive resuscitation and monitoring should be done from admission till discharge.

On the contrary, there was a significant co-relation between normal haemoglobin level and mortality (p-value 0.0127). Surgical outcome is greatly affected by anemia which is a sign of an underlying disease or condition and decreasing Hb shows the

severity of the pathology (Carson JL et al., 1996). Decreasing pre-operative hemoglobin concentrations, especially hemoglobin level of less than 6 g/dL increases risk of mortality (Marik PE, Corwin HL., 2008). In this study however mortalities were few in patients with low haemoglobin. This positive co-relation of normal haemoglobin with mortality might be due to the high sample size and other contributing factors that are co-related to mortality. Also majority patients having borderline Hb would be operated without being transfused despite the blood loss intra-operatively unlike patients with low Hb who would have several units of blood transfused pre-operatively, intra-operatively and post-operatively.

#### **5.4.4. Treatment of NTCASE at MTRH**

Fluid administration and monitoring was found to be a challenge. This was similar to findings of previous studies conducted in the same hospital (Kuremu RT., 2004). The quantity and composition of the administered fluid varied among patients as prescribed by the clinician, often a registrar in general surgery or a consultant surgeon as there is no protocol for fluid administration at MTRH. Evaluation of the effectiveness of rehydration was based on clinical assessment since it was difficult to measure urine output in children especially neonates due to lack of being catheterised. This study, like the ones conducted previously at the same hospital, demonstrates the urgent need to improve on fluid administration and monitoring in these patients with NTCASE who present at different health facilities in Kenya including referral centres such as MTRH, even as they await surgery. There is need to train ward staff, particularly nurses on the importance of fluid therapy in patients with NTCASE not only preoperatively but also post-operatively. The fact that surgery is not the end in these patient's care but only a step in that process must be emphasized to all who care for these patients.

On the other hand, 123 patients (87.9%) received one or more parenteral antimicrobial before they were operated on. The antimicrobials given were aimed at covering gram-negative, gram positive and anaerobic bacteria which was in agreement with existing publications (Jackson PG et al., 2011). However, use of these antimicrobials was not shown to reduce infective complications. This is probably because the commonly used antimicrobials (ceftriaxone) were in widespread use in the hospital and the region and the choice of these drugs was not guided by known antimicrobial sensitivity patterns contrary to literature (Jackson PG et al., 2011). Also majority of patients presented late therefore the pathological changes were so advanced that perhaps the antibiotic therapy was not effective enough.

#### **5.4.5. Bowel strangulation**

Twentyfour percent of patients with intussusception had gangrenous bowel. This is a reduction from the 31% reported by Kuremu at the same institution in a study evaluating childhood intussusception (Kuremu RT., 2004).

This high rate of strangulation was similar to previous studies that indicate delay in surgery of more than 24 hours after onset of illness leads to high chance of bowel resection as compared to when surgery is done within 12 hours of illness onset (Kadhim Jawad Obaid., 2011).

Majority of our patients were operated >24 hours after illness onset. This was due to late presentation to hospital similar to what other authors (Malik AM et al., 2010) from other developing countries have reported. However no co-relation was found between bowel gangrene and mortality contrary to other studies.

#### **5.4.6. Development of complication**

Development of complications (p-value 0.0001) had significant co-relation with mortality. The high rate of complication might be due to the advanced disease process indicating that early presentation of illness should be encouraged through community education. It could also be due to errors in practice of aseptic techniques in theatre.

#### **5.4.7. Age**

Neonates have intrinsic challenges like increased susceptibility to infections, hypocalcaemia, hypoglycaemia and poor cardiovascular reserves related to the transition from the foetal life to post natal life. Trauma of surgery distorts the delicate balance and making them susceptible to sepsis, dyselectrolytaemias, anaemia and nutritional deficits and respiratory complications (Ademuyiwa Adesoji et al., 2012). Thus severity of pathology distorts developing physiology of a child.

#### **5.4.8. ASA classification**

American Society of Anaesthesiologists (ASA) classification was done by the anaesthesia team involved in the management of these patients. The ASA score has been found to be a strong predictor of postoperative mortality in various surgical fields (Claudio AR et al., 2008, Ridgeway S et al., 2005, Tang R et al., 2001, Sauvanet A et al., 2005). In a study by Thomas J. Hopkins, there was a positive co-relation between increasing ASA designation and mortality within 48 h of surgery in patients undergoing both elective and emergent procedures (Thomas J. Hopkins., 2016). This correlates with the findings in this study. As a general rule of thumb, any patient who is ASA 3 or 4 should have a senior anaesthetic review (Jo Fitz Henry., 2011).

## CHAPTER SIX

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1. Conclusions

1. The most common aetiology of NTCASE in neonates at MTRH is gastroschisis and in non-neonates is intussusception.
2. The mortality and morbidity rates from NTCASE at the MTRH are significantly high. The most affected group is the neonates.
3. The factors co-related with mortality in patients with NTCASE are deranged potassium level, ASA classification grade 3 and 4, neonatal age, normal haemoglobin level, duration of illness presentation < 24 hours and development of complications.

#### 6.2. Recommendations

1. There is need to reduce the increased morbidity and mortality in children with non-traumatic abdominal surgical emergencies at MTRH by considering the factors associated with it.
2. Further studies on specific aetiologies and other factors like birth weight, albumin levels that affect neonatal mortality should be advocated.

## REFERENCES

- Abantanga, F.A., Nimako,B., Amoah, M(2009). The range of abdominal surgical emergencies in children older than 1 year at the Komfo Anokye Teaching Hospital, Kumasi, Ghana.*Annals of African medicine* ,8 (4),236-242
- Abantanga F. A., Kokila, L (2010). Inguinal and Femoral Hernias and Hydroceles. *Paediatric surgery in Africa* , 1,77-83
- Adesoji, A., Bode, C., Opeoluwa, A., Olumide,A. (2012). Non-trauma related paediatric abdominal surgical emergencies in Lagos, Nigeria: Epidemiology and indicators of survival. *Nigerian Medical Journal*. 53(2), 76–79
- Ameh, E.A., Chirdan, L.B. (2001). Paediatric surgery in the rural setting: prospect and feasibility. *West African Journal of Medicine*; 201,52-55.
- Ameh, E.A., Chirdan, L.B., Nmadu, P.T., Yusufu, L.M (2003). Complicated umbilical hernias in children. *Pediatric Surgery International; America* ,21,909-935
- Aviral,I., Chana, R.S., Ahmad, I. (2005). Role of ultrasonography in the evaluation of children with acute abdomen in the emergency set-up. *Journal of Indian Association Pediatric Surgery* ,10,41-43.
- Awan, M. Y ., Shukr, I., Mahmood M.A., Qasmi S.A. (2013). Acute appendicitis: most common clinical presentation and causative microorganism. *Pakistan armed forces medical journal* ,1,57-59
- Barlow, A., Muhleman M., Gieleck,i J., Matusz, P., Tubbs, R.S., Loukas, M. (2013). The Vermiform Appendix :A Review.*Clinical Anatomy* ,26,83
- Bay-Nielsen, M., Kehlet, H., Strand, L., Malmstrøm, J., Andersen, F., Wara, P. (2001). Quality assessment of 26,304 herniorrhaphies in Denmark: a prospective nationwide study. *Lancet* ,358,1124–1128.
- Bhargava, P., Mahajan, J.K., Kumar, A. (2006). Anorectal malformations in children. *Journal of Indian Association Pediatric Surgery* ,11,136-139
- Bickler, S.W., Rode, H. (2002). Surgical services for children in developing countries. *Bulletin of the World Health Organization* ,80,829-836
- Bickler, S.W., Sanno-Duanda, B. (2000). Epidemiology of paediatric surgical admissions to a government referral hospital in the Gambia. *Bulletin of the World Health Organization* ,78,1330-1336.

- Bines, J.E., Kohl, K.S., Forster J., Zanardi, L.R., Davis, R.L. (2004) Acute intussusception in infants and children as an adverse event following immunization: case definition and guidelines of data collection, analysis, and presentation. *Vaccine* 22,569–574
- Brisighelli, G., Moran, A., Parolini, F., Leva, E. (2012). Appendicitis in a 14-month-old infant with respiratory symptoms. *African Journal of Paediatric Surgery*, 9( 2 ),151
- Brunnicardi, C. F. (2006). *Schwartz manual of surgery (8<sup>th</sup> ed,1015)*
- Buedeker, N., Broadis, E., Borgstein, E., Hugo, A.H. (2013). The hidden mortality of imperforate anus. *African journal of paediatric surgery*,10 ,302-306.
- Carson, J.L., Duff, A., Poses, R.M.(1996). Effect of anaemia and cardiovascular disease on surgical mortality and morbidity. *Lancet*. 348,1055.
- Chalya, P.L., Mabula, J.B., Chandika, A.B., Giiti, G. (2014). Dynamic bowel obstruction: aetiology, clinical presentation, management and outcome at Bugando Medical Centre, Mwanza,Tanzania. *Tanzania Journal of Health Research*. 16(1),56-57
- Chung, K. W ., Chung, H. M. (2008) . *BRS gross anatomy (6<sup>th</sup> ed, 185)*
- Claudio, A.R., Wagner, M., Sigurdsson, G., Schilling, M., Buchler, M. (2008). ASA annual meeting abstracts. The ASA-Physical Status Classification Predicts not only Short- Term but also Long-Term Outcome in Patients Undergoing Liver Resection. *Clinics*,32(4),1229-1247
- Drake, R. L., Vogl, W., Mitchell, A.W. M. (2007) . *Grays anatomy for students (2<sup>nd</sup> ed ,256-293)*
- Hesse, A., Abatanga, F., Kokila, L. (2010). *Intussusception. Peadiatric surgery in Africa (2 ,404).*
- Insinga, V., Lo-Verso, C., Antona, V., Cimador, M., Ortolano, R., Carta, M., La-Placa. S., Giuffrè, M., Corsello, G. (2014). Perinatal management of gastroschisis. *Journal of Pediatric Neonatal Individual Medicine* ,3(1),74-76
- Jackson, P.G., Raiji, M. (2011). Evaluation and management of intestinal obstruction. *American family physician*. 83(2),159-165
- Jiang, J., Jiang, B., Parashar, U., Nguyen, T., Bines, J., Patel, M. (2013).Childhood Intussusception: A Literature Review ,2,88-91
- Jo-Fitz, H. (2011).The ASA classification and peri-operative risk.*Annals of College of Surgical Engineering* ,93(3),185–187.



- Jumbi, G. (2014). Epidemiology of Acute Intestinal Obstruction in Uasin Gishu County, Kenya.
- Kadhim, J. O. (2011). Intestinal obstruction: etiology, correlation between pre-operative and operative diagnosis: *University of Kebangsaan Malaysia*.
- Kahi, C.J., Rex, D.K. (2012) Bowel obstruction and pseudo-obstruction. *Gastroenterology Clinics*.32(4),1229-1247
- Katz, D. (2001). Evaluation and management of inguinal and umbilical hernias. *Pediatric Annals* ,30,729-735.
- Kenya population data sheet ( 2011): *population reference bureau,Nairobi*
- Kuremu, R.T. (2004). Childhood intussusception at the Moi teaching and Referral Hospital Eldoret: management challenges in a rural setting. *East African Medicine Journal*.81(9),443-446
- Lau, S.T., Lee, Y.H., Caty, M.G. (2007). Current management of hernias and hydrocoeles. *Seminar of Pediatric Surgery* ,16,50-57
- Lukman, O., Abdur-Rahman O., Adeniran, J., Olusanya, A. (2012). Paediatric surgical abdominal emergencies in a north central Nigerian centre. *Annals of Pediatric Surgery* ,8(2),56-58
- Lund, C.H., Bauer, K., Berrios, M. (2007). Gastroschisis: incidence, complications, and clinical management in the neonatal intensive care unit.. *Journal of Perinatal Neonatal Nursing* ,21,63-68
- Malik, A.M, Shah, M., Pathan, R., Sufi, K. (2010). Pattern of Acute Intestinal Obstruction: Is There a Change in the Underlying Etiology? *Saudi Journal of Gastroenterology : Official Journal of the Saudi Gastroenterology Association*,16(4),272-274.
- Marik, P.E., Corwin, H.L. (2008). Efficacy of red blood cell transfusion in the critically ill: a systematic review of the literature. *Critical Care Medicine*. 36,2667
- McCullough, M., Ghazala, Q., Sharieff, M. (2003). Abdominal surgical emergencies in infants and young children. *Emergency medicine clinics of North America* ,21,909-935
- Mensah, Y. B., Glover-Addy, H., Etwire V., Twum, M.B., Asiamah, S., Appeadu-Mensah, W., Hesse-Afua A.J. (2011). Pneumatic reduction of intussusception in children at Korle Bu Teaching Hospital: An initial experience. *African Journal of Paediatric Surgery* ,8(2),181.

- Moore, K. L., Persaud, T.V.N. (2006). *clinically oriented anatomy (5th ed,256)*
- Moore, S.W., Sidler, D., Hadley, G.P. (2005) . Anorectal malformations in Africa. *South African journal of science* ,43(4),99
- Nah, S.A., Giacomello, L., Eaton, S., de-Coppi, P., Curry, J.I., Drake, D.R. (2011). Surgical repair of incarcerated inguinal hernia: Laparoscopic or open? *European Journal of Pediatric Surgery* , 21,8-11.
- National Family Health Survey (1999). *NFHS 2 India 1998-1999*
- Norberg, E., Mwobobia, I., Muniu, E. (2002). Major and minor surgery output at district level in Kenya: Review and issues in need of further research. *African Journal of Health Science* , 9,17–25.
- Nyundo, M., Rugwizangoga, E., Ntakiyiruta, G., Kakande, L. (2013). Outcome of Emergency Abdominal Surgery at Kigali University Teaching Hospital: A review of 229 cases. *East and Central African Journal of Surgery* ,18 (1),90-94
- Ohene-Yeboah, M., Abantanga, F.A. (2011). Inguinal Hernia Disease in Africa: A Common but neglected surgical Condition. *West African Journal of Medicine* ,30(2),77-83
- Ohmann, C., Franke, C., Kraemer, M., Yang, Q. (2002). [Status report on epidemiology of acute appendicitis]. *Chirurg* ,73,769-776
- Osman, M A., Abdelbasit, E .A. (2014) Incidence, clinical presentation and outcome of gastroschisis and omphalocele in Sudan. *Sudan Medicine Journal August*;50(2),107
- Pierro, A., Ong, E.G. (2004). Malrotation. *Pediatric Surgery. New York: Springer-Verlag Berlin Heidelberg*,197-201.
- Pujari, A., Methi, R.N., Khare, N. (2008). Acute gastrointestinal emergencies requiring surgery in children at Indira Gandhi Government Medical College and Hospital, Nagpur. *African journal of paediatric surgery* , 5 (2) ,61-64
- Rajendra, K. G., Budhwani, K.S., Dhirendra, K., Shrivastava (2011). Exploratory laparotomy for acute intestinal conditions in children: A review of 10 years of experience with 334 cases .*African Journal of Paediatric Surgery*, 8(1),64-67
- Ridgeway, S., Wilson, J., Charlet, A., Pearson, A., Coello, R. (2005). Infection of the surgical site after arthroplasty of the hip. *Journal of Bone Joint Surgery* 87,844–850.
- Sadler, T. (2012). *Langman's Medical Embryology (12th ed,312)*

- Sauvanet, A., Mariette, C., Thomas, P., Lozac'h, P., Segol, P., Tiret, E. (2005). Mortality and morbidity after resection for adenocarcinoma of the gastroesophageal junction: Predictive factors. *Journal of American College of Surgery*. 201,253–262.
- Sebastian, E. (2010). Profile of Pediatric Abdominal Surgical Emergencies in a Developing Country-*International surgery* ,95(4),319-324
- Shiekh, K.A., Baba, A.A., Ahmad, S.M., Shera, A.H., Patnaik, R., Sherwani, A.Y.(2010). Mechanical small bowel obstruction in children at a tertiary care centre in Kashmir.*African journal of paediatric surgery* , 7(2),81-85
- Shivaleela, C., Vinay, K. K., Suresh, N.M.(2014). Gastroschisis: recent trends, embryology, maternal and infant risk factors.*International Journal of Medicine Research Health Science* .,3(2),480-484
- Sidler, D., Debrew, M., Kokila, L. (2010) . Neonatal Intestinal Obstruction-*pediatric surgery in Africa* ,2,99-110
- Smith, S.D. (2006). Disorders of intestinal rotation and fixation. *Pediatric Surgery*, 1346.
- Snell, R. S. (2010). *Clinical anatomy by regions*.(8th ed, 242)
- Snell, R.S. (2010). *Clinical anatomy by regions*.(8th ed 202-238)
- Snell, R. S .(2010). *Clinical anatomy by regions*.(8th ed ,238)
- Snyder, C.L. (2010). Inguinal hernias and hydroceles. *Ashcraft's Pediatric Surgery*,341-350
- Tang, R., Chen, H.H., Wang, Y.L., Changchien, C.R., Chen, J.S., Hsu, K.C. (2001). Risk factors for surgical site infection after elective resection of the colon and rectum: A single-center prospective study of 2,809 consecutive patients. *Annals of Surgery*. 234,181–189.
- Thomas, J. H. (2016). Associations between ASA Physical Status and postoperative mortality at 48 h: a contemporary dataset analysis compared to a historical cohort. *Perioperative Medicine* ,5,29.
- Tseng, Y.C., Lee, M.S., Chang, Y.J., Wu, H.P. (2008). Acute abdomen in pediatric patients admitted to the pediatric emergency department. *Pediatric Neonatal* , 49,126-134
- Uba, A.F., Chirdan, L.B., Ituen, A.M., Mohammed, A.M. (2007). Typhoid intestinal perforation in children: A continuing scourge in a developing country. *Pediatric Surgery International* ,23,33

WHO (2002). Acute intussusception in infants and children. Incidence, clinical presentation and management: a global perspective. *Geneva: World Health Organization. Document WHO/V & B/02 (19) 1–98.*

## **APPENDICES**

### **Appendix 1: Consent and Assent**

#### **Consent for inclusion in the study: Explanation**

My name is Dr Shazim Harunani and I am studying for a higher degree in surgery at the Moi university. My work place is at Moi teaching and referral hospital. In order to improve the care we provide to patients, there is need to evaluate how the patients we treat respond to the care given. I am conducting one such evaluation to find out how children treated for abdominal surgical emergencies respond to the treatment at MTRH. To conduct this evaluation, I have to collect some information from the patients who are being treated for this condition. This information will consist of your age and gender, duration of your illness, what the doctors found during the operation and what was done to correct the problem. During your hospital stay, I will visit you again to see how you respond to the treatment you receive until you leave hospital. I will not release the information I gather from you to any other persons and neither will I interfere with the treatment you are receiving. Your participation in this evaluation will be voluntary and should you choose not to be included, the treatment you are getting will not be interfered with in any way. If you agree to be included in this evaluation, please sign the section below.

**CONSENT**

I .....confirm that the purpose of this study and my role have been well explained to me by Dr Shazim Harunani. I agree to the conditions explained and give consent to be included, or for.....who is my dependant by virtue of being a minor or unable to consent.

Name.....

Sign.....

IP No.....

Witness .....

Sign.....

Date.....

Contact: Dr Shazim Harunani

Telephone number: 0721 473 844

**ASSENT**

I .....confirm that the purpose of this study and my role have been well explained to me by Dr Shazim Harunani. I, being a minor, agree to the conditions explained and give assent to be included in this study.

Name.....

Sign.....

IP No.....

Witness .....

Sign.....

Date.....

Contact: Dr Shazim Harunani

Telephone number: 0721 473 844

**Appendix 2: Data Collection Sheet****Data collection sheet****Code.....**

1. IP NO.....

2. Age .....

3. Sex: Male  Female 

4. Referral status.....

5. Preoperative duration of symptoms.....

<24hrs: 24-48hrs: 48-72hrs: 72hrs-1wk: >1wk: 

6. Symptoms

Vomiting: Yes  No Abdominal pain: Yes  No Hotness of body: Yes  No Constipation: Yes  No Bloody stool: Yes  No 

7. Signs

Dehydration: Yes  No Severity: mild  moderate  severe Pallor: Yes  No Abdominal distension: Yes  No Abdominal tenderness: Yes  No  generalized  localized Abdominal mass: Yes  No  If yes, where.....Peritonitism: Yes  No 

DRE finding.....



8. Reason for late presentation (>24hrs).....

Lack of money:

Referral system:

Managed elsewhere:

Traditional medicine:

Transport:

Unawareness:

Others:  if yes, state .....

9. Pulse on admission.....

Blood pressure on admission.....

10. Creatinine.....

11. Urea.....

12. Electrolytes.....

13. Hb.....

14. WBC.....

15. ASA classification.....

16. Radiology: Yes  No . If yes, findings.....

17. Suspected diagnosis.....

18. Preoperative stabilisation

Fluids..... How much.....

Anaesthetics: Yes  No . If yes which one .....

Empirical antibiotic: Yes  No . If yes which one .....

19. Surgical operative management:

Procedure done.....

Findings.....

Final diagnosis.....

20. Neoplasia suspected: Yes  No

If yes, histological findings: Ca  Benign

21. Postoperative complications Yes  No .if yes, which

.....

22. Duration of hospital stay: .....

23. Mortality: Yes  No

24. Follow up: Yes  No  if yes, state condition.....

If yes, any complications.....

### Appendix 3: Normal ranges

#### Normal ranges for WBC and Hb

Age	normal WBC count	normal HB count
Birth-1 week	9.0-30.0 x 10 <sup>(9)</sup> /L	13.5-22.0 g/dL
1 week-1 month:	5.0-20.0 x 10 <sup>(9)</sup> /L	12.5-21.0 g/dL
1-5 months:	5.0-15.0 x 10 <sup>(9)</sup> /L	10.0-14.0 g/dL
>5 months	4.0-11.0 x 10 <sup>(9)</sup> /L	11.0-14.0 g/dL

#### Normal heart rate (beats/minute)

Age	Awake Rate	Sleeping Rate
Neonate (<28 d)	100-205	90-160
Infant (1 mo-1 y)	100-190	90-160
Toddler (1-2 y)	98-140	80-120
Preschool (3-5 y)	80-120	65-100
School-age (6-11 y)	75-118	58-90
Adolescent (12-15 y)	60-100	50-90

**Appendix 4: ASA Classification**

<b>ASA Class</b>	<b>Clinical state at the time of surgery</b>
ASA I	Normally healthy patient
ASA II	Mild systemic disease
ASA III	Severe systemic disease that limits activity but not incapacitating
ASA IV	Incapacitating systemic disease which poses a constant threat to life
ASA V	Moribund: not expected to survive 24h even with operation
ASA VI	A declared brain dead patient whose organs are being removed for donor purposes

\*A prefix E is used in emergencies.

**Appendix 5: Work Plan**

<b>Activity</b>	<b>Duration</b>
Selection of topic –In December 2014	2 months
Literature review –In February 2014	3 months
Writing proposal – In May 2014	1 month
Submission to IREC – In June 2014	1 month
Approval by IREC-In September 2014	1 month
Data collection-In January 2015	12 months
Writing the thesis report-In June 2016	12 months
Submission of thesis	1 month
Oral defense of thesis	

**Appendix 6: Budget**

<b>Code</b>	<b>Item</b>	<b>Cost (Kshs)</b>
1	Six Reams of plain and ruled paper @ 500	3,000.00
2	Pens, pencils, folder and other stationery	2,000.00
3	Two Computer Flash discs	5,000.00
4	Printing research proposals	5,000.00
5	Printing thesis, four copies	5,000.00
6	Binding thesis	3,000.00
7	Research assistant	15,000.00
8	I.R.E.C. fee	1,000.00
9	Data handling	20,000.00
10	Miscellaneous	5000.00
11	Add 10% contingency	6700.00
	<b>TOTAL</b>	<b>70,700.00</b>

## Appendix 7: IREC Approval



MOI TEACHING AND REFERRAL HOSPITAL  
P.O. BOX 3  
ELDORET  
Tel: 334711029  
Reference: IREC/2014/129  
**Approval Number: 0001277**



MOI UNIVERSITY  
SCHOOL OF MEDICINE  
P.O. BOX 4606  
ELDORET  
22<sup>nd</sup> September, 2014

Dr. Shazim M. Harunani,  
Moi University,  
School of Medicine,  
P.O. Box 4606-00200,  
**ELDORET-KENYA.**



Dear Dr. Harunani,

**RE: FORMAL APPROVAL**

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

***"Causes and Outcomes of Non-Traumatic Abdominal Surgical Emergencies in Children at Moi Teaching and Referral Hospital."***

Your proposal has been granted a Formal Approval Number: **FAN: IREC 1277** on 22<sup>nd</sup> September, 2014. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 21<sup>st</sup> September, 2015. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

**PROF. E. WERE**  
**CHAIRMAN**

**INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE**

cc	Director - MTRH	Dean - SOP	Dean - SOM
	Principal - CHS	Dean - SON	Dean - SOD

## Appendix 8: MTRH Approval



### MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4  
 Fax: 61749  
 Email: director@mtrh.or.ke

P. O. Box 3  
 ELDORET

Ref: ELD/MTRH/R.6/VOL.II/2008  
 Dr. Shazim M. Harunani,  
 Moi University,  
 School of Medicine,  
 P.O. Box 4606-00200,  
**ELDORET-KENYA.**

22<sup>nd</sup> September, 2014

#### **RE: APPROVAL TO CONDUCT RESEARCH AT MTRH**

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:

***"Causes and Outcomes of Non-Traumatic Abdominal Surgical Emergencies in Children at Moi Teaching and Referral Hospital."***

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

  
**DR. JOHN KIBOSIA**

**DIRECTOR**  
**MOI TEACHING AND REFERRAL HOSPITAL**

CC - Deputy Director (CS)  
 - Chief Nurse

