College of Medicine and Health Sciences

School of Medicine and Pharmacy

EPIDEMIOLOGICAL STUDY OF PERITONITIS IN PEDIATRIC POPULATION AND FACTORS PREDICTING MORTALITY. CASE OF CHUK.

Submitted in partial fulfillment of the requirements for the award of the Degree of Master of Medicine in General Surgery at University of Rwanda.

By Dr MUTABAZI Emmanuel

Supervisors: Dr Alex Bonane.

Dr Ndibanje Alain Jules.

Kigali, June 2016

DECLARATION

Researcher:

I hereby declare that this dissertation: "Epidemiological study of peritonitis in pediatric population and factors predicting mortality. Case of CHUK" is my own work and has not been submitted to any university in Rwanda for the award of any degree.

Signed  Date …03th August 2016

Dr MUTABAZI Emmanuel

Supervisor:

I hereby declare that this dissertation has been submitted with my approval as the supervisor.

Signed  Date 03th August 2016

Dr Alex BONANE

ACKNOWLEDGEMENTS

My gratitude goes first to my supervisor, Dr Alex BONANE for his continuous support and meticulous guidance from the initial steps of this work.

My second thanks go to Dr Alain Jules NDIBANJE for his scientific enthusiasm from the time he accepted to co-supervise this dissertation. His encouragements, availability and guidance express a high level of teaching skills and mentorship.

Special thanks go to Dr Georges NTAKIYIRUTA, the academic head of surgical department, who judged me to be fit for Surgery. His deep knowledge of general surgery and his willingness to strengthen the UR postgraduate program in surgery improved it from far to where it is now.

To you Drs Robinson SSEBUUFU, Ahmed KISWEZI, Rashna GINWALLA, Michael KURCI with your advices, encouragements and push I succeeded to decide my destiny.

I take this opportunity to thank the whole team of the department of surgery at CHUK through Dr Faustin NTIRENGANYA the head of department and general surgery program coordinator, your effort to guide and help us day to day has been a great experience and has made our dreams a reality.

A particular note of thanks goes to Dr Innocent NZEYIMANA and Dr KARENZI Irene David for their help throughout the different steps of this work. Without your help, this work would not have been completed.

To you, members of my family, my wife Dr Marie Grace UWIMANA, our daughters Ange Henriette IRADUKUNDA and Louange Ghisrraine ISHIMWE. Your love supported me, and stimulated my progress to success.

Last but not least, thanks to you, parents, brothers and sisters, friends and good wishers, we have got blessings to come over this hard way.

For all of you, cited or not cited herewith, find true recognition of your love and commitment.

Dr Emmanuel MUTABAZI

DEDICATION

To the memory of my brother USHIZIMPUMU Fidele, even though you couldn't be there with me through my surgical training or walk down the way I have chosen, you were always my inspiration and my guide in striving for excellence.

To you Mother for your love patience and hard work.

To you my brother Desire NKURUNZIZA, sisters and friends for your help and encouragements.

To you my beloved wife Dr Marie Grace UWIMANA and our daughters: Ange Henriette IRADUKUNDA and Louange Ghisrraine ISHIMWE.

This work is dedicated.

ABSTRACT

Background: Peritonitis in children is a life threatening surgical condition requiring prompt and adequate surgical management. The knowledge of its common causes and factors linked with its morbidity and mortality may contribute to early recognition of patients in need of special care.

Objectives: This study aims at identifying common causes of peritonitis in children and factors affecting morbidity and mortality.

Methods: A prospective observational study was done on 63 patients operated for peritonitis from 1st September 2015 to 28th February 2016 at CHUK.

Results: Of 63 patents, 35 were male and 28 female, sex ratio (M: F) was 1.25:1. The age ranged from 4 months to 15 years, the mean was 8.8 years. 73% of patients presented within the first week of symptom onset. 14 of 63 died (22.2%); 2 died on table; 6 died of sepsis in ICU settings and 6 of post operative respiratory problems. 4 of 6 patients (66.7%) who had traumatic small bowel perforation died.

Appendicular perforation (25.4%) and gangrenous intussusceptions (23.8%) were the common causes of peritonitis. 60.3% were operated after 24 hours of admission. 74.6% of morbidity and 22.2% mortality were registered. The principal operator; symptom duration; post operative ICU admission and septic shock were potential predictors of mortality. ($p<0.05$)

Conclusion: Peritonitis in children is a life threatening surgical emergency at CHUK, bearing a significant morbidity and mortality. A wide variety of factors are linked significantly with the overall outcome. Efforts need to be put in reducing the delayed presentation, improving survival of trauma related peritonitis by providing care providers at different levels with regular training in terms of trauma management and ICU inputs to improve recovery for this particular group of patients.

LIST OF ABBREVIATIONS

BP: Blood pressure

CD4: Cluster of differentiation 4

CHUK : centre hospitalier universitaire de Kigali

CMHS: College of medicine and health sciences

CRP: C-reactive protein

CT: Computed tomography

ESR: Erythrocyte sedimentation rate

FBC: Full blood count

GI: Gastro intestinal

GIT: Gastrointestinal tract

Hb: Hemoglobin

Hg: Mercury

HID/AIDS: Human immunodeficiency disease/ Acquired immune deficiency syndrome

IRB: Institutional review board

IO: Intestinal obstruction

LOS: Length of stay

MOH: Ministry of Health

ºC: Degree centigrade

PaCO2: Partial arterial pressure of carbon dioxyde

PID: Pelvic inflammatory diseases

PMNL: Polymorpho nucleic leucocytes

Rwf: Rwandan francs

SBP: Spontaneous bacterial peritonitis.

SIRS: Systemic inflammatory response syndrome

TB: Tuberculosis

UR: University of Rwanda

WBC: White blood count

LIST OF TABLES.

LIST OF FIGURES

TABLE OF CONTENTS

I. INTRODUCTION

I.1. Background

Despite a better understanding of pathophysiology, as well as advances in diagnosis, surgery, antimicrobial therapy and intensive care support, peritonitis remains a potentially fatal condition. Severe bacterial peritonitis following gastrointestinal tract (GIT) perforation carries high morbidity and mortality. [1]

Contamination of the peritoneal cavity can lead to a cascade of infection, sepsis, multisystem organ failure and death if not treated timely and efficiently [3, 4]. The diagnosis is often delayed or even missed, so that many patients deteriorate and develop septic shock and organ failure. Successful management of peritonitis is aimed at timely surgical intervention to control or to eliminate the source of the intra-abdominal infection and to decrease the contamination of the peritoneal cavity, along with appropriate antimicrobial therapy. Various surgical interventions may be performed, depending on the source of the infection, the severity of peritoneal contamination and inflammation, the degree of septic deterioration, and the patient's previous state of health [2].

Even with ideal treatment there is high morbidity and mortality (ranging from 10 to 20%) resulting from peritonitis. [6, 7]

The etiology of peritonitis in adults in developing countries tends to be different from that in western countries. Whereas in high-resource settings peritonitis most commonly occurs due to lower gastrointestinal (GI) perforations such as diverticulitis, in low-resource areas upper GI perforations, especially peptic ulcer perforations, are more common[14].On the other hand, less is known about whether the causes of peritonitis in the paediatric population differ in high versus low-resource settings.

For example, although certain clinical conditions, such as primary peritonitis and appendicitis, are found to be more common in children [5] it is unclear whether this is true throughout the world. In Rwanda specifically there is a paucity of data regarding the etiology of peritonitis in children.

I.2 . General considerations of peritonitis.

I.2.1. Definition

Peritonitis is referred to as inflammation of the peritoneum, the serosal lining of the abdominal cavity and its contained viscera, commonly due to generalized or localized infection.

I.2.2. Etiologies

The most common cause of peritonitis in the general population are:

- Perforated appendicitis
- Perforated duodenal ulcer
- Typhoid ileal perforations.
- Complications of pelvic inflammatory disease (PID) for women.
- Abdominal trauma resulting in intestinal injury.
- Perforated bowel obstruction.

With HIV/AIDS emergence tuberculous and primary (SBP) are known but are rarely found in the general population, the later being more prevalent in patients undergoing chronic peritoneal dialysis and with liver failure.

I.2.3. Pathophysiology

Injury results in an influx of protein rich fluid, activation of the complement cascade, up-regulation of peritoneal mesothelial cell activity and invasion of the peritoneum with polymorphonuclear neutrophils and macrophages. [12].

There is stimulation of cytokine and chemokine production. Bacteria are opsonized and killed by white blood cells and cleared through the lymphatics. The local consequences of this activation are the translocation of granulocytes from peritoneal capillaries to the mesothelial surface and a dilatation of peritoneal blood vessels resulting in enhanced permeability, peritoneal edema and lastly the formation of protein-rich peritoneal exudate. [13]

The first line of host defense is clearance of noxious agents via the lymphatics of the parietal peritoneum, diaphragm and omentum. The formation of fibrin acts to wall of the infection, it is associated with abscess formation. [15] The response to intra-abdominal infection depends on 5 key elements: inoculum size; virulence of the contaminating organisms; the presences of adjuvants within the peritoneal cavity; adequacy of local, regional, and systemic host defenses; and the adequacy of initial management. [16]

Inflammation within the peritoneal cavity induces a sequence of secondary changes that produce the clinical syndrome of peritonitis. These features are part of the Systemic Inflammatory Response Syndrome (SIRS), whose characteristics include two or more of the following: Temperature >38° C or <36° C; Heart rate >90 beats/min; Respiratory rate >20 breaths/min or Paco2 <32 mm Hg; WBC >12,000 cells/mm3 or <4000 cells/mm3. Severe sepsis denotes organ dysfunction distant from the site of infection [renal, cardiac, respiratory or brain] or hypotension [systolic < 90mm Hg or mean BP < 70 mm Hg]. Septic shock is sepsis with hypotension unresponsive to fluid administration and requiring vasopressors.

The acute inflammatory process within the abdomen results in sympathetic activation, and suppression of intestinal peristalsis, or ileus. Fluid absorption through the wall of the bowel is impaired, and significant amounts of tissue fluid may be sequestered within the lumen of the gut, resulting in systemic hypovolemia.

Moreover reduced intestinal peristalsis promotes microbial overgrowth, leading to translocation of bacteria and their products from the gut lumen into regional nodes, the peritoneal cavity, and the portal circulation. [17]

I.2.4. Diagnosis

I.2.4.1. Clinical features

The diagnosis of peritonitis remains mainly clinical. Appropriate information on past, medical, surgical, gynecological and familial history, as well as the history of the presenting complaint is paramount for accurate diagnosis. Physical examination is crucial and must include inspection, auscultation, percussion and palpation, in that order. Rectal, genital and, in women, pelvic examination should always be performed as well as that of extra-abdominal systems.

The first sign of peritoneal irritation is localized tenderness on deep palpation. With increasing severity the signs progress to voluntary guarding, involuntary guarding or rigidity. Rebound tenderness is a useful sign for localized peritoneal irritation. Generalized tenderness and board like rigidity are pathognomonic of generalized peritonitis.

I.2.4.2. Laboratory

Tests including Hb, WBC, urinalysis and, if available, basic biochemistry including electrolytes, amylase and liver function tests will be helpful.

I.2.4.3. Imaging

Routine 2 view examination of the supine and upright abdomen or chest x-rays are effective in diagnosing pneumoperitoneum. CT scan has no additional advantage on standard x rays as imaging in peritonitis.

I.2.5 Classification

Based on the mechanism, peritonitis is classified in 3 categories: primary, secondary and tertiary peritonitis.

I.2.5.1. Primary peritonitis or spontaneous bacterial peritonitis (SBP)

Results from spontaneous bacterial infection in the peritoneum, rarely requires any surgical treatment.

I.2.5.2. Secondary peritonitis

Secondary to GIT perforation resulting in contamination of the peritoneal cavity and bacterial colonization depending on the site of perforation.

I.2.5.3. Tertiary peritonitis

Characterized by a class of very ill patients in whom secondary peritonitis fails to resolve despite appropriate management and is associated with multi-organ failure.

I.2.6. Management

Adequate resuscitation, early antibiotics, source control and peritoneal lavage, are cornerstones of appropriate management of peritonitis.

Ressuscitation aiming at restoration of cardiac and pulmonary function recognized by normalization of blood pressure, urinary output and oxygen saturation through the prompt administration of supplemental oxygen and intravenous fluids, is critical to survival. These measures should be instituted immediately on initial assessment of the patient and continued throughout the operative and post-operative period.

I.2.6.1 Antibiotics

Even if antibiotics are necessary in the treatment of peritonitis, there is paucity of evidence to recommend one antibiotic regime over another. [25] Primary peritonitis is often mono-microbial while secondary peritonitis is usually polymicrobial with both gram-negative aerobes and anaerobes predominating. Antibiotics with adequate spectra to cover these organisms are recommended.

I.2.6.2. Peritoneal lavage

Some studies in the last 3 decades have questioned the use of peritoneal lavage post laparotomy for peritonitis, but most of them were lacking strong evidence. Thus, intra-operative lavage remains standard therapy. All fluid should be aspirated at the closure of the abdomen as there is evidence that the ongoing presence of fluid decreases macrophage efficiency. [24]

I.3. Problem statement

Peritonitis is one of the most serious surgical conditions commonly received at Accident and Emergency in developing countries and more especially in paediatric patients where the common causes are not well known, nor are the factors that can delay the prompt diagnosis and management plan [24]

This often delays the prompt diagnosis and management plan, resulting into increased morbidity and mortality associated with the condition in this fragile population.

We conducted a study which was intended to identify different causes of peritonitis in children, as well as the factors related to mortality and morbidity in this population in order to contribute to better diagnosis and management of peritonitis in this group of patients.

I.4. Research question

What are the etiologies of peritonitis in the Rwandese paediatric population, and what are the factors that are associated with an increased risk of mortality?

I.5. Study objectives

I.5.1. General objective

To study the causes, treatment, and outcome of pediatric patients with peritonitis in Rwanda, in order to identify key ways in which management and survival can be improved.

I.5.2. Specific objectives

1 .To identify different causes of peritonitis in children at CHUK.

2. To identify the treatments received by these children.

3. To assess the patients' in-hospital outcomes.

4. To demonstrate the association of mortality and its various predictors.

I.6. Significance of the study.

A wide variety of disease states give rise to intra-abdominal infection. While varying according to age, gender and geography, the three most common causes of generalized peritonitis in low-income countries in general population are probably appendicitis, perforated duodenal ulcer and typhoid perforations, in no particular order. [8] Similarly, a study of Nigerian children with peritonitis found that 50% of patients had typhoid perforation [9]

While in Rwanda one study showed peptic ulcer perforation and ileal typhoid perforation as the main causes of peritonitis in the general population [33]. However, the causes of peritonitis in Rwandan children have not been studied.

By reviewing the surgical database of the year 2014 (January to December) we found that among a total 695 abdominal surgeries done the whole year including emergencies and elective surgeries only 30 were done for peritonitis in children, representing 4.3%.[32]

The understanding of the main causes of peritonitis may assist in the early diagnosis in children, particularly because their history and clinical exam may have a little value compared to the counterpart adult population.

This may reduce the range of diagnostic investigations and the timeframe between admission and treatment initiation, hopefully reducing the associated morbidity and mortality and contributing to cost-effective health service delivery to our population.

Similarly, understanding the factors that are associated with poor outcomes following peritonitis may allow for earlier and more aggressive interventions in those patients who are at the highest risk, particularly for death.

II. LITERATURE REVIEW

The generalized surgical acute abdomen is a significant cause of morbidity and mortality among children. [9] The three most common causes of generalized peritonitis in low-income countries are probably appendicitis, perforated duodenal ulcer and typhoid perforations in general population, but still differences exist from country to country. [10] However, little evidence concerning causes of peritonitis in children is available.

Most studies discussing the etiologies and outcome of peritonitis were done for the general population, few of them with children consideration in Africa were found mainly from West Africa. [2, 9, 14, 33, 34, 35, 36]

II.1. Causes of peritonitis

There is a lot of controversies throughout the available literature concerning the common causes of peritonitis. The causes tend to differ from region to region or country to country.

Jeteender et al in India found the most common cause of peritonitis to be peptic perforation [9], the same as Sajid in Pakistan [2] while Ntirenganya in Rwanda found ileal perforation to be the most common cause of peritonitis[33] in the general population. These findings differ from results of Jonathan in Malawi in 190 patients operated for peritonitis in Kamzu referral hospital who found appendicular perforation to be the most common cause in the general population [36].

Controversies still exist in few studies done on peritonitis in children; Adesunkanmi [9] in Nigeria working on 69 children in Obafemi Owolowo teaching hospital from 1993 to 1997 found typhoid intestinal perforation the common cause of peritonitis in Nigeria. Similar results were found by Abantanga in Ghana in a study done in Komfo Anokye teaching hospital in Kumasi. However Osarumwense, even if in the same region and working on children, found appendicular perforation to be the most common cause [34].

II.2. Morbidity and mortality due to peritonitis

The generalized surgical acute abdomen is a significant cause of morbidity and mortality among children, ranging from 10 to more than 50% in some studies [9].

Many factors have been described as responsible for surgical morbidity and mortality of children who underwent laparotomy for peritonitis. These comprise delayed presentation, nature of operation, delayed diagnosis and management. [2, 37, 35,14] Age was generally not likely to influence significantly mortality[14,34], but Nuhu in Nigeria found children aged less than 11 years to be significantly vulnerable from peritonitis as compared to other age groups.[35]

The leading cause of death in paediatric peritonitis differs from site to site and from study to study, however, typhoid intestinal perforation has been found to be more lethal. [35, 37]

Our peritonitis paediatric patients may have the similar characteristics possibly associated with morbidity and mortality, however no data is available.

III. METHODOLOGY

III.1. Study design and setting

This study was a prospective descriptive observational study from 1st September, 2015 to 28th February, 2016.

The research was conducted in the Surgical Department at CHUK, one of the three major referral hospitals, with 170 surgical beds, six operative rooms and an emergency department receiving the majority of the surgical emergencies of the capital city of Kigali and from all over the country. For that high demand, the department has 9 general surgeons, 1 plastic surgeon and 1 urologist, combining both clinical and academic activities. The hospital has a varying number of foreign surgeons coming for teaching purposes and a varying number of medical officers. As any other teaching hospital, CHUK has a number of junior and senior residents in different surgical disciplines as well as medical and nursing students.

III.2. Study population

All pediatric surgical patients admitted and operated on with a pre or post-operative diagnosis of peritonitis at CHUK during the period of the study.

III.3. Selection criteria

Inclusion criteria:

All pediatric patients aged from 1 month to 15 years surgically managed for peritonitis.

Exclusion criteria:

Patients transferred in after undergoing laparotomies for peritonitis or other conditions outside CHUK or patients transferred to continue treatment related to peritonitis in other hospitals after surgery.

III.4. Sampling and sample size calculation.

Patients meeting the inclusion criteria were consecutively enrolled in the study until the sample size was achieved.

The sample size was calculated using the Fischer's formula considering the prevalence of peritonitis in CHUK at 4.3%.

$N= [\alpha^2*p*q]/ e^2$

Where N: Sample size

p: Estimated peritonitis prevalence in children estimated at 4.3% at CHUK

q:1-p

e: Precision, if confidence interval = 95%, e = 0.05

α: Relative error risk corresponding to 95% confidence interval.

Generally equals 1.96 for clinical studies.

Then, $N= [(1.96)^2*0.043*0.957]/(0.05)^2= 63$ patients.

III.5. Data collection and analysis

Data collection was done using a coded data sheet/questionnaire of variables under investigation (see Appendix). Data were recorded by the investigator himself. The investigator didn't influence in any case the treating surgeon in the management or discharge plan and didn't play a role in discussion of the management to anyone.

Patients were primarily admitted to CHUK either from pediatric emergency side or through the main accident and emergency unit of the hospital. From there initial assessment was always done, laboratory and imaging investigations were done as needed, and then the surgical team on day or night call was consulted for review and management.

If the diagnosis of peritonitis was established upon arrival of the surgical team, patients were optimized and brought to theatre for surgery. Patients were recruited in the study after postoperative diagnosis of peritonitis.

Data were initially extracted from the file of the patient and interview to the parents/guardians within the first 24 hours after surgery after identifying the operated patient's name in the surgical register.

Patients operated in absence of the researcher were traced using surgical register within the first 24 hours post operative.

At the initial visit, relevant data on history of symptoms, investigations done and results, pre and post-operative diagnosis, intraoperative findings, and definitive surgical procedure as per case notes were noted.

Variables recorded at this time included: age, sex, presenting symptoms and their duration, presenting vital signs, diagnosis on admission, preoperative diagnosis, investigations done and results (full blood count, urea, creatinine, electrolytes), post-operative diagnosis, and surgical procedure performed. For analysis, age groups were stratified basing on FDA(Food and Drug Administration guidelines). Patients were followed throughout their hospital stay in order to ascertain whether any complications occurred, and whether the patient survived to discharge.

Data were recorded using EpiData software and analyzed using Statistical Package of Social Sciences software, version 16.0.

Pearson's chi square was calculated to compare variables and a p value < 0.05 was considered statistically significant. A bivariate analysis was done to determine variables associated with an increased risk of morbidity and mortality. Variables with significant link were crossed with outcome variables including mortality and complications to draw their correlation with mortality and morbidity. Descriptive demographic data tables and cross tabulations were directly extracted from SPSS; charts and figures were obtained using SPSS or MS Office Excel 2007.

III.6. Study limitations

Being an observational study, we assumed that patients received adequate care in accordance with the diagnosis. However system related problems may have led to inadequate management thus contributing negatively to the outcome while these were not part of the study.

The constraints of study period compelled the researcher to be limited to short term outcome. Long term outcome may be a subject for another study in the future.

III.7. Ethical considerations

The research protocol obtained approval, respectively from the department of Surgery, research commission of the School of Medicine at the University of Rwanda and the ethical committee of CHUK. All the participants were required to sign an informed consent through their parents/ guardians. Participation in the study was voluntary, and wouldn't, in any case, affect the patients' management. The information obtained was treated confidentially, and only used for research purposes by the researcher.

IV. RESULTS

IV.1. Demographic characteristics

In total 64 patients meeting the admission criteria were found during the period of study. 1 of them was excluded as he was not yet discharged at the end of the study period, thus we had in total 63 patients corresponding to the sample size. The patients' age was ranging between 4 months and 15 years with a mean of 8.83±5.18 years and the mode was 15 years.

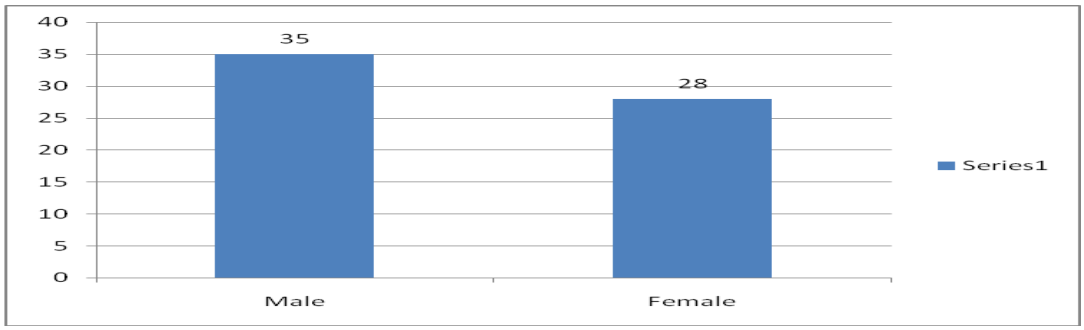
35 of them (55.6%) were male while 28 (44.4%) were female with a sex ratio M: F of 1.25:1.

Table 1 Distribution according to age

Age groups	Frequency	%
>1month to 2 years	10	15.9
>2 to 12 years	33	52.4
>12 to 15 years	20	31.7
Total	63	100.0

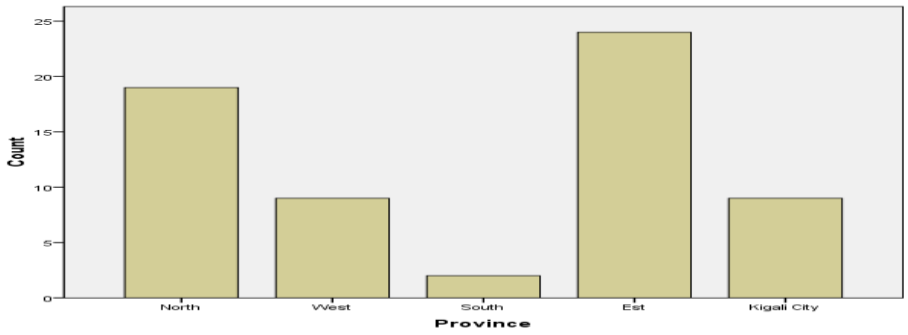
Most patients (52.4%) were in children age range (2 to 12years). The minimum age was 4 months, maximum 15 years with a mean of 8.83±5.18 years; the median age was 10 years, while the mode was 15 years.

Figure 1: Distribution according to sex



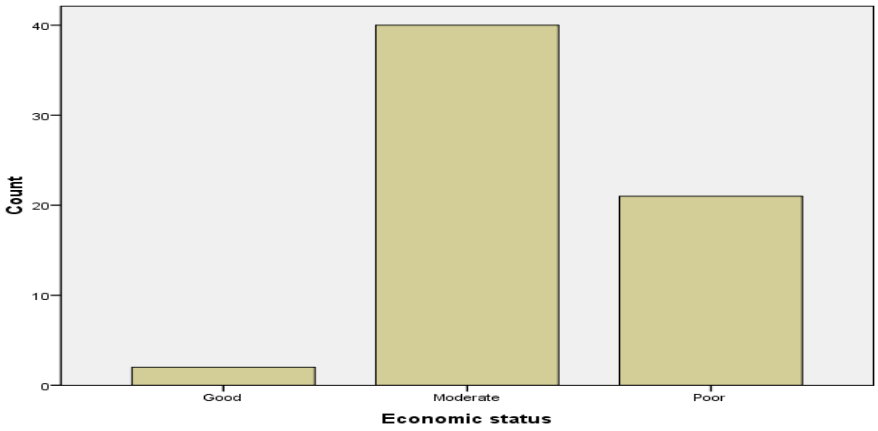
35 of 63(55.5%) of the sample were male while female were 28(45.5%)

Figure 2: Distribution according to the Province of residence



24 patients (38.1%) came from East, 19(30.2%) from North, 9(14.3%) from West and Kigali city each, only 2 (3.2%) came from South. Patients were coming from 22 of 30 districts in all 5 provinces of the country: Nyagatare (in East) and Gakenke (in North) had 8 (12.7%) each, Rubavu District in West had 6 (9.5%).

Figure 3: Distribution according to the economic status

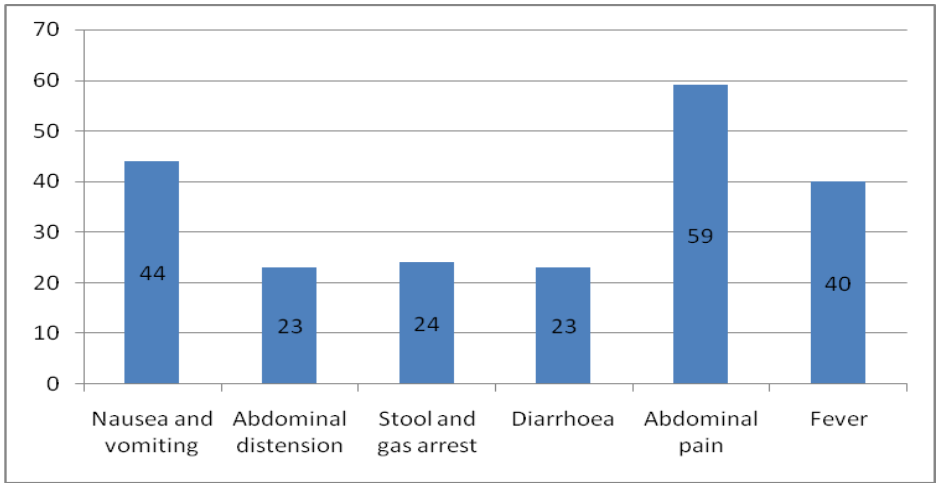


40 patients (63.5%) were from middle income families, 21 (33.3 %) from low income and 2 (2.2 %) from better income families respectively.

IV.2. Clinical presentation

IV.2.1. Symptoms

Figure 4: Distribution according to symptoms at admission



Abdominal pain/tenderness in 59(93.7%); nausea and vomiting reported in 44(69.8%); fever was present in 40 patients (63.5%); constipation in 24(38.1%); abdominal distension in only 23(36.5%).

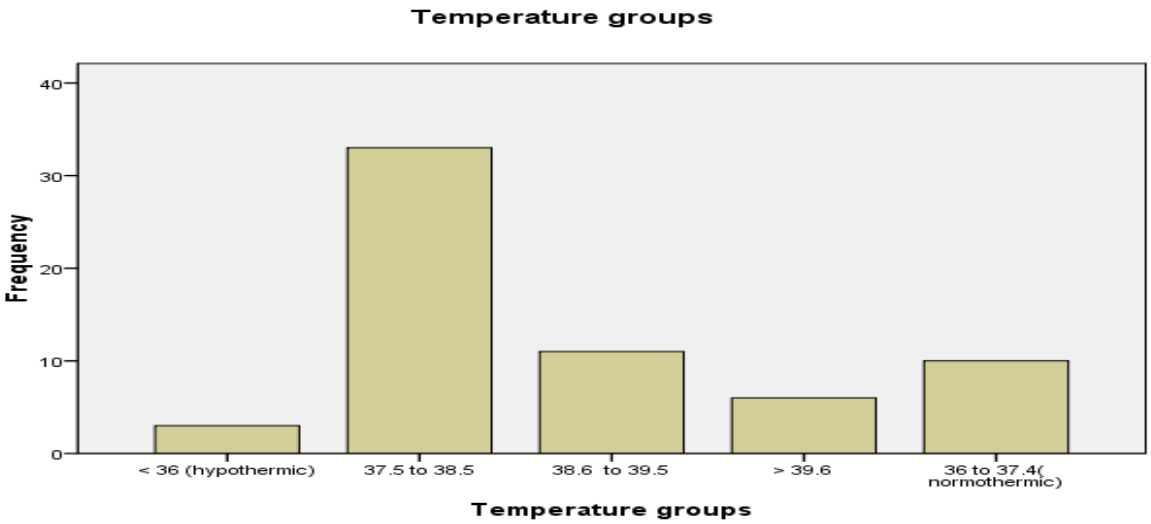
Table 2: Distribution according to symptom duration

Symptoms duration	Frequency	%
1 to 7 days	46	73.0
> 7 days	17	27.0
Total	63	100.0

The pretransfer symptom duration ranged from 1 to 28 days with a mean of 7.38±6.45 days. 73% of patients presented at CHUK within the first week of symptoms onset and 27% after 1 week.

IV.2.2. Vital signs

Figure 5: Temperature at admission



45 patients (71.4%) presented with abnormal temperature (fever or hypothermia) whilst 18(28.6%) exhibited normal temperature. Grouped in ranges hypothermia (<36ºC) was found in 3 patients (4.8%); 36.1 to 37.4ºC found in10 (15.9%); 37.5 to 38.5ºC found in 33 (33%) 38.6 to 39.5ºC found in 11% and 6 patients (9.5%) had > 39.5ºC.

Blood pressure and heart rate: Only 36.5% presented with hypotension while considering the systolic blood pressure at different age groups, 81% presented with tachycardia.

IV.2.3. Laboratory findings

Leucocytosis/leucopenia was found in 79.4% of cases; 44% were found to have anemia; 14.3% with hemoconcentration probably secondary to dehydration; 41.3% had normal hemoglobin.

No case of renal failure found with reference to creatinine level, platelets were all in normal range.

25.4% had low Na level, 41.3% had low K level and 36.5% had low chloride level. HIV serology was negative in 57.1% of our sample, in 42.9% the serology was unknown due to the fact that the test is not systematically done preoperatively in CHUK.

IV.2.4. Diagnosis

The right diagnosis of peritonitis was done preoperatively in only 60.3% of cases whereas it was done post operatively in 40% of cases.

Appendicitis was the disease most commonly complicated by bacterial peritonitis(25.4%), followed by perforated intussusceptions in 15 patients(23.8%) and typhoid ileal perforation and perforated traumatic or obstructed ileum with 11(17.5%) and 6(9.5%) respectively, whereas the least common cause of peritonitis was the liver or biliary origin(3.2%).

Table 3 : Distribution according to the cause of peritonitis

Causes of peritonitis	**Frequency**	**%**
Appendix perforation	16	25.4
Perforation of gangrenous ileal obstruction	6	9.5
Gangrenous intussusceptions	15	23.8
Traumatic ileal perforation	6	9.5
Liver/biliary empyema	2	3.2
PID	3	4.8
Primary peritonitis	4	6.3
Typhoid ileal perforation	11	17.5
Total	**63**	**100.0**

Appendicular perforation(25,4%), Gangrenous intussusceptions(23.8%) and Typhoid ileal perforation(17.5%) were the first on the list to cause peritonitis, while trauma and primary peritonitis were responsible for 9.5% and 6.3% respectively.

IV.2.5. Management

Patient waiting period to be operated ranged from 1 to 120 hours of admission to CHUK with a mean of 23.29±20.24 hours. 60.3% were operated after 24 hours post admission in CHUK.

Table 4 : Distribution according to time elapsed between admission and surgery

Surgery delay	**Frequency**	**%**
Surgery performed before 24 hours	25	39.7
Surgery performed after 24 hours	38	60.3
Total	**63**	**100.0**

Most patients (60.3%) got operated after 24 hours of admission to CHUK. 63.5% of operations were done during night calls, performed by senior residents in 76.2%, general or pediatric surgeon in 20.6% and by a junior resident in 3.2% of cases respectively.

Table 5: Distribution according to the time of surgery

Time of surgery	**Frequency**	**%**
Day time	23	36.5
Night duty	40	63.5
Total	**63**	**100.0**

63.5% of patients were operated during the night call.

Table 6 : Distribution according to the operator

Principal operator	**Frequency**	**%**
General/pediatric surgeon	13	20.6
Senior resident	48	76.2
Junior resident	2	3.2
Total	**63**	**100.0**

In 76.2% the principal operator was a senior resident either PGY III or PGY IV. 74.6% of surgery done consisted either of laparotomy/perforation repair and lavage or resection/anastomosis and lavage. Stomas were done in 9.5% of cases. Post operatively antibiotics were prescribed for therapeutic purpose in 81% and 29% as prophylaxis.

Table 7: Distribution according to post operative antibiotic use

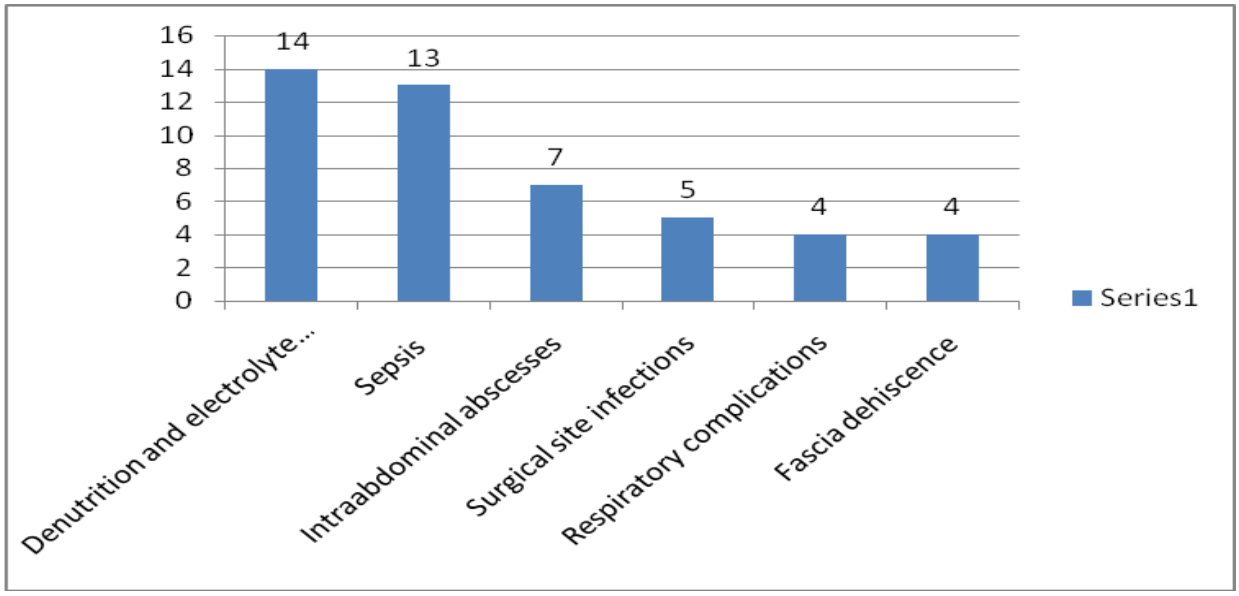
Post operative antibiotic use	Frequency	%
Antibioprophylaxis	12	19.0
Antibiotherapy	51	81.0
Total	**63**	**100.0**

81% of patients got antibiotics in terms of antibiotherapy postoperatively.

IV.2.6. Complication

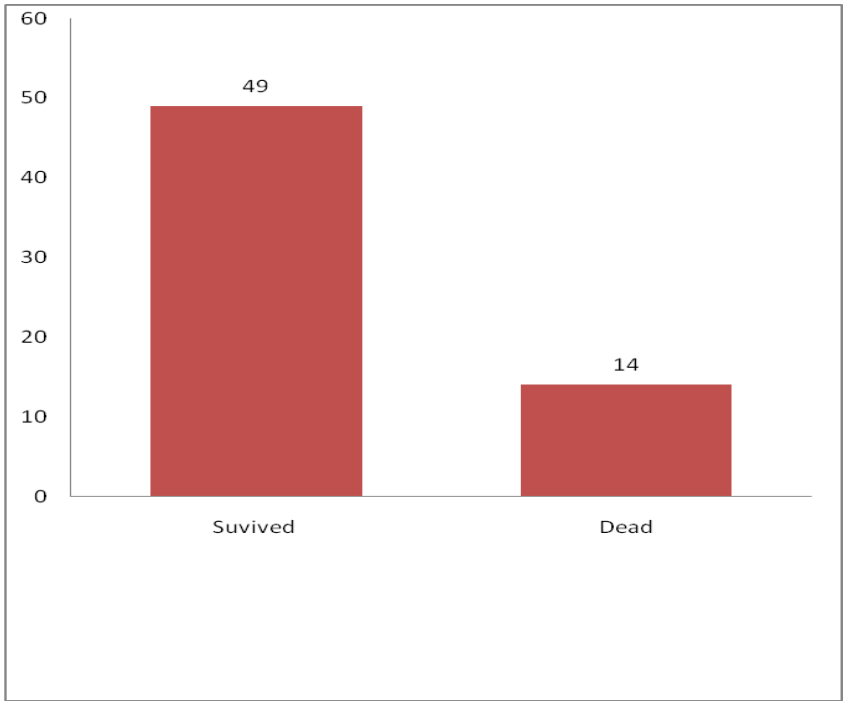
Complications occurred in 74.6% of cases with 29.8% of denutrition and electrolyte imbalance; 27.6% of sepsis and septic shock; 10.6% of surgical site infection; 8.5% of respiratory complications and fascia dehiscence as well. Re-laparotomy for compliactions was performed in 8(12.7%) in the whole post operative course. 14/63 (22.2%) cases of deaths were registered, 2 died on table, 6 died of sepsis in ICU settings and 6 died of post operative respiratory problems.

Figure 6: Distribution according to complications occurred



Denutrition and electrolyte imbalance was the most registered complication(29.8%) ; followed with sepsis and septic shock(27.6%); surgical site infection(10.6%); then respiratory complications and fascia dehiscence(8.5%).

Figure 7: Distribution according to mortality



14 deaths (22.2%) were registered among whom 8(57.1%) have been admitted in ICU postoperatively. 2 of them died on table; 8 died of sepsis in ICU settings and for the remaining 4 the cause of deaths was due to respiratory infections postoperatively.

Table 8: Distribution of mortality according to the cause of peritonitis

Cause of peritonitis	Deaths registered	%
Traumatic ileal perforation	4	**28.6**
Perforated gangrenous ileal obstruction	3	21.4
Gangrenous intussusception	3	21.4
Appendix perforation	2	14.3
Typhoid ileal perforation	2	14.3
Liver/biliary empyema	0	0
Primary peritonitis	0	0
PID	0	0
Total	**14**	**100**

Trauma caused more mortality than other causes of peritonitis: 4 of 6 patients died representing 28.6% of overall mortality and 66.7% of mortality within trauma patients.

IV.2.7. Length of stay

The length of stay varied between 1 and 28 days with a mean of 12.14±5.736 days. 44.4% were hospitalized for 8 to 14 days; 34.9% for > 15 days while 20.6% stayed between 1 and 7 days.

Table 9 : Distribution according to LOS

Length of stay	Frequency	%
1 to 7 days	13	20.6
8 to 14 days	28	44.4
>15 days	22	34.9
Total	**63**	**100.0**

44.4% had a LOS of 8-14 days 34.9% the LOS of >15 days and 20.6% a LOS of 1 week or less.

IV.3. Analysis

IV.3.1. Relationship between age and cause of peritonitis

Table 10: Correlation of age and cause of peritonitis

Cause of peritonitis	Age groups			Total
	>1month to 2	>2 to 12	>12 to 15	
Appendix perforation	1	9	6	16
	6.2%	56.2%	37.5%	100.0%
Perforation of gangrenous obstructed SB	1	3	2	6
	16.7%	50.0%	33.3%	100.0%
Gangrenous intussusception	8	7	0	15
	53.3%	46.7%	.0%	100.0%
Traumatic hollow viscus perforation	0	6	0	6
	.0%	100.0%	.0%	100.0%
Liver/biliary empyema	0	0	2	2
	.0%	.0%	100.0%	100.0%
PID	0	1	2	3
	.0%	33.3%	66.7%	100.0%
Primary peritonitis	0	3	1	4
	.0%	75.0%	25.0%	100.0%
Typhoid ileal perforation	0	4	7	11
	.0%	36.4%	63.6%	100.0%
Total	10	33	20	63
	15.9%	52.4%	31.7%	100.0%

Age was found to be significantly associated with the cause of peritonitis with most intussusceptions below the age of 2 years and most TIP and PID at above 10 years of age.(p=0.001)

IV.3.2. Bivariate analysis

Bivariate analysis was done to identify factors significantly linked with an increased risk of morbidity (post operative complications) and mortality and found the following:

Table 11: Variables associated with mortality (bivariate analysis).

	Score	df	Sig.
SYMPTOM DURATION	5.699	1	.012
PRINCIPLE OPERATOR	5.248	1	**.013**
PRESENCE OF NAUSEA AND VOMITING	6.222	1	**.012**
SEPSIS AS COMPLICATION	20.942	1	**.000**
POST OP ICU ADMISSION	14.649	1	**.000**

Table 12: Principal operator and complication occurrence (p=0.023)

Principal surgeon	**Complication occurrence**		**Total**
	Yes	**None**	
General/pediatric surgeon	2	11	13
	6.5%	34.4%	20.6%
Senior resident	28	20	48
	90.3%	62.5%	76.2%
Junior resident	1	1	2
	3.2%	3.1%	3.2%
Total	31	32	63
	100.0%	100.0%	100.0%

90.3% of patients who got complications were operated by senior residents; only 6.5% were operated by a general or pediatric surgeon. ($p<0.05$)

Table 13: Correlation of the cause of peritonitis and length of stay (p=0.030).

Cause of peritonitis	**Length of stay**			**Total**
	1 to 7 days	8 to 14 days	>15 days	
Appendix perforation	2	8	6	16
	12.5%	50.0%	37.5%	100.0%
Perforation of gangrenous obstructed small bowel	2	4	0	6
	33.3%	66.7%	.0%	100.0%
Gangrenous intussusception	5	5	5	15
	33.3%	33.3%	33.3%	100.0%
Traumatic hollow viscus perforation	3	2	1	6
	50.0%	33.3%	16.7%	100.0%
Liver/biliary empyema	0	1	1	2
	.0%	50.0%	50.0%	100.0%
PID	0	2	1	3
	.0%	66.7%	33.3%	100.0%
Primary peritonitis	0	4	0	4
	.0%	100.0%	.0%	100.0%
Typhoid ileal perforation	1	2	8	11
	9.1%	18.2%	72.7%	100.0%
Total	13	28	22	63
	20.6%	44.4%	34.9%	100.0%

Peritonitis secondary to typhoid ileal perforation was found to be more associated with the longer length of stay 72.75 as compared to other causes of peritonitis in pediatric population (p=0.030)

Table 14: Pulse rate status and Complication occurrence (p=0.002)

Pulse rate status	**Complication occurrence**		**Total**
	Yes	None	
Normal	1	11	12
	3.2%	34.4%	19.0%
Tachycardia	30	21	51
	96.8%	65.6%	81.0%
Total	31	32	63

96.8% of patients who got complications post operatively had tachycardia at admission. (p<0.05)

Table 15: Postoperative ICU admission and complication occurrence (p=000)

Post operative ICU admission	**Complication occurrence**		**Total**
	Yes	**None**	
Yes	12*(38.7%)*	1*(3.1%)*	13*(20.6%)*
No	19*(61.3%)*	31*(96.9%)*	50*(79.4%)*
Total	31*(100.0%)*	32*(100.0%)*	63*(100.0%)*

96.9% of patients who had no post operative complications have had post operative recovery without ICU requirement. p<0.05)

Table 16: Symptom duration and complication occurrence (p=0.009)

Pretransfer symptoms duration groups	**Complication occurrence**		
	Yes	**None**	**Total**
1 to 7 days duration	18	28	46
	39.1%	60.9%	100.0%
> 7 days duration	13	4	17
	76.5%	23.5%	100.0%
Total	31	32	63
	49.2%	50.8%	100.0%

76.5% of patients who had postoperative complications were admitted after 7 days of symptoms onset. (p<0.05)

Table 17: Cause of peritonitis and complication occurrence (p=0.046)

Per operative diagnosis	**Complication occurrence**		**Total**
	Yes	None	
Appendix perforation	5*(31.2%)*	11*(68.8%)*	16*(100.0%)*
Gangrenous obstructed SB perforation	2*(33.3%)*	4*(66.7%)*	6*(100.0%)*
Gangrenous intussusception	8*(53.3%)*	7*(46.7%)*	15*(100.0%)*
Traumatic hollow viscus perforation	4*(66.7%)*	2*(33.3%)*	6*(100.0%)*
Liver/biliary empyema	0*(.0%)*	2*(100.0%)*	2*(100.0%)*
PID	1*(33.3%)*	2*(66.7%)*	3*(100.0%)*
Primary peritonitis	1*(25.0%)*	3*(75.0%)*	4*(100.0%)*
Typhoid ileal perforation	10*(90.9%)*	1*(9.1%)*	11*(100.0%)*
Total	31*(49.2%)*	32*(50.8%)*	63*(100.0%)*

Patients with peritonitis post TIP were the most to develop post operative complications (90.9%) followed by traumatic intestinal perforation (66.7%) ($p<0.05$)

Table 18: Nausea/vomiting and complication occurrence (p=0.041)

Nausea and/or vomiting	**Complication occurrence**		**Total**
	Yes	None	
Yes	18	26	44
	58.1%	81.2%	69.8%
No	13	6	19
	41.9%	18.8%	30.2%
Total	31	32	63
	100.0%	100.0%	100.0%

Patients who had nausea and vomiting as symptoms at admission were the most to develop post operative complications (58.1%) ($p<0.05$)

Table 19: LOS and antibiotic use (p=0.018)

Antibiotic use	**Length of stay**			**Total**
	1 to 7 days	8 to 14 days	>15 days	
Antibioprophylaxis	6	4	2	12
	46.2%	14.3%	9.1%	19.0%
Antibiotherapy	7	24	20	51
	53.8%	85.7%	90.9%	81.0%
Total	13	28	22	63
	100.0%	100.0%	100.0%	100.0%

Patients treated with antibiotherapy were the ones to have a longer LOS as compared to their antibioprophyaxis counterparts. ($p<0.05$)

Table 20: Province and LOS (p=0.046)

Province	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
North	8	8	3	19
	61.5%	28.6%	13.6%	30.2%
West	0	4	5	9
	.0%	14.3%	22.7%	14.3%
South	0	2	0	2
	.0%	7.1%	.0%	3.2%
Est	4	10	10	24
	30.8%	35.7%	45.5%	38.1%
Kigali City	1	4	4	9
	7.7%	14.3%	18.2%	14.3%
Total	13	28	22	63
	100.0%	100.0%	100.0%	100.0%

Patients from Eastern province were the most to stay longer in hospital than others ($p<0.05$). Most of typhoid fever patients 35.3% were from the Eastern province and typhoid fever patients were the ones who stayed longer(>15 days) as compared to others (72.7%).

Table 21: Economic status and LOS (p=0.014)

Economic status	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
Good	0	2	0	2
	.0%	100.0%	.0%	100.0%
Moderate	7	13	20	40
	17.5%	32.5%	50.0%	100.0%
Poor	6	13	2	21
	28.6%	61.9%	9.5%	100.0%
Total	13	28	22	63
	20.6%	44.4%	34.9%	100.0%

Patients in poor economic condition were the most to have a longer LOS (61.9%) as compared to others. ($p<0.05$)

Table 22: Pretransfer symptom duration and LOS (p=0.035)

Pretransfer symptoms duration	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
1 to 7 days duration	12	22	12	46
	92.3%	78.6%	54.5%	73.0%
> 7 days duration	1	6	10	17
	7.7%	21.4%	45.5%	27.0%
Total	13	28	22	63
	100.0%	100.0%	100.0%	100.0%

Patients admitted within the first 7 days of symptoms onset were the ones to stay shorter in hospital post operatively(92.3%), this making early admission a factor of quick recovery.($p<0.05$)

Table 23: Fascia dehiscence and LOS (p=0.019)

Fascia dehiscence	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
Yes	0	0	4	4
	.0%	.0%	100.0%	100.0%
No	13	28	18	59
	22.0%	47.5%	30.5%	100.0%
Total	13	28	22	63
	20.6%	44.4%	34.9%	100.0%

All patients (100%) who had fascia dehiscence as complication had a prolonged LOS (>15 days) as compared to their counterparts. (p<0.05)

Table 24: Intraabdominal abscess and LOS(p=0.011)

Intaraabdominal abscesses	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
Yes	0	1	6	7
	.0%	14.3%	85.7%	100.0%
No	13	27	16	56
	23.2%	48.2%	28.6%	100.0%
Total	13	28	22	63
	20.6%	44.4%	34.9%	100.0%

85.7% of patients who had intraabdominal absce as complication had a long LOS, making this a factor of poor prognosis for recovery in post operative course. (p<0.05)

Table 25: Denutrition/electrolyte imbalance and LOS(p=0.003)

Denutrition and electrolyte imbalance	Length of stay			Total
	1 to 7 days	8 to 14 days	>15 days	
Yes	0	4	10	14
	.0%	28.6%	71.4%	100.0%
No	13	24	12	49
	26.5%	49.0%	24.5%	100.0%
Total	13	28	22	63
	20.6%	44.4%	34.9%	100.0%

71.4% of patients with denutrition and electrolyte imbalance as post operative complication stayed > 15 days in hospital. (p<0.05)

Table 26: Post operative ICU admission and outcome (p=0.001)

Post operative ICU admission	Treatment outcome		Total
	Cure	Death	
Yes	5	8	13
	10.2%	57.1%	20.6%
No	44	6	50
	89.8%	42.9%	79.4%
Total	49	14	63
	100.0%	100.0%	100.0%

89.8% of cured patients recovered from anesthesia without ICU requirement and 57.1% of deaths have been admitted in ICU postoperatively. ICU requirement post operatively predicts poor prognosis, while safe post anesthesia recovery was found to be a factor of good prognosis. (p<0.05)

Table 27 Symptoms duration and outcome (p=0.012)

Pre transfer symptoms duration	**Treatment outcome**		**Total**
	Cure	Death	
1 to 7 days duration	38	8	46
	82.6%	17.4%	100.0%
> 7 days duration	11	6	17
	64.7%	35.3%	100.0%
Total	49	14	63
	77.8%	22.2%	100.0%

There were more cure in patients admitted within the first week of symptoms onset (82.6%) and more deaths in the ones admitted after 7 days of symptoms onset(35.3%); this makes the longer pretransfer symptom duration a good predictor of the outcome.($p<0.05$)

Table 28: Nausea/vomiting and outcome (p=0.017)

Nausea and/or vomiting	**Treatment outcome**		**Total**
	Cure	Death	
Yes	38	6	44
	77.6%	42.9%	69.8%
No	11	8	19
	22.4%	57.1%	30.2%
Total	49	14	63
	100.0%	100.0%	100.0%

Most cured patients had nausea and vomiting symptom at admission (77.6%) ($p<0.05$) Nausea and vomiting was found in intestinal obstruction and intussusceptions causing peritonitis without massive fecal peritoneal spillage.

Table 29: Principal operator and outcome (p=0.013)

Principal surgeon	**Treatment outcome**		**Total**
	Cure	Death	
General/pediatric surgeon	13	0	13
	26.5%	.0%	20.6%
Senior resident	35	13	48
	71.4%	92.9%	76.2%
Junior resident	1	1	2
	2.0%	7.1%	3.2%
Total	49	14	63
	100.0%	100.0%	100.0%

100% of death cases (14/14) were operated by residents while all patients operated by a general or pediatric surgeon survived. This makes low operative skills a factor associated with an increased risk of mortality. ($p<0.05$)

Table 30: Sepsis and outcome (p=0.000)

Sepsis	**Treatment outcome**		**Total**
	Cure	Death	
Yes	4	9	13
	8.2%	64.3%	20.6%
No	45	5	50
	91.8%	35.7%	79.4%
Total	49	14	63
	100.0%	100.0%	100.0%

64.3% of deaths cases (9/14) had sepsis as postoperative complication, while 91.8% of cured patients (45/49) didn't have sepsis as complication. ($p<0.05$)

V. DISCUSSION

Peritonitis is a commonly encountered surgical pediatric emergency in Rwanda like in other developing countries. [9]

In most of cases patients with well established peritonitis present tardy to the hospital. Thus purulent/faecal contamination leads to varying degree of abdominal sepsis with typical signs and symptoms making it possible to make a clinical diagnosis of peritonitis for almost all patients.

In our study the main causes of peritonitis in pediatric population were appendicular perforation (25.4%), gangrenous intussusceptions(23.8%), typhoid ileal perforations (17.5%). These results are similar to findings in the study done in Pakistan [2] where typhoid ileal perforation was found to cause peritonitis in 17% of cases. Surgical management, which included bowel resection and anastomosis, stoma creation, and closure of perforations, was dependent on the intraoperative findings and to the surgeon's judgment, and the options adopted were similar to those reported in other studies.[9, 34]

Mortality found in our study, (22.2%), was comparable to results found in other studies in Africa [34, 35]. However, this is high compared to the one found in studies done in Pakistan (9%) [2] and West Africa: Nigeria (11.6%) [9]. In contrary to results of studies done in children [34, 35] lower age was not found to be a predicting factor of mortality in our sample (p=0.133). In keeping with other studies [14, 2] tachycardia and sepsis were found to be associated with an increased risk of mortality. Correlation of nausea and vomiting and the high risk of mortality was a new finding not similar to results in available data [2,14,9].In contrary with findings elsewhere in literature, surgery delay was not found to be associated with increased risk of mortality(p=0.277) nor with the risk of morbidity(p=0.459).[1,2,4,9]

4 of 6 patients with peritonitis due to traumatic intestinal perforation died, representing 66.7% p=NS (0.277), other studies in developing countries found lower figures ranging from 10 to 20% [9, 14].

Peritonitis in pediatric population in CHUK has been found to be associated with a low length of stay (12.14 days) as compared to finding in adults in the same hospital (15.3 days).[33] Nevertheless, this LOS is greater than the mean overall surgical LOS in CHUK which was 8 days in January 2016 (CHUK monthly report; January 2016).

Peritonitis related complications occurred in 49.2% of our population the most frequent was denutrition with electrolyte imbalance and sepsis representing 22.2% and 20.6% respectively.

The resident as principal operator was significantly correlated with mortality: 100% of death cases (14/14) were operated by residents while all patients operated by a general or pediatric surgeon survived. This demonstrates how low expertise and operative skills contribute negatively to the outcome and thus, the need of close senior supervision of surgeries performed by surgical trainees on children.

Post operative ICU admission, presence of nausea and vomiting at admission and sepsis as complication were correlated with mortality ($p<0.05$). This may be due to severe illness, dehydration with electrolyte disorders contributing to mortality. [14]

Some variables like the post operative antibiotic use; poor economic status of the family; delayed presentation to hospital and the eastern province origin were associated with high risk of morbidity; even if not associated significantly with mortality, they influence the overall outcome.

Patients operated by residents stayed longer and had more complications compared to ones operated by specialists. Like for mortality, low technical skills may be the explanation.

Patients who needed antibiotherapy post operatively were already very sick with abdominal purulent/fecal contamination exposing them to the higher risk of morbidity and mortality, but data are still not conclusive.

VI. CONCLUSION AND RECOMMENDATIONS

VI.1. Conclusion

Our study has achieved its objectives. Peritonitis in pediatric population in CHUK was found to be among the common causes of admission in the surgical department. It bears the significant morbidity and mortality. The challenges found and mostly correlated with an increased risk of morbidity and mortality were the delayed transfer of patients from the District hospitals; the delayed surgery; skills of operators; the postoperative sepsis and severe illness requiring ICU post operatively.

Other factors like pulse rate (tachycardia), cause of peritonitis, nausea and vomiting, economic status, denutrition were found to be significantly linked with an increased morbidity and prolonged LOS; these could be regarded as influencing also the overall outcome. However, a multi institutional study covering the other surgical centers of the country with a larger number of patients is needed for further validation of our findings.

Other studies focusing trauma related peritonitis in children as well as the causes of mortality in peritonitis patients, especially children, in ICU settings could be considered in the future.

VI.2. Recommendations

In the light of these results we recommend the following:

- To CHUK surgical department, to ensure close supervision by consultants to laparotomies for peritonitis in children performed by surgical trainees.
- To CHUK, to conduct regular training to clinicians from peripheral health facilities under its catchment zone, on trauma care and common abdominal surgical emergencies with emphasis to children, to improve early recognition and management of peritonitis.
- To CHUK in collaboration with MOH, to increase CHUK ICU admission capacity.

VIII. REFERENCES

1. Dean A, Clark C, Sinclair A. The late prognosis of perforated duodenal ulcer. Gut 1962; 3:60-64.

2. Dr. Sajid Aziz , Dr. Shazia Jehan, Dr. Muhammad Ateeq .Non appendicular perforation peritonitis spectrum and management outcome"Experience at peripheral teaching hospitals".Professional Med J 2014;21[4]: 613-620.

3. Schein M. Management of severe intra-abdominal infections. Surg Ann 1992; 24: 47-48.

4. Wittmann DH, Schein M, Condon RE. Management of secondary peritonitis. Ann Surg 1996; 224:10-18.

5. Thompson AE, Marshall JC, Opal SM. Intraabdominal infections in infants and children: descriptions and definitions. [Review] [47 refs]. Pediatric Critical Care Medicine 6[3 Suppl]:S30-5, 2005.
6. Weigelt JA. Empiric treatment options in the management of complicated intra-abdominal infections. [Review] [59 refs]. Cleveland Clinic Journal of Medicine 74 Suppl 4:S29-37, 200
7. http://simplelink.library.utoronto.ca.myaccess.library.utoronto.ca/url.cfm/35054
8. Levinson M&BL. Peritonitis and Intra-abd Abscesses. In: Mandell B&D, editor. Principles and Practice of Infectious Diseases. Churchill Livingstone, 2005.
9. Adesunkanmi AR, Oseni SA, Adejuyigbe O, Agbakwuru EA. Acute generalized peritonitis in African children: assessment of severity of illness using modified APACHE II score. ANZ Journal of Surgery 73[5]:275-9, 2003.
10. Gupta S, Kaushik R. Peritonitis - the Eastern experience. World J Emerg Surg 2006; 1:13. PM:16759427
11. Mhando S, Young B, Lakhoo K. The scope of emergency paediatric surgery in Tanzania. Pediatr Surg Int 2008;24:219- 22
12. Hall JC, Heel KA, Papadimitriou JM, Platell C. The pathobiology of peritonitis. [Review] [126 refs]. Gastroenterology 114[1]:185-96, 1998.
13. Farthmann EH, Schoffel U. Epidemiology and pathophysiology of intraabdominal infections [IAI]. [Review] [26 refs]. Infection 26[5]:329-34, 1998;-Oct.
14. Jeteendar S Jhobta et al , Spectrum of perforation peritonitis in India review of 504 consecutive cases,World Journal of Emergency Surgery 2006.

15. Riquelme A, Calvo M, Salech F, Valderrama S, Pattillo A, Arellano M et al. Value of adenosine deaminase [ADA] in ascitic fluid for the diagnosis of tuberculous peritonitis: a meta-analysis. [Review] [34 refs]. Journal of Clinical Gastroenterology 40[8]:705-10, 2006.
16. Malangoni MA. Contributions to the management of intraabdominal infections. [Review] [30 refs]. American Journal of Surgery 2005; 190[2]:255-259.
17. Marshall JC. Intra-abdominal infections. [Review] [66 refs]. Microbes & Infection 6[11]:1015-25, 2004.
18. Lee MJ. Non-traumatic abdominal emergencies: imaging and intervention in sepsis. [Review] [33 refs]. European Radiology 12[9]:2172-9, 2002.
19. Marshall JC, Innes M. Intensive care unit management of intra-abdominal infection. [Review] [110 refs]. Critical Care Medicine 31[8]:2228-37, 2003.
20. Streat SJ, Plank LD, Hill GL. Overview of modern management of patients with critical injury and severe sepsis. [Review] [68 refs]. World Journal of Surgery 24[6]:655-63, 2000.
21. Weigelt JA. Empiric treatment options in the management of complicated intra-abdominal infections. [Review] [59 refs]. Cleveland Clinic Journal of Medicine 74 Suppl 4:S29-37, 2007.
22. Schein M, Gecelter G, Freinkel W, Gerding H, Becker PJ. Peritoneal lavage in abdominal sepsis. A controlled clinical study. Archives of Surgery 125[9]:1132-5, 1990.
23. Schein M. Surgical management of intra-abdominal infection: is there any evidence?. [Review] [30 refs]. Langenbecks Archives of Surgery 387[1]:1-7, 2002.
24. Dorairajan LN, Gupta S, Deo SVS, Chumber L: Peritonitis in india –A decades experience. Tropical Gastroentrology 1995, 16(1): 33-38.
25. Koulaouzidis A, Bhat S, Karagiannidis A, Tan WC, Linaker BD. Spontaneous bacterial peritonitis. [Review] [91 refs]. Postgraduate Medical Journal 83[980]:379-83, 2007.
26. Mowat C, Stanley AJ. Review article: spontaneous bacterial peritonitis--diagnosis, treatment and prevention. [Review] [70 refs]. Alimentary Pharmacology & Therapeutics 15[12]:1851-9, 2001.
27. Wiggins KJ, Johnson DW, Craig JC, Strippoli GF. Treatment of peritoneal dialysis-associated peritonitis: a systematic review of randomized controlled trials. [Review] [76 refs]. American Journal of Kidney Diseases 50[6]:967-88, 2007.
28. Bosscha K, van Vroonhoven TJ, van der WC. Surgical management of severe secondary peritonitis.[see comment]. [Review] [85 refs]. British Journal of Surgery 86[11]:1371-7, 1999.
29. Hunter JD, Damani Z. Intra-abdominal hypertension and the abdominal compartment syndrome. [Review] [64 refs]. Anaesthesia 59[9]:899-907, 2004.
30. Malangoni MA. Evaluation and management of tertiary peritonitis. [Review] [25 refs]. American Surgeon 66[2]:157-61, 2000.

31. Evans HL, Raymond DP, Pelletier SJ, Crabtree TD, Pruett TL, Sawyer RG. Diagnosis of intra-abdominal infection in the critically ill patient. [Review] [36 refs]. Current Opinion in Critical Care 7[2]:117-21, 2001.
32. CHUK Surgical database.2015
33. F. Ntirenganya, G. Ntakiyiruta, I. Kakande. Prediction of Outcome Using the Mannheim peritonitis Index in Patients with Peritonitis at Kigali University Teaching Hospital. East and Central African Journal of Surgery. July/August 2012 Volume 17.
34. Osarumwense D. Osifo and Scott O. Ogiemwonyi. Peritonitis in Children: Our Experience in Benin City, Nigeria. SURGICAL INFECTIONS. Vol. 12, Number 2, 2011.
35. Nuhu Ali and Bata Mtaku Gali. Causes and treatment outcome of perforation peritonitis in north eastern Nigeria.Surgical Practice. (2010) 14, 92–96.
36. Jonathan C SamuelJaveria S Qureshi, Gift Mulima,Carol G Shores. An Observational Study of the Etiology, clinical presentation and outcomes associated with peritonitis in Lilongwe, Malawi. World Journal of Emergency Surgery20116:37
37. F.A Abatanga, B. Nimako, M.Amoah.The range of abdominal surgical emergencies in children older than 1 year at Komfo Onokye Teaching Hospital, Kumasi,Ghana.Annals of African medicine.Vol 8,No 4;2009: 236-242.

VIII. APPENDICES

1. Data collection form

1.Study number: …….

2.Date of admission: ……./……../20…….

3.Date of discharge: ……./……../20……..

4.Length of stay in days:……

5.Hospital ID: ……..

6.Age in years:……..

7.Sex: Male: 1 Female: 2 ☐

8.Address(District/Province): ……/…..……

9.Socio economic status: Good: 1; Moderate: 2; Poor: 3 ☐

10.Presenting symptoms: 1. Fever; 2. Nausea and/or vomiting; 3.Abd. pain; 4.Abd. distension; 5. Stool & gas arrest; 6. Diarrhea. Others(specify):…….…….. ☐

11. Period between symptoms onset to transfer (days): …….

12. Period between the admission and surgery(hours/days):….……

13. Laboratory investigations results:

Leucocytes(10ˆ6/mL) :…….

Platelets(10ˆ3/mL):……

Hemoglobin level (g/dL):……..

Creatinine(micromol/L) :……..

Na(mmol/L):……. K(mmol/L):…….. Cl(mmol/L):……..

HIV serology: Positive ☐ Negative ☐ Unknown ☐

CD4 count (if HIV positive):……

14.Vital signs

Temperature in centigrades:……. BP(mmHg):…… Pulse(bt/min):……. SpO2(%):……

15.Diagnosis at admission: App perforation ☐ gastric perf ☐ Gangrenous IO ☐ Intussusception Trauma ☐ Others(mention):…….. ☐

16.Operation time: Daytime: 1, During the night: 2 ☐

17.Principal operator: General surgeon: 1, Senior resident: 2, Junior resident: 3, Medical officer: 4, others(specify)…… ☐

18.Operation done:……

19.Perioperative cause of peritonitis: 1.App perforation; 2.Gastric perf.; 3.Gangrenous IO; 4.Intussusception; 5.Trauma; 6.Others[mention]:…….. ☐

20. Medical treatment: 1.Prophylactic antibiotics; 2.Therapeutic antibiotherapy; 3. None; 4. Others (specify):…….. ☐

21.Complications: 1.Burst abdomen; 2.Sepsis ;3.Others: ……..… ☐

22. Required ICU? Yes: 1, No: 2 ☐

23. Status at discharge: Improved: 1, Non improved: 2, Dead: 3 ☐

2. Consent form(English)

Patient's number:……..

I am **Dr MUTABAZI Emmanuel** a postgraduate student at University of Rwanda in the department of Surgery who is carrying out a study on ***"Epidemiological study of peritonitis in pediatric population and predictors of mortality. Case of CHUK".*** I am doing it in partial fulfillment for the award of the degree of MMed (General Surgery).

You will be required to understand its purpose, risks and benefits before you agree to participate in it.

Aim: To identify the common causes of peritonitis in children and assess their correlation with the treatment outcome in CHUK.

Risks to the participants

There are no major risks in this study.

Benefits

The information from the study will provide useful input for early recognition/ diagnosis and thus treatment of peritonitis in children.

Results of the study will help in improving the management of peritonitis in children. There are no financial benefits to be provided to the participants in the study.

Confidentiality:

All informations will be kept confidential by the principal investigator for purposes of the study strictly.

Questions

Participants of the study are free to ask questions or seek any clarifications about the study when they so wish. My phone number: 0788550617.

Rights to withdraw from the study

You are free to withdraw from the study at any time you wish to without any consequence.

Statement of consent

I have read the information above and understood the contents. I have had a full explanation of the nature and purpose of the study, risks and benefits in a language I understand. I have understood that I have right to withdraw from the study at anytime I wish to.

By signing this consent form, I understand that I am accepting (my child) to be enrolled in this study.

I hereby sign for myself.……as a proof to participate in the study.

Names :……..Date :……

I have explained the purpose of the study to the participant to the best of my knowledge and he has fully understood the purpose, benefits and risks to him or her.

Signature:……Date :……

3.Consent form (Kinyarwanda)

URUPAPURO RWO KWEMERA KUGIRA URUHARE MU BUSHAKASHATSI

Nitwa Dr **MUTABAZI Emmanuel**, umuganga w'umunyeshuri wiga kubaga muri Kaminuza y'u Rwanda nkaba ndi gukora ubushakashatsi ku ndwara ya peritonite mu bana n'impamvu z'ingenzi zifitanye isano n'impfu za bamwe muri abo bana barwaye iyi ndwara.

Urasabwa kubanza gusobanukirwa intego y'ubu bushakashatsi, inyungu n'ingaruka zishobora kubaho igihe wemeye ko bukorerwa ku mwana urwaje/ubereye umubyeyi.

Intego: Kugaragaza inkomoko y'uburwayi bwa peritonite mu bana ndetse n'impamvu z'ingenzi zifitanye isano n'impfu z'abo bana barwaye ubu burwayi.

Ingaruka:

Nta ngaruka ugize uruhare muri ubu bushakashatsi azagira.

Inyungu:

Ibizava muri ubu bushakashatsi bizafasha mu kwihutisha kumenya no kuvura ubu burwayi mu bana.

Ibizava muri ubu bushakashatsi bizafasha kandi kuvura neza abana barwaye indwara ya peritonite. Nta nyungu y'amafaranga uwagize uruhare muri ubu bushakashatsi azabukuramo.

Ibanga:

Amakuru yose kuri buri muntu azajya abikwa n'umushakashatsi kugira ngo akoreshwe mu bushakashatsi gusa.

Ibibazo:

Umuntu wese wemeye kugira uruhare muri ubu bushakashatsi yemerewe kubaza ibibazo byose igihe cyose yifuza ubundi busobanuro. Nimero ya telefoni yanjye ni: 0788550617.

Uburenganzira bwo kwivana mu bushakashatsi

Ufite uburenganzira bwo kwivana mu mubare w'abakorerwaho ubushakashatsi igihe ubishakiye kandi nta ngaruka ugize.

Amasezerano yo kwemera gukorerwaho ubushakashatsi

Maze gusoma ibyanditse hejuru kandi nabisobanukiwe. Nasobanuriwe birambuye mu rurimi numva intego, inyungu n'ingaruka muri ubu bushakashatsi. Nasobanuriwe n'uko nemerewe kwivana mu mubare w'abakorerwaho ubushakashatsi igihe mbishakiye nta ngaruka ngize.

Nshyize umukono kuri aya masezerano nsobanukiwe kandi nemera ko umurwayi wanjye akorerwaho ubushakashatsi.

Umukono wanjye:……itariki:……

Nasobanuriye umurwayi/umurwaza mu buryo burambuye intego, inyungu n'ingaruka by'ubu bushakashatsi.

Umushakashatsi:…….itariki:…….

4. Informed assent form for children above 7 years

Patient ID:……

I am **Dr MUTABAZI Emmanuel** a postgraduate student in Surgery at University of Rwanda, conducting a study entitled ***"Epidemiological study of peritonitis in pediatric population and factors predicting mortality. Case of CHUK"***. I am doing it in partial fulfillment for the award of the degree of MMed (General Surgery). You will be required to understand its purpose, risks and benefits before your agreement to participate in it without which you will not take part in the study.

Purpose of the Study: To identify the common causes of peritonitis in children and formulate their correlation with the treatment outcome in CHUK.

Choice of participants: We are asking you to take part in the study because you have been diagnosed with this disease and you are a child.

Participation is voluntary: You can accept yourself to us to be part of the study or if you wish ask your parent/guardian to take the decision.

Procedures: If you accept we will take information regarding your disease since its beginning till now and take data on your evolution during your hospitalization course to be used in the study. No particular procedure will be done to you by us.

Risks: There is no expected risk to the participants in this study and no hurt nor physical discomfort.

Benefits: Results of the study will help in improving the management of peritonitis in children. There are no financial benefits to be provided to the participants in the study.

Confidentiality: Information provided on your person during the study will be kept confidential by the principal investigator and will only be used for research purpose. What will be published are only general results from the study. Your parent/guardian also has been given more information.

Right to Refuse or Withdraw: As participation in this study is voluntary you have also the right to withdraw from the study at any point you wish.

Who to Contact: You are allowed to ask any question to the researcher any time you wish to or ask your parent/guardian to do it for you using my number: 0788550617.You can also talk to anyone they want to about this (your doctor, your friend, your teacher,…)

Statement of Assent

I know that I can choose to be in the research study or choose not to be in the research study. I know that I can stop whenever I want. I had this information read to me and I understand it.

I hereby sign for myself……as a proof to participate in the study.

Names :……..Date :……

Witness: Names and signature:……..

5. Informed assent form (Kinyarwanda)

Urupapuro rwo kwemera kugira uruhare mu bushakashatsi ku bana(barengeje imyaka irindwi)

Nimero y'umurwayi:……

Nitwa MUTABAZI Emmanuel, umuganga w'umunyeshuri wiga kubaga muri Kaminuza y'u Rwanda nkaba ndi gukora ubushakashatsi ku ndwara ya peritonite mu bana n'impamvu z'ingenzi zifitanye isano n'impfu za bamwe muri abo bana barwaye iyi ndwara.

Intego: Kugaragaza inkomoko y'uburwayi bwa peritonite mu bana ndetse n'impamvu z'ingenzi zifitanye isano n'impfu z'abo bana barwaye ubu burwayi mu bitaro bya CHUK.

Impamvu twaguhisemo: Twahisemo kugusaba ko wagira uruhare muri ubu bushakashatsi kubera ko abaganga basanze urwaye ubu burwayi kandi ukaba uri umwana.

Kugira uruhare muri ubu bushakashatsi ni ubushake: Ushobora kutwemerera ku bushake bwawe kugira uruhare muri ubu bushakashatsi cyangwa ugasaba umubyeyi/umurwaza wawe kubifataho icyemezo.

Ibizagukorerwaho: Ni ubyemera tuzafata amakuru ajyanye n'uburwayi bwawe guhera butangiye kugeza ubu. Tuzanafata kandi amakuru ajyanye n'uburyo uburwayi bwawe buzzagenda buhinduka mu gihe cyose uzaba uri mu bitaro kugira ngo yose azakoreshwe mu bushakashatsi. Uretse ibyo nta kindi gikorwa duteganya kuzagukoreraho.

Ingaruka: Nta ngaruka ubushakashatsi buzatera abazagira uruhare muri ubu bushakashatsi kandi nta gikorwa kibabaza kizakorerwa ku mubiri wawe.

Inyungu : Ibizava muri ubu bushakashatsi bizafasha kandi kuvura neza abana barwaye indwara ya peritonite. Nta nyungu y'amafaranga uwagize uruhare muri ubu bushakashatsi azabukuramo.

Ibanga: Amakuru yose kuri buri muntu azajya abikwa n'umushakashatsi kugira ngo akoreshwe mu bushakashatsi gusa. Hazatangazwa gusa ibyavuye mu bushakashatsi muri rusange ubushakashatsi burangiye. Umubyeyi/umurwaza wawe nawe yahawe amakuru ahagije kuri ibyo.

Uburenganzira bwo kwivana mu bushakashatsi

Ufite uburenganzira bwo kwivana mu mubare w'abakorerwaho ubushakashatsi igihe ubishakiye.

Uwo wasobanuza: Wemerewe kubaza umushakashatsi ibibazo byose wifuza bifitanye isano n'ubu bushakashatsi igihe ubishakiye cyangwa ugasaba umubyeyi/umurwaza wawe kubigukorera hakoreshejwe nimero yanjye ya telefoni ariyo: 0788550617.Wemerewe kandi kuganiriza uwo wifuza wese ibijyanye nabwo(inshuti yawe, umwarimu wawe,…)

Amasezerano yo kwemera kugira uruhare mu bushakashatsi

Nzi neza ko nshobora kwemera cyangwa kwanga kugira uruhare muri ubu bushakashatsi. Nzi neza ko nshobora guhagarika kugira uruhare muri ubu bushakashatsi igihe mbishakiye. Ibi byose nabisobanuriwe kandi nabyumvise neza.Nshyize umukono kuri aya masezerano nk'ikimenyetso cy'uko nemeye kugira uruhare mu bushakashatsi.

Umukono……...

Amazina :……..Itariki :……

Umuhamya: Amazina n'umukono:……..

6. CMHS IRB ETHICAL CLEARANCE

UNIVERSITY OF RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 31/08/2015
Ref: CMHS/IRB/**263**/2015

Dr MUTABAZI Emmanuel
School of Medicine and Pharmacy, CMH, UR

Dear Dr MUTABAZI Emmanuel

RE: ETHICAL CLEARANCE

Reference is made to your application for ethical clearance of the revised protocol of the study entitled **"Epidemiological study of peritonitis in pediatric population and factors predicting mortality. Case of CHUK."**

Having reviewed your application and been satisfied with your revised version incorporating the comments from the IRB, your study is hereby granted ethical clearance. The ethical clearance shall last for one year from the date it is issued and it is renewable on request upon submission of the progress report in accordance with the guidelines of the Institutional Review Board (IRB) of the College of medicine and Health Sciences. In addition, at the end, the IRB shall need to be given the final report of your study.

We wish you success in this important study.

Professor Kato J. NJUNWA
Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR

Cc:
- Principal, College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

7. CHUK ETHICAL CLEARANCE

CENTRE HOSPITALIER UNIVERSITAIRE
UNIVERSITY TEACHING HOSPITAL

Quality Health Care
Training & Research

Ethics Committee / Comité d'éthique

September 07, 2015 **Ref.: EC/CHUK/161/2015**

Review Approval Notice

Dear **Dr. Emmanuel Mutabazi**,

Your research project: ***"Epidemiological study of peritonitis in pediatric population and factors predicting mortality at University Teaching Hospital of Kigali (CHUK)."***

During the meeting of the Ethics Committee of University Teaching Hospital of Kigali (CHUK) that was held on 07/09/2015 to evaluate your protocol of the above mentioned research project, we are pleased to inform you that the Ethics Committee/CHUK has approved your protocol.

You are required to present the results of your study to CHUK Ethics Committee before publication.

PS: Please note that the present approval is valid for 12 months.

Yours sincerely,

ETHICS COMMITTEE CHUK

John Nyirigira
The Secretary, Ethics Committee,
Kigali University Teaching Hospital

<<University teaching hospital of Kigali Ethics committee operates according to standard operating procedures (Sops) which are updated on an annual basis and in compliance with GCP and Ethics guidelines and regulations>

B.P. :655 Kigali- RWANDA Tél. Fax : 00 (250) 576638E-mail : chuk.hospital@chukigali.org