MODIFIED ALVARADO SCORE AND ULTRASONOGRAPHY IN THE DIAGNOSIS OF ACUTE APPENDICITIS AT MOI TEACHING AND REFERRAL HOSPITAL, ELDORET, KENYA

BY

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THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS OF MEDICINE IN GENERAL SURGERY, OF MOI UNIVERSITY

DECLARATION

Declaration by candidate

This thesis is my original work and has not been presented for a degree or any academic credit in any other university or examining body. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

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DEDICATION

I dedicate this work to my parents who have lovingly raised me and to my wife who has always encouraged and motivated me.

DISCLOSURE

The researcher did not receive any external funding or grant in support for this study. Neither he nor members 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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ABSTRACT

Background: Acute appendicitis is a common surgical emergency. Its diagnosis can be challenging. Scoring systems that make use of clinical and laboratory findings, like the Alvarado score, have been developed to improve on the diagnosis of acute appendicitis. Ultrasonography is used as an adjunct in the diagnosis. Correlation between the clinical and ultrasound diagnosis with histopathology has been done in various places globally, however, there is no data in our locality.

Objective: To assess accuracy of Alvarado score and Ultrasonography in comparison to histopathology in the diagnosis of acute appendicitis at Moi Teaching and Referral Hospital (MTRH).

Method: Hospital-based descriptive cross-sectional study at MTRH. Consecutive sampling was done between January 2015 and June 2016. Patients who were clinically diagnosed to have acute appendicitis and subsequently underwent appendectomy were included. Questionnaires were used to collect data, which included symptoms and signs at presentation and the ultrasound findings, obtained from the case notes. Alvarado scoring was done for all patients. Histopathology reports were sought from the pathology laboratory and finally the results were analysed.

Result: A total of 85 patients were studied. Male to female ratio was 1.3:1. Age ranged from 6 to 64 years. Mean duration of onset of symptoms to presentation was 4.56 days (range of <1 – 21 days). Commonest signs and symptoms were right lower quadrant tenderness, right lower quadrant pain and nausea/vomiting in 90.6% (n=77), 84.7% (n=72) and 78.8% (n=67) patients respectively. Sensitivity and specificity of the ultrasound were 70.5% and 30% respectively. Majority, (81.2%, n=69) had Alvarado score of ≥ 4, of which, 90.6% (n=58) had appendicitis. In the 0 - 3 Alvarado score group, majority (62.5%, n=10) had no appendicitis. The sensitivity and specificity of Alvarado score from ≥ 4 was 90.6% and 47.6% respectively. The overall negative appendectomy rate was 24.7%.

Conclusion: Alvarado score is an accurate tool in the diagnosis of acute appendicitis. Ultrasonography is not as accurate as Alvarado score and cannot be relied upon on its own to make a diagnosis of acute appendicitis.

Recommendation: Application of Alvarado score should be made the standard operating procedure in diagnosing acute appendicitis at MTRH. Ultrasound should not be heavily relied upon in diagnosis of acute appendicitis.

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ABBREVIATIONS AND ACRONYMS

IREC	Institutional Research and Ethics Committee
MTRH	Moi Teaching and Referral Hospital
RLQ	Right Lower Quadrant
WBC	White Blood Cell

OPERATIONAL DEFINITION OF TERMS

Alvarado score	A clinical scoring system used for the diagnosis of acute appendicitis. It makes use of six clinical and two laboratory parameters which are each assigned a numerical value totaling to a maximum score of 10.
Appendectomy	The surgical removal of the appendix
Appendicitis	Inflammation that begins at the mucosa of the appendix that can progress through all the layers
Appendix	A narrow blind-ended tube-like structure that arises from the caecum usually in the right lower quadrant of the abdomen
Negative appendectomy	Removed appendix specimen that was confirmed negative for appendicitis on histopathological evaluation

CHAPTER ONE: INTRODUCTION

1.1 Background Information

The vermiform appendix is considered by most to be a vestigial organ. Its importance in surgery arises only because of its propensity for inflammation, which results in the clinical syndrome known as acute appendicitis (Bailey, 2008), first described in 1886 by a Harvard pathologist, Reginald H. Fitz (Fitz, 1886). Acute appendicitis is a common cause of an 'acute abdomen' such that appendectomy is a very frequently performed urgent abdominal operation. Appendectomy remains the gold standard treatment of appendicitis (Andersen et al., 2015).

Despite being a commonly encountered problem in the emergency department, it is often a clinical challenge to make an accurate diagnosis of acute appendicitis (Petroianu, 2012). Clinicians have resorted to the use of diagnostic tools like the scoring systems and modern radiographic imaging techniques to help in making a more accurate diagnosis.

Clinical scoring systems like the Izbicki, Christian, Acute Inflammatory Response (AIR) Score, RIPASA, Alvarado score among others that have been developed over the years to help in making a more accurate diagnosis (Meystre, 2003). The most frequently used is the Alvarado score that is based on symptoms and signs of acute appendicitis and a blood count (CBC) (Andersen et al., 2015). The most common used imaging in the diagnosis of acute appendicitis is the ultra sound (U/S).

It is paramount to make an accurate diagnosis of acute appendicitis as a wrong diagnosis would increase the negative appendectomy rates which is significantly associated with increased hospital length of stay and cost, increased case fatality rate and increased rate of infectious complications (Flum & Koepsell, 2002). On the other

hand, a missed diagnosis could subsequently lead to perforation and significantly increase morbidity and prolong hospitalization.

The Alvarado score and ultrasound have shown a variable diagnostic accuracy in the diagnosis of acute appendicitis in published literature. In our local setup, at MTRH, the diagnostic accuracy of the Alvarado score and of ultrasonography has not been studied.

1.2 Problem statement

Accurately diagnosing acute appendicitis can sometimes be challenging even for the experienced surgeon. There is a high negative appendectomy rate that has been observed at MTRH (Anecdotal evidence). Alvarado scoring and ultrasound are tools that are commonly used to help in making a diagnosis. However, at MTRH, clinicians don't often make use of the Alvarado score while most patients are routinely sent for ultrasonography. The accuracy of these tests is also not known as no studies have been conducted in this institution.

1.3 Justification for study

Misdiagnosing acute appendicitis can be devastating for the patient. A missed diagnosis could lead to the possibility of perforations with increased associated morbidity and even mortality. On the other hand, a wrong diagnosis would lead to increase in negative appendectomies which are significantly associated with increased cost, increased infectious complication and fatality rates.

This study fills in the information gap and informs the clinician on the reliability of the Alvarado score and the ultrasound, hence enabling them to make a more informed judgment in the diagnosis of acute appendicitis in our set-up.

The data can be used in making standard operating procedures and protocols (SOPs) to guide clinicians in accurately diagnosing acute appendicitis in patients seen at MTRH and thus reducing the negative appendectomy rate. This will benefit the patient in terms of cost, waste of time, and unnecessary surgery with its complications. It will also benefit the hospital in saving its limited resources and utilizing it in a better way.

1.4 Objectives

1.4.1 Broad objective

To assess the accuracy of Alvarado score and ultrasonography in diagnosing acute appendicitis at MTRH

1.4.2 Specific objectives

1. To describe signs and symptoms in patients clinically diagnosed to have appendicitis at MTRH.
2. To determine the accuracy of the Alvarado score and ultrasonography in diagnosing acute appendicitis at MTRH.
3. To determine the negative appendectomy rate at MTRH.

1.5 Research question

What is the accuracy of Alvarado score and ultrasonography in diagnosing acute appendicitis at MTRH?

CHAPTER TWO: LITERATURE REVIEW

2.1. Definition, Epidemiology, Etiology and Pathophysiology of acute appendicitis

Appendicitis is defined as an acute inflammation of the vermiform appendix that starts from the mucosal layer and can spread through its wall to the serosa.

The vermiform appendix is a narrow worm-like blind intestinal diverticulum that arises from the caecum, the first part of the large intestine which is usually located in the right lower quadrant (RLQ). It usually arises from its postero-medial wall about 2-3 cm infero-lateral to the iliocaecal valve. It is enclosed in a small mesentery, the mesoappendix, attached to the lowest part of the colonic mesentery. The surface marking of the base of the appendix is at the McBurney's point which is at the junction of the lateral third and the medial two thirds of a line, the spino-umbilical line, extending from the anterior superior iliac spine to the umbilicus (McBurney, 1891).

The vermiform appendix varies widely in terms of its location and morphology in the abdomen (Banerjee, Kumar, Tapadar, & Pranay, 2012). Knowledge of these variations in the position of the vermiform appendix is very important to the clinician because, in appendicitis, its variable positions may produce variable symptoms and signs which mimic other pathologies (Pittman-Waller, Myers, Stewart, & Dent, 2000). The topography of vermiform appendix in Kenyans showed that the most common position of the appendix overall was retrocecal (27.1%), followed by the pelvic type (25%). Other variations seen were subileal (18.8%), postileal (18.8%),

subcecal (4.2%), subhepatic (4.2%) and paracaecal (2.1%) type (Mwachaka, El-busaidy, Sinkeet, & Ogeng'o, 2014).

Pieper et al, in his epidemiological study in Europe found the mean yearly incidence to be 1.16/1000 with incidence of 1.33 and 0.99/1000 in male and female population respectively (Pieper & Kager, 1982). The peak incidence has been reported to be around the second and third decade of life with a lifetime risk of 7-8% (Bhangu, Søreide, Di Saverio, Assarsson, & Drake, 2015). In Ghana, West Africa, the yearly incidence was found to be 1.8/10,000 of the population with peak age of 25 to 29 years (Ohene-Yeboah & Abantanga, 2009). In Kenya, the peak incidence was also found to be in the third decade. Males accounted for 61% and females 39% (Chavda, Hassan, & Magoha, 2005).

There is no conclusive evidence regarding the etiology of acute appendicitis. Burkitt et al reported that decreased dietary fiber and increased consumption of refined carbohydrates could be important. This is in accordance with the occurrence of a right-sided fecal reservoir and the fact that dietary fiber reduces transit time (Burkitt, Walker, & Painter, 1972). While appendicitis is clearly associated with bacterial proliferation within the appendix, no single organism is responsible solely. Usually a polymicrobial growth of aerobic and anaerobic organisms is seen. The most common bacteria was found to be E.coli, followed by C. perfringes and mixed anaerobes (Awan, Shukr, Mahmood, & Qasmi, 2013).

Two clinical syndromes of acute appendicitis are recognized, acute catarrhal (non-obstructive) appendicitis and acute obstructive appendicitis. Non-obstructive appendicitis is due to primary infection of the appendix. The initiating event causing bacterial proliferation is controversial (Bailey, 2008). Acute obstructive appendicitis is due to an obstruction of the appendix lumen either by a faecolith or other cause.

Hardin Jr. observed lymphoid hyperplasia to be the most important cause of appendicitis in children and adolescents (Hardin, 1999). It is characterized by a much more acute course, thus the onset of symptoms is abrupt. Urgent surgical intervention is required because of its more rapid progression to perforation. Within the obstructed lumen, there is continuous secretion of fluids and mucus from the mucosa and the stagnation of this material. This results in elevated intraluminal pressures, leading to appendiceal wall ischemia, over-growth of bacteria, transmural inflammation, appendiceal infarction, and subsequently perforation (Bailey, 2008).

2.2. Diagnosis

Despite being a commonly encountered problem in the emergency departments, acute appendicitis can sometimes be difficult to diagnose accurately.

Negative appendectomy rate varies from 4 – 45% (Joshi, Joshi, Alam, Agarwal, & Kumar, 2015). Unnecessary surgeries come with their own risks and complications, besides the financial implications to the patient. On the other hand, in up to 30% of patients, true cases of acute appendicitis are missed, only to be identified later on. This delay in early diagnosis and definitive treatment carries an increased risk of perforation, which may occur in up to 33% cases (Louis Graff et al., 2000). Perforation rates are even higher in the elderly and associated with a 20 fold increase in mortality (Ghnnam, 2012).

The clinical presentation of acute appendicitis may be typical or atypical. Approximately 20-33% of the patients suspected of having acute appendicitis present with atypical findings (Lewis, Holcroft, Boey, & Dunphy, 1975). Atypical presentations could be due to the positions of the appendix in the abdomen and may

present with pain that is predominantly somatic or visceral and not well localized. This is usually seen in the elderly population (Horattas, Guyton, & Wu, 1990).

The typical features are those of an ill patient with low-grade pyrexia, localized abdominal tenderness on the RLQ region, muscle guarding and rebound tenderness. The patient would be anorexic and may present with nausea or even vomiting. Upon inspection of the abdomen there could be some limitation of respiratory movement in the lower abdomen. The patient, when asked to point out where the pain began and where it is most concentrated would demonstrate that it migrated toward the RLQ from around the umbilicus. This area of maximum tenderness demonstrated by the patient is the pointing sign. Gentle superficial palpation of the abdomen, beginning in the left iliac fossa moving anticlockwise to the RLQ will detect muscle guarding over the point of maximum tenderness, the McBurney's point. Asking the patient increase the intra-abdominal pressures by coughing or gentle percussion over the site of maximum tenderness will elicit rebound tenderness. Deep palpation of the left iliac fossa may cause pain in the RLQ, which is the Rovsing's sign. This is helpful in supporting a clinical diagnosis of appendicitis by ruling out other pathologies.

Occasionally, an inflamed appendix could lie in the pelvis irritating the psoas muscle, and the patient would prefer to lie with the right hip flexed for pain relief. On extension of the hip joint, the patient would feel pain. This is elicited as the psoas sign. Spasm of the Obturator internus is sometimes demonstrable when the patients' hip is flexed and internally rotated. This is when an inflamed appendix comes into contact with the Obturator internus muscle. This maneuver will cause pain in the hypogastrium, elicited as the Obturator sign.

In various studies done around the globe, it has been shown that the most common presentation for acute appendicitis is pain perceived in the RLQ by the patient while the most common sign on examination is RLQ tenderness (Memon, Irfan, Fatima, Iqbal, & Sami, 2013; Nshuti, Kruger, & Luvhengo, 2014; Samir, Hefzy, Gaber, & Moghazy, 2016).

Many other conditions can clinically present as acute appendicitis, with complaints of RLQ pains. These could be other gastro-intestinal pathologies like Crohn's disease, infectious enterocolitis, mesenteric adenitis, caecal diverticulitis, Meckel's diverticulitis, epiploic appendagitis, and omental infarcts. Genitourinary pathologies like pyelonephritis and ureterolithiasis may also mimic appendicitis. In females, gynaecological pathologies like ovarian torsion, hemorrhagic ovarian cyst, pelvic inflammatory disease, and ectopic pregnancy should be considered (Thompson, Selvaraj, & Nicola, 2014).

To aid in the diagnosis of acute appendicitis, several scoring systems have been developed. The scoring systems are noninvasive, easily administrable and cost effective (Alvarado, 1986; Christian & Christian, 1992). In these systems, clinical variables are elicited from the patient and each is given a numeric value; then, the sum of these values is used to predict probability of acute appendicitis.

Some of these scoring systems are; the Izbicki scoring system, developed in 1990, that makes use of 7 parameters which are gender, leucocyte counts, guarding, rebound pain, duration of pain, migration and type of pain (Izbicki et al., 1992). The Christian scoring system makes use of 5 parameters which are abdominal pain, vomiting, tenderness, fevers and leukocytosis (Christian & Christian, 1992). There is also the Paediatric appendicitis score which is similar to Alvarado score in the parameters but

gives higher points to rebound tenderness (Samuel, 2002). The Acute Inflammatory Response (AIR) Score is also similar to Alvarado score but makes use of additional laboratory CRP parameter (Andersson & Andersson, 2008). Also the RIPASA score which has the patients' gender, age and other laboratory tests in addition to the parameters in the Alvarado score and is available for use (Chong et al., 2010). The best known of these scoring systems is the Alvarado score, which makes use of the acronym; MANTRELS, which tabulates the migration of pain, anorexia, nausea and/or vomiting, tenderness in the RLQ, rebound tenderness, elevated temperature, leukocytosis, and shift to the left (Alvarado, 1986).

In a study done to compare the Alvarado score, Izbicki and Christian score, Prashant noted that Alvarado score was more accurate (Nema & Jain, 2016). Between the Alvarado and the Paediatric appendicitis score, there was no difference noted in their sensitivity and specificity (Pogorelic, Rak, Mrklic, & Juric, 2015). The AIR score was found to be more accurate at excluding appendicitis in those deemed low risk and predicting appendicitis in those deemed high risk than the Alvarado score (Kollár, McCartan, Bourke, Cross, & Dowdall, 2015). The RIPASA score was also found to be more accurate than the Alvarado score in the diagnosis of acute appendicitis (Nanjundaiah, Mohammed, Shanbhag, Ashfaque, & Priya, 2014).

Table 1: Alvarado (MANTRELS) Score

Characteristic	Score (if finding present)
M = Migration of pain from periumbilical region to the RLQ	1
A = Anorexia	1
N = Nausea and/or vomiting	1
T = Tenderness on palpation in the RLQ	2
R = Rebound tenderness (Blumberg sign)	1
E = Elevated temperature (>37.3ºC)	1
L = Leukocytosis (>10,000)	2
S = Shift of WBCs to the left = neutrophilia of >70%	1
Total	10
Source: Alvarado.	
RLQ = right lower quadrant; WBCs = white blood cells	

Interpretations of Alvarado Score (Alvarado, 1986)

Score 0 – 4 = unlikely to be having acute appendicitis

Score 5 – 6 = possibility of having acute appendicitis

Score 7 – 10 = likely to be having acute appendicitis

Alvarado proposed from his study that patients with a score of 7 or above should be operated as they are likely to have acute appendicitis while those with scores of 5 and 6 could be observed. Patients with scores of 4 and below may not be having appendicitis (Alvarado, 1986). Several studies have since been done in different parts of the globe to correlate the Alvarado score with histopathology. Some of these are highlighted in the table.

Table 2: Studies correlating Alvarado score with histopathology

Study	Sensitivity %	Specificity %	PPV %	NPV %	Accuracy %
(Memon et al., 2013)	93.5	80.6	92.3	83.3	89.8
(Tamanna, Eram, Hussain, Khateeb, & Buhary, 2012)	59.57	85.13	71.79	76.82	75.2
(Schneider, Kharbanda, & Bachur, 2007)	72	81	65	85	
(Malhotra et al., 2016)	83.7	71	94.7	83.3	

In studies done at Kenyatta National Hospital (KNH) in Nairobi, to evaluate the Alvarado score, the overall sensitivity was found to be 80.3% while the specificity was low at 16.8% (Saidi & Chavda, 2003).

Radiology has also been used, mainly as an adjunct to clinical findings, for diagnosis of acute appendicitis. Most commonly used is ultrasound as it is readily availability, easy and quick to perform, does not require any preparation or contrast, cheaper than other modalities and can exclude other pathologies that are similar in presentation to acute appendicitis. However, ultrasonography is user dependent and thus the overall sensitivity and specificity varies widely. Values of as low as 44% to as high as 95% have been reported (Ihsan, Ayaz, Farooq, Saeed, & Aslam, 2017). The key ultrasound findings of acute appendicitis are a dilated and noncompressible appendix with a thickened wall. An appendicolith, which can be identified by its acoustic shadow, can sometimes be visualized. The loss of the submucosal echogenic layer, as well as the

presence of hyperechoic periappendiceal fat and loculated pericecal fluid collection, is indicative of perforation. The inflamed appendix is less likely than the normal appendix to contain luminal air. Mesenteric lymphadenopathy is sometimes present. A normal appendix can be visualized by ultrasound in less than 5% of the time (Albiston, 2002).

It has been shown in a study done by Stephanie and colleagues that a three step sequential positioning during ultra sound evaluation, where the patient is first examined in supine position, then placed in a left posterior oblique position and then re-examined in the supine position, significantly increases the visualization rates of the appendix on ultra sound (Chang, Jeffrey, & Olcott, 2014).

Abdominal CT scan has also been used in the diagnosis of acute appendicitis and is considered superior to the ultrasound in terms of accuracy and reducing the negative appendectomy rates (Elghany & Ali, 2011). CT scans have an accuracy of 93 – 98% and its routine use pre-operatively can reduce the negative appendectomy and perforation rates (Rao, Rhea, Rattner, Venus, & Novelline, 1999). It has an enhanced ability to detect a normal appendix (Albiston, 2002). It provides a high accuracy of detecting other pathologies that cause RLQ pain that can clinically mimic acute appendicitis (Kaddah & Ayad, 2016). The criteria for diagnosis of appendicitis include appendiceal dilation, wall thickening and appendicolithiasis. Periappendiceal changes are more readily identified by CT and include blurred pericecal fat, mesenteric fat stranding, phlegmon, abscess, abnormal collections of air and fluid accumulations. Inflammatory thickening of the wall of the cecum is also often seen. It is not possible to assess the compressibility or motility of the appendix on CT scan (Albiston, 2002). However, CT scans are not a first line radiological test in diagnosing

appendicitis as they are not readily available in most places due to their high cost. And even in places where the scanners are available, their use at odd hours is often a challenge as it requires greater preparations and frequent need for contrast material.

Laboratory tests are used as parameters in scoring systems such as the Alvarado score. They can be used on their own to make a diagnosis of acute appendicitis (Bhangu et al., 2015). White blood cell (WBC) counts and differential neutrophil counts are commonly performed by emergency clinicians for suspected appendicitis cases. Clinicians should be wary on solely relying of the WBC and neutrophil counts as an indicator of acute appendicitis (Cardall, Glasser, & Guss, 2004). Some studies have shown that hyperbilirubinaemia is a more specific marker to WBC and C-reactive protein for simple and perforated appendicitis (Emmanuel, Murchan, Wilson, & Balfe, 2011). Nevertheless, it consistently suffers from low sensitivity and thus cannot be used as a reliable marker to diagnose acute appendicitis (Bhangu et al., 2015).

Histopathology is the gold standard for diagnosing appendicitis. It a confirmatory tool to find out whether the patient had appendicitis or not. Routinely, the tip of the appendix, a cross-section from the resection zone and one cross-section from the zone which macroscopically gave evidence of inflammation are taken for histological analysis. An early appendicitis, where there is no macroscopic evidence of inflammation, can thus be falsely interpreted as negative appendicitis on histopathology if the whole specimen is not analyzed (Brochhausen et al., 2010). Stambolis and Wagner clearly demonstrated that in this case a further re-evaluation of the entire appendix could minimize the cases of negative appendectomies (Stambolis & Wagner, 1985).

2.3. Management and prognosis

The gold standard treatment for acute appendicitis is appendectomy. It is most important that patients with appendicitis be taken to the operating room for definitive surgical treatment early as there is a significant increase in the morbidity and mortality in those experiencing appendiceal perforations (McBurney, 1891). However, this urgency leads to 15 – 25% of the normal appendices being removed at appendectomy (Flum & Koepsell, 2002). Rash decisions should not be made to operate though, when the diagnosis is not clear. Patients should be continuously monitored clinically as this observation helps to distinguish patients with from those without appendicitis, thus reducing the negative appendectomy rates and complications of surgery (LG Graff, Radford, & Werne, 1989; Gupta, Regmi, Hazra, Panhani, & Talwar, 2010). Intravenous fluids, sufficient to establish adequate urine output, and appropriate antibiotics should be given.

Acute appendicitis can also be managed conservatively using medical therapy (Turhan et al., 2009). However, caution should be exercised by closely monitoring the patient and preparing for appendectomy in cases of worsening symptoms.

Appendectomy carries a complication rate of 4 – 15%, as well as associated costs and the discomfort of hospitalization and surgery. Therefore, the goal of the surgeon is to make an accurate diagnosis as early as possible. Delayed diagnosis and treatment, account for much of the mortality and morbidity associated with appendicitis (Tschuor et al., 2012).

The overall mortality rate of 0.2-0.8% is attributable to complications of the disease rather than to surgical intervention. The mortality rate in children ranges from 0.1% to

1% and in patients older than 70 years, the rate rises above 20%, primarily because of diagnostic and therapeutic delay (Tschuor et al., 2012).

Appendiceal perforation is associated with increased morbidity and mortality compared to non-perforating appendicitis. Post-operative complications are three times more common in the perforated group, 75% as compared to 25% in the non-perforated group (Omari et al., 2014). Barlas Sulu reported surgical site infection rate of 22% and 8% for patients with and without perforation, respectively (Barlas, Günerhan, Palanci, Işler, & Çağlayan, 2010). At Kenyatta National Hospital, in Kenya, the rate of perforation and gangrene was found to be 29.7%. Post-operative complication was 19.4% in perforated appendicitis and 7.6% in non-perforated appendicitis (Chavda et al., 2005).

CHAPTER THREE: METHODOLOGY

3.1 Study site

The study was done at the Moi Teaching and Referral Hospital (MTRH), located along Nandi road in Eldoret town, Uasin Gishu County, Kenya (310 Kilometers Northwest of Nairobi). This is a level 6 hospital, the largest referral facility in western Kenya region. It is the second largest referral hospital in Kenya after KNH. It serves residents of Western Kenya, parts of Eastern Uganda and Southern Sudan. The study was conducted in the emergency department, surgical wards and the histopathology laboratory.

3.2 Population

The study population was the patients that were seen at MTRH who were clinically diagnosed with acute appendicitis and underwent appendectomy during the period of study which was from January 2015 to June 2016 and who met the selection criteria.

3.3 Study design

The study was an institution based descriptive cross-sectional study.

3.4 Study procedure

The patients who were diagnosed of acute appendicitis by the attending clinician at the accident and emergency department were identified and subsequently underwent appendectomy and had a histopathology record were included consecutively from the surgical wards until the sample size population was attained. Structured questionnaires were used to collect data obtained from the case records. Informed consent was sought from patients and parents or guardians and assent was sought from children before inclusion. To maintain confidentiality the patient names were not included in the questionnaire rather a coding system was used. Data captured included

the demographic data (age and gender) of patient and the duration of onset of symptoms from the time of presenting to the hospital. The symptoms the patients presented with, which included any fevers, migratory pains, nausea/vomiting, RLQ pains and anorexia and the signs that were found on physical examination of the patient which included RLQ tenderness, rebound tenderness, pointing sign, Rovsings sign, Psoas sign and Obturator sign were also recorded. The vital signs which included the temperature, pulse rate and blood pressure were also included. The laboratory results which included the WBC counts with the differentials together with the radiological tests which included ultrasound findings done by the sonographer on duty were obtained from the case files and recorded on the questionnaire.

Alvarado scoring was done for all patients in the surgical wards by the principal investigator. This was calculated by assigning a numerical value for each sign and symptom and two laboratory parameters; namely the WBC counts and the neutrophil counts (found on presentation to the accident and emergency department prior to surgical intervention), and then summing them up to a maximum score of 10. The totals of the scores were grouped in ranges of 0 – 3, 4 – 6 and 7 – 10. Finally, the histopathological findings of the specimen, done by a qualified pathologist, were sought from the pathology laboratory and also recorded on the questionnaire. This was marked as the end of the study procedure.

All filled questionnaires were checked for completeness. The data was entered in a password secured MS Access at the end of each day for storage and backup. Analysis was done using SPSS statistics software.

3.4 Sample size determination

One of the objectives of the study was to estimate the rate of negative appendectomy at MTRH. A sample size formula by Daniel for estimating a single proportion in a finite population was used (Daniel, 1999).

$$n \geq \frac{NZ^2{}_{\alpha/2}P(1-P)}{d^2(N-1)+Z^2{}_{\alpha/2}P(1-P)}$$

Where:

n = Minimum sample size required

N = Total estimated accessible population (N = number of patients clinically diagnosed of appendicitis and appendectomy done at MTRH in 1 and half years [between 2013 January to June 2014] = 135)

$Z_{\alpha/2}$ = Critical value for standard normal distribution at α-level of significance (α=0.05, $Z_{\alpha/2}$=1.96)

p = Estimated prevalence (proportion of positively diagnosed appendicitis 0.82 [previous study done at KNH by Chavda et al., 2005]).

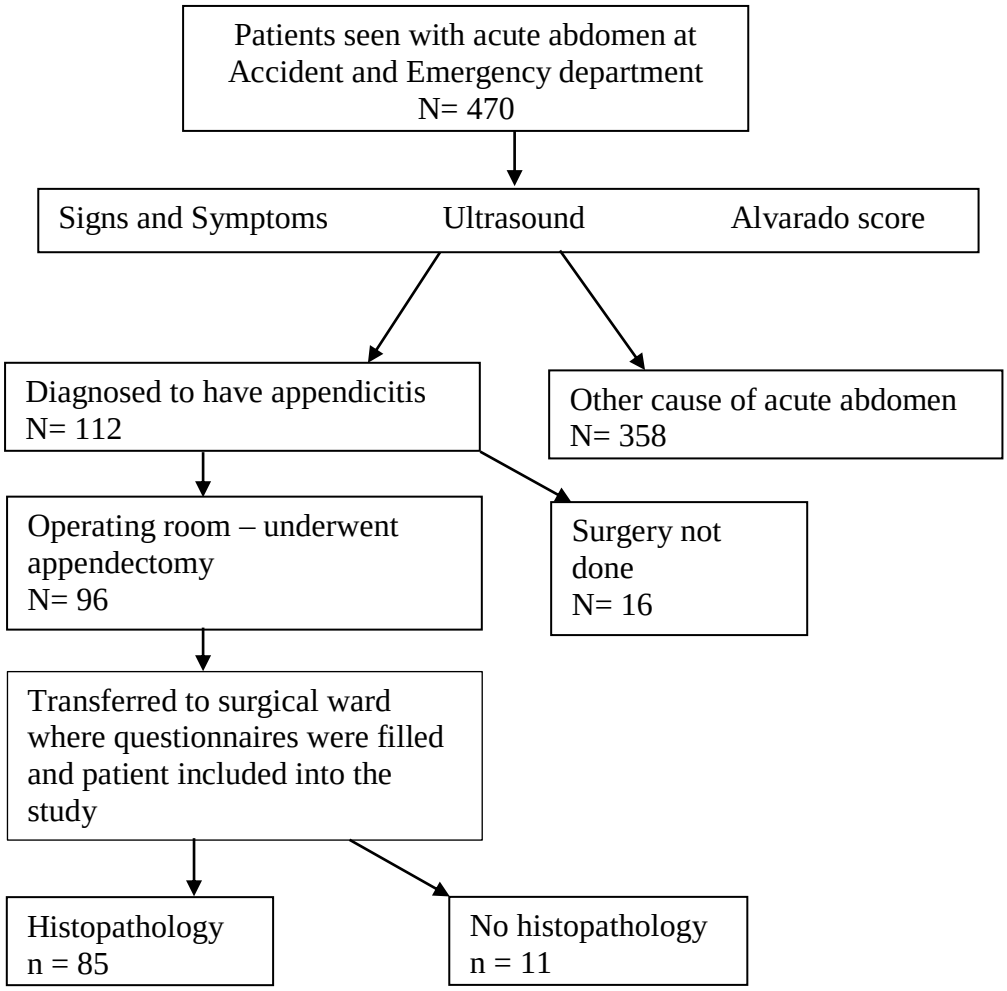
d = Margin of error set at 0.05

In substitution:

$$n = \frac{135 \text{ x } 1.96^2 \text{x } 0.82\ (1-0.82)}{0.05^2(135-1) + \ 1.96^2 \text{x } 0.82\ (1-0.82)} = 84.9, \textit{rounded up to } 85 \textit{ samples}$$

The minimum required sample size was 85

3.5 Sampling procedure



3.6 Eligibility criteria

3.6.1 Inclusion criteria

Patients that underwent appendectomy for a diagnosis of acute appendicitis within the time period of study at MTRH were included.

3.6.2 Exclusion criteria

1. Patients who did not have a histopathological diagnosis.

3.7 Data analysis and presentation

Measures of central tendency (mean and median) and dispersion (standard deviation and interquartile range) were used to summarize numerical variables such as age. Categorical variables such as sex were summarized using frequencies and proportions. Total row agreement level, sensitivity and specificity were calculated to compare the Alvarado and Ultrasound diagnosis of appendicitis with Histopathology. The results were presented in tables, charts, figures and in pros form.

3.8 Ethical consideration

1. The proposal, on approval by the supervisors was submitted to IREC for approval before commencing data collection.
2. Informed consent from the patient or parent/guardian was sought before inclusion in the study. Assent was sought from children above 7 years.
3. Information gathered was kept confidential and used only for the purpose of the study. No patient names or other identifying characteristics were used in the course of the study; instead, patient hospital numbers and codes were used to ensure confidentiality.
4. The research findings will be disseminated through publications and seminars.

CHAPTER FOUR: RESULTS

A total of 85 patients were included in the study.

4.1. Demographics

The age of participants ranged from 6 years to 64 years old with a mean of 27.0 (SD 12.3) years and a median of 26 years (IQR 17-36) years. The male to female ratio was 1.3: 1.

4.2. Duration of onset of symptoms to presentation

The duration of onset of symptoms varied from less than 1 day to up to 3 weeks. Majority of the patients (54%) presented within 3 days of onset of symptoms, 36% presented between 4 – 7 days while the rest took up to 21 days. The mean duration of onset of symptoms was 4.56 days (SD 4.34) and the median was 3.0 days.

4.3. Clinical presentation

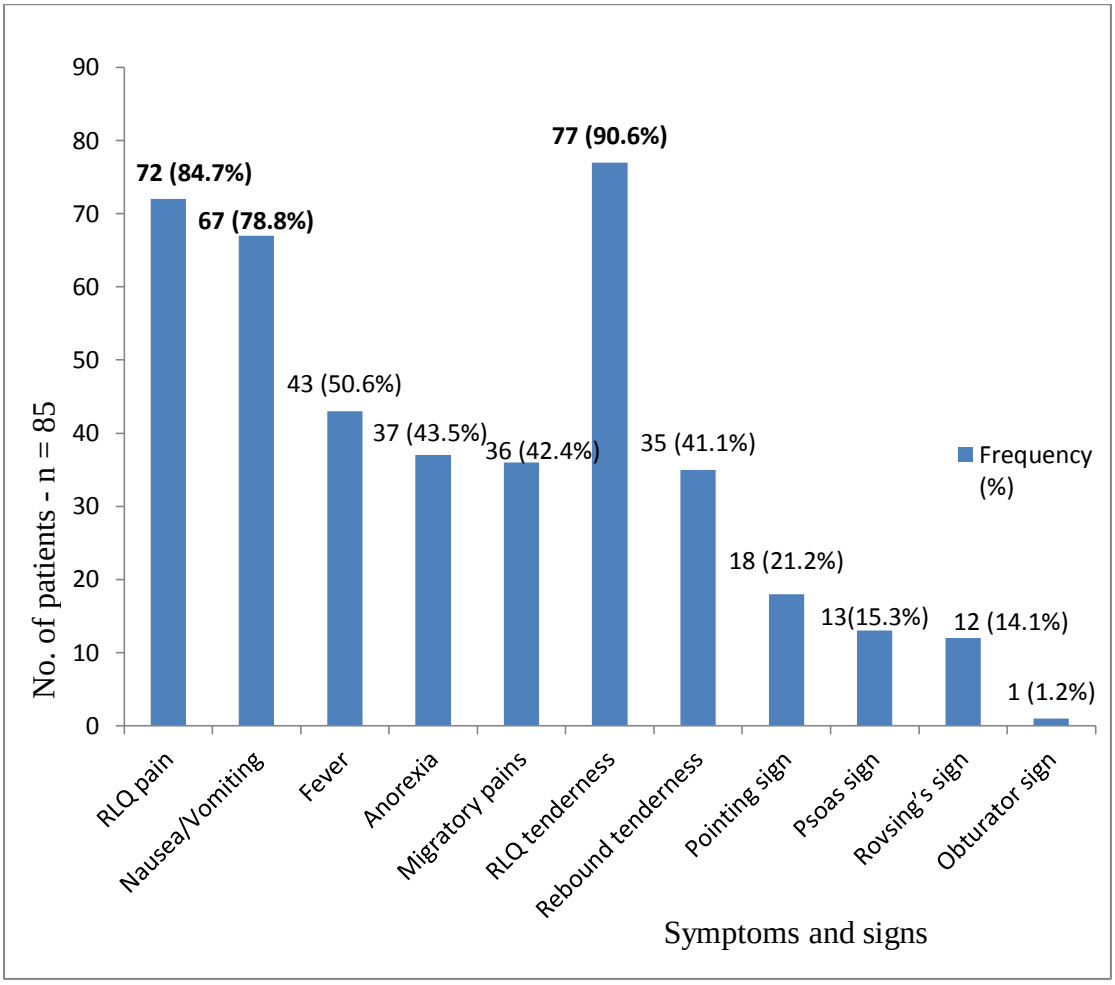


Figure 1: Symptoms and signs

Figure 1 highlights the symptoms and signs that the patients presented with. The leading symptoms were RLQ pain which was present in 84.7% (n=72) followed by nausea/vomiting which presented in 78.8% (n=67) patients. Peri-umbilical/migratory pains were reported in 42.4% (n=36) of the patients. The commonest sign was RLQ tenderness which was present in 90.6% (n=77) patients. This was followed by rebound tenderness in 41.2% (n=35).

4.4. Clinical scoring

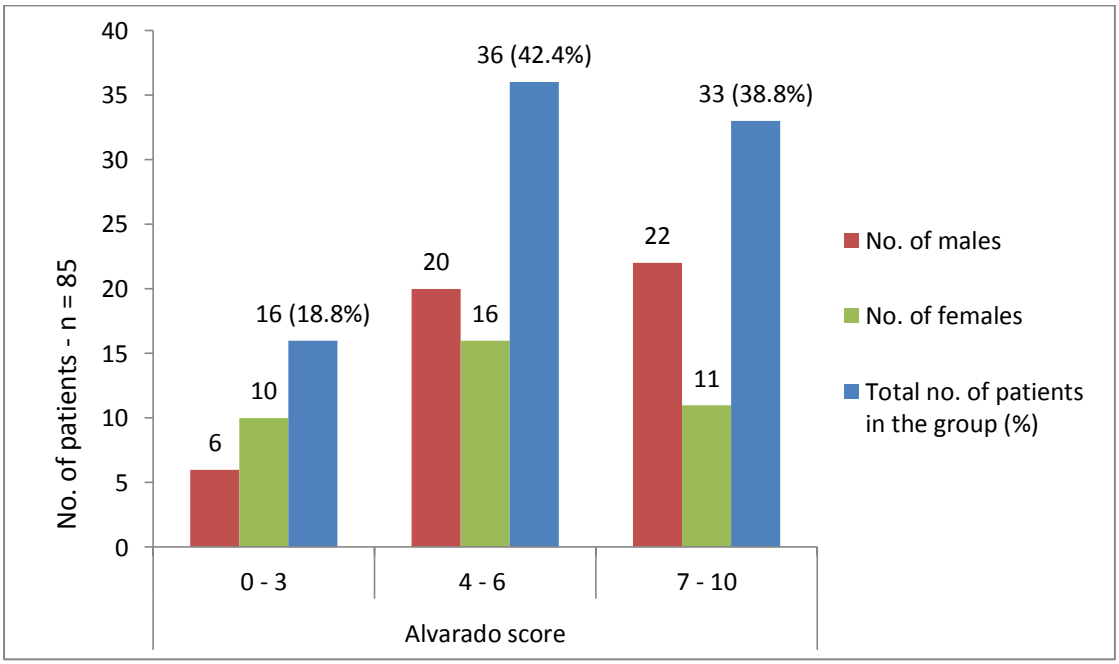


Figure 2: Alvarado score

As shown in the figure above, the majority of patients had an Alvarado score of 4 – 6 (42.4% n = 36) followed by 7 – 10 (38.8% n = 33).

4.5. Imaging

The imaging study that was done was predominantly an Abdomino-pelvic ultra sound (U/S). There was no patient in whom a CT scan or MRI was ordered. Eighty one patients, which accounted for the majority of the study population (95.3%), had an abdomino-pelvic ultrasound done. The findings were either reported as 'normal' or 'abnormal' based on the report by the sonographer (clinician performing the ultrasound examination). The normal findings meant not suggestive of appendicitis while the abnormal findings were suggestive of appendicitis. Majority of the ultrasound findings were suggestive of appendicitis (67% n = 57). The findings are illustrated in the figure below.

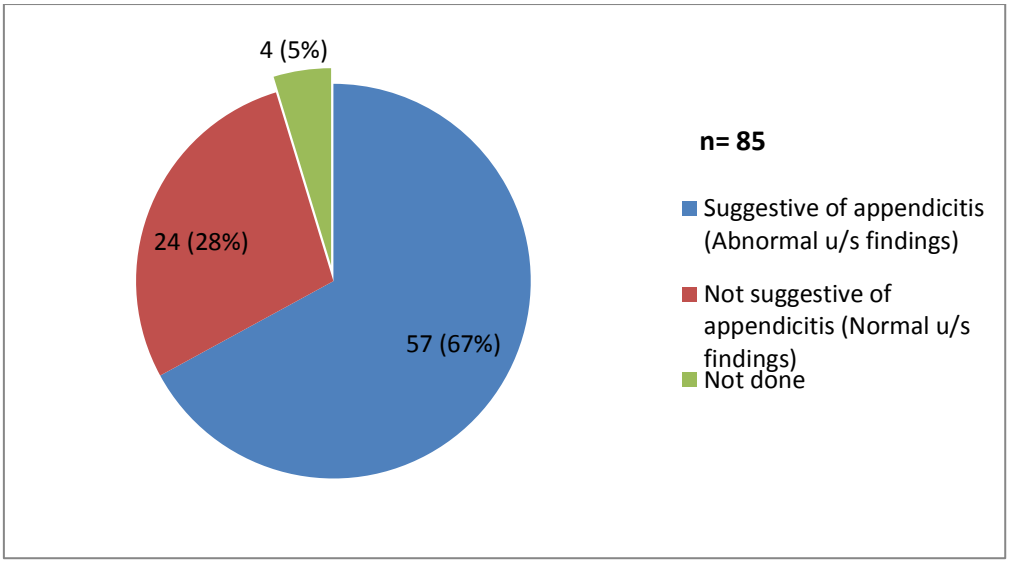


Figure 3: Ultrasonographic findings

4.6. Histopathological finding

A total of 21 patients who had appendectomy done for clinical diagnosis of acute appendicitis did not have appendicitis on the histopathological exam. This accounted for overall negative appendectomy rate of 24.7%. Figure 5 below depicts the findings.

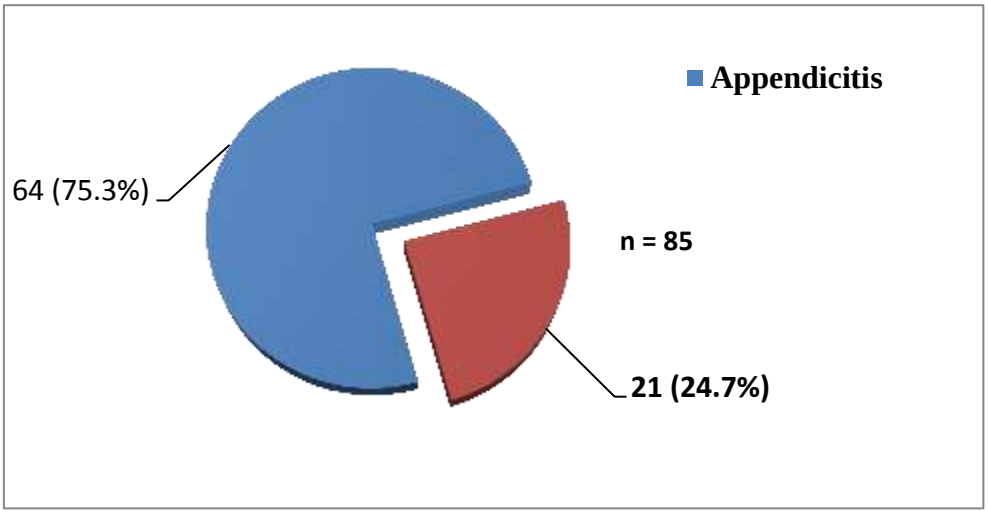


Figure 4: Histopathological findings

The negative appendectomy rate was much higher in females (32.4%) as compared to males (18.7%). This is highlighted in the figure below.

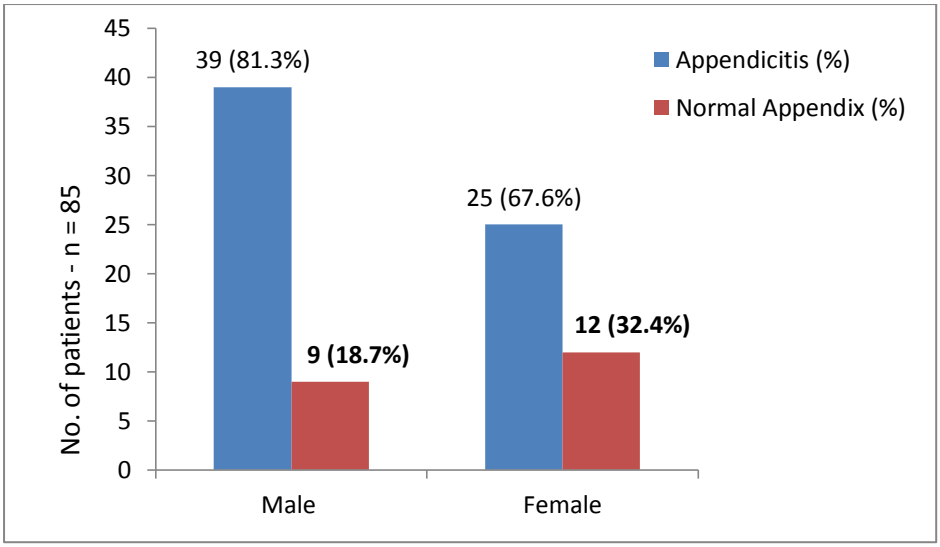


Figure 5: Negative appendectomy rates between genders

4.7. Validity of Alvarado score

The negative appendectomy rate reduced as the Alvarado scores increased (P value < 0.001). There was a 62.5% negative appendectomy rate in the 0 – 3 score group (10 out of 16 patients) as compared to 25% in the 4 – 6 score group (9 out of 36 patients) and 6.1 % in the 7 – 10 score group (2 out of 33 patients).

For the patients who had an Alvarado score group of 0 – 3, only 37.5% had appendicitis on histopathology. In the 4 – 6 Alvarado score group, 75% of the patients actually had appendicitis on histopathology while in the 7 – 10 score group, 93.9% had appendicitis on histopathology. The figure below depicts this.

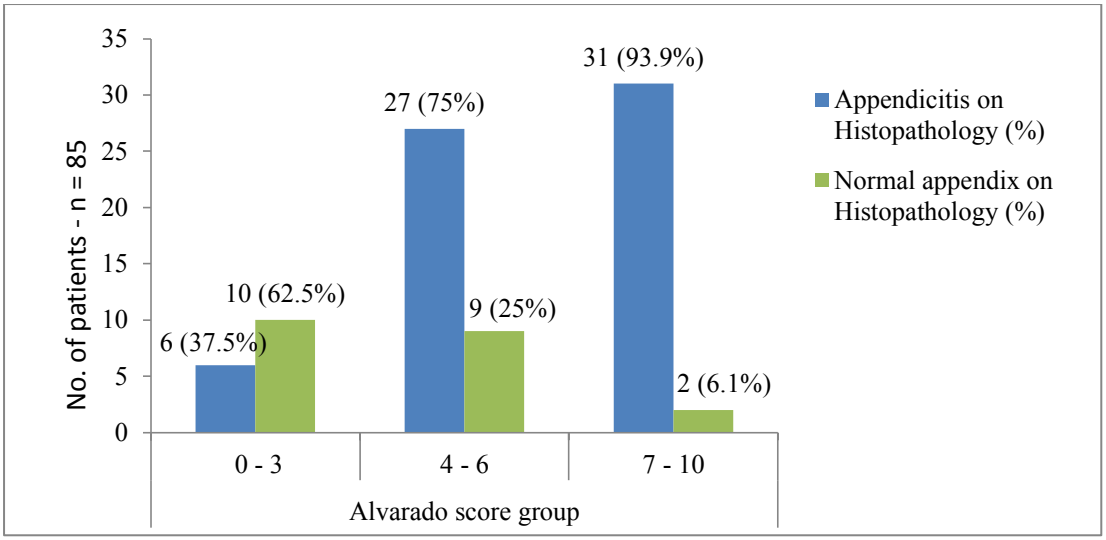


Figure 6: Histopathology compared with the Alvarado score

Two by two tables were constructed to calculate the sensitivity, specificity, predictive values and accuracy of the Alvarado score. It was assumed that the Alvarado score of 0 – 3 is a negative test for appendicitis while a score of ≥ 4 is a positive test for appendicitis. Two cut off points were set on the Alvarado scale to calculate these values; the first at a score of ≥ 4 and the other at ≥ 7.

Table 3: Alvarado score cut off set at ≥ 4

		Disease		
		Appendicitis on Histopathology	Normal appendix on histopathology	Total (n)
Test	Alvarado score 4 - 10	58	11	69
	Alvarado score 0 - 3	6	10.0	16
	Total	64	21	85

$$\text{Sensitivity} = \frac{\text{True test positive (n=58) x 100}}{\text{Total patients with appendicitis on histopathology (n=64)}} = 90.6\%$$

$$\text{Specificity} = \frac{\text{True test negative (n=10) x 100}}{\text{Total patients with normal appendix on histopathology (n=21)}} = 47.6\%$$

$$\text{Positive predictive value (PPV)} = \frac{\text{True test positive (n=58) x 100}}{\text{Total patients with positive test (n=69)}} = 84.1\%$$

$$\text{Negative predictive value (NPV)} = \frac{\text{True test negative (n=10) x 100}}{\text{Total patients with negative test (n=16)}} = 62.5\%$$

The overall (when the cutoff point is set at ≥ 4) sensitivity of the Alvarado score was 90.6% with a specificity of 47.6%. The positive predictive value (PPV) was 84% and the negative predictive value (NPV) was 62.5%.

Table 4: Alvarado score cut off set at ≥ 7

		Disease		
		Appendicitis on Histopathology	Normal appendix on histopathology	Total (n)
Test	Alvarado score 7 - 10	31	2	33
	Alvarado score 0 - 6	33	19	52
	Total	64	21	85

$$\text{Sensitivity} = \frac{\text{True test positive (n=31) x 100}}{\text{Total patients with appendicitis on histopathology (n=64)}} = 48.4\%$$

$$\text{Specificity} = \frac{\text{True test negative (n=19) x 100}}{\text{Total patients with normal appendix on histopathology (n=21)}} = 90.5\%$$

$$\text{Positive predictive value (PPV)} = \frac{\text{True test positive (n=31) x 100}}{\text{Total patients with positive test (n=33)}} = 93.9\%$$

$$\text{Negative predictive value (NPV)} = \frac{\text{True test negative (n=19) x 100}}{\text{Total patients with negative test (n=52)}} = 36.5\%$$

For the Alvarado score group of 7 – 10, the sensitivity, specificity, PPV and NPV was 48.4%, 90.5%, 93.9% and 36.5% respectively.

4.8. Comparing the histopathology with ultrasound findings.

Ultrasound findings suggestive of acute appendicitis corresponded to positive histopathological findings in 75.4% of patients. Ultrasound findings of a normal appendix corresponded to normal histopathological findings in only 25% of patients. This is illustrated in the table below.

Table 5: Histopathology compared with ultrasonography findings

	Appendicitis on histopathology	Normal appendix on histopathology	Total
Appendicitis on ultrasound	43	14	57
No appendicitis on ultrasound	18	6	24
Total n = 81	61	20	81

$$\text{Sensitivity} = \frac{\text{True abnormal ultrasound (n=43) x 100}}{\text{Total patients with appendicitis on histopathology (n=61)}} = 70.5\%$$

$$\text{Specificity} = \frac{\text{True normal ultrasound (n=6) x 100}}{\text{Total patients with normal appendix on histopathology (n=20)}} = 30\%$$

$$\text{Positive predictive value (PPV)} = \frac{\text{True abnormal ultrasound (n=43) x 100}}{\text{Total patients with Abnormal ultrasound (n=57)}} = 75.4\%$$

$$\text{Negative predictive value (NPV)} = \frac{\text{True normal ultrasound (n=6) x 100}}{\text{Total patients with Normal ultrasound (n=24)}} = 25\%$$

The sensitivity of the ultrasound in diagnosing appendicitis was 70.5% with a specificity of 30%. The PPV was 75.4% and NPV was 25%.

CHAPTER FIVE: DISCUSSION

In this study a total of 85 patients were clinically evaluated to have appendicitis. The male to female ratio of 1.3:1 and the age range from 6 years to 64 years captured in this study with majority of them being in their third decade of life, was found to be comparable to previous studies done in Kenya and other places across the world (Alvarado, 1986; Chavda et al., 2005; Dave, Dharaviaparmar, Vaghasiya, Vekariya, & Sankhala, 2016; Guss & Richards, 2000; Ongaro, 2005). The demographic pattern suggest that acute appendicitis could be a possibility in both genders and at any age, though, the clinician should have a high index of suspicion in patients presenting in their third decade.

Majority of the patients (90.4%) presented within 7 days of onset of symptoms, of which 54.1% presented within 3 days. Similar findings were reported at KNH where 50% of the patients presented within 3 days of onset of symptoms (Ongaro, 2005). The remaining, 10.1%, had symptoms of more than 7 days. Late presentation of more than 3 days could be due to the patients delay in seeking professional help.

This study showed that the commonest symptoms were RLQ pain which presented in 84.7% and nausea/vomiting which presented in 78.8% patients. These symptoms had a high sensitivity but a very low specificity. This makes it not to be very reliable especially when used solely to make a judgment of acute appendicitis as it can give a high false positive rate. Fevers were reported to be present in 50.6% of patients, Anorexia in 43.5% while Peri-umbilical or Migratory pains was the least commonest symptom seen in only 42.4% of the patients. The study done in Karachi showed similar results (Memon et al., 2013). The study done at KNH reported that RLQ pain was commonest, followed by Peri-umbilical or Migratory pains (Chavda et al., 2005).

Dave et al reported Migratory pain and tenderness to be present in 100% patients, while fever, vomiting and anorexia present in approximate 70% to 80% patients (Dave et al., 2016). In Nigeria, Babatunde reported the most common symptom was RLQ abdominal pain in 95% which later became generalized in 21.8% of cases. The other symptoms included fevers in 81%, vomiting in 56% and anorexia in 48% (Duduyemi, 2015).

The common signs to look for in acute appendicitis are RLQ tenderness and Rebound tenderness. There are many other clinical signs that the physician can assess to help in the diagnosis. In this study RLQ tenderness was present in 91.0% patients and had a high sensitivity but a low specificity thus also making it not very reliable to make a diagnosis of appendicitis if used on its own. Rebound tenderness was found in only 38.2% and had a low sensitivity but a higher specificity. This makes it also not very reliable as it would give a high false negative rate if used solely to make a diagnosis of appendicitis. Similar findings were documented at KNH (Chavda et al., 2005). Pointing sign was present in 21.3 %, Rovsing's sign in 11.2%, while Psoas and Obturator were present in only 13.5 % and 1.1 % of patients respectively. These findings were also similar to studies done at KNH (Chavda et al., 2005).

All appendectomy specimens are usually sent to the laboratory for histopathological diagnosis. Histopathology was done by a qualified pathologist. Examination revealed 75.3% had appendicitis while 24.7% had a normal appendix. Patients who had negative appendectomies were followed up by the clinicians in the outpatient department. Babatunde in Nigeria, reported negative appendectomy rate of 4.1% (Duduyemi, 2015). In this study, females had a higher negative appendectomy rate of 32.4% as compared to males with 18.7%. Higher negative appendectomy rates in

females are speculated to be as a result of other gynaecological pathologies that mimic appendicitis in females. This is also similar to what was found in other studies (Chavda et al., 2005; Gupta et al., 2010; Memon et al., 2013).

It was found that 18.8% of the patients had an Alvarado score of between 0 – 3, of which females accounted for 62.5% and males were 37.5%. Only 37.5% of patients in this group had a true positive appendicitis (as confirmed by histopathology) while 62.5% had a negative appendectomy done (histology revealed a normal appendix).

Most patients (42.4%) had an Alvarado score between 4 – 6, of which females accounted for 44.4% and males were 55.6%. The patients in this group who had a true positive appendicitis (as confirmed by histopathology) accounted for 75% while 25% had a negative appendectomy done (histology revealed a normal appendix).

The patients who were scored in the 7 – 10 Alvarado group accounted for 38.8%, of which females were 33.3% and males 66.7%. The majority (93.9%) of patients in this group had a true positive appendicitis (as confirmed by histopathology) while only 6.1% had a negative appendectomy done (histology revealed a normal appendix).

The negative appendectomy rates of 62.5%, 25% and 6.1% in the score groups of 0 – 3, 4 – 6, and 7 – 10 respectively suggest that as the Alvarado scores increases, the chances of having a true positive appendicitis increases, thus lowering the rate of negative appendectomy. Zahid in his study reported that the negative appendectomy rate for the score of <6 was 83.3% whereas 7.7% had a negative appendectomy in the Alvarado score group of >7 (Memon et al., 2013).

From the results of this study, if only patients with scores of ≥ 4 are considered for appendectomy and patients who score ≤ 3 are further worked up by other imaging modalities like the CT scan before being considered for appendectomy, then the chances of negative appendectomy rates would reduce to 15.9% from 24.7%. However, careful monitoring should be done not to miss the diagnosis in the few (37.5%) that had appendicitis in the 0 – 3 group. Short term monitoring in the ward and re-scoring the patient makes the diagnosis clearer (LG Graff et al., 1989). Those whose Alvarado scores continue to increase should be operated while those whose scores reduce or remain the same and clinically do not worsen should not be operated on. On the other hand, if the cutoff point of the Alvarado score was set for ≥ 7, then the negative appendectomy rates would even reduce further to 6.0%. However, there would be higher chances of missing patients with acute appendicitis in up to 63.4% from the Alvarado scores of 0 – 6 bringing about a higher incidence of perforation in this population. To include more cases of appendicitis, the cutoff needs to be as low as possible, but on the other hand, a very low cutoff could increase the negative appendectomy rate. Thus, a balance needs to be set on the Alvarado scale where the surgeon needs to decide on whom to operate.

The sensitivity of the score is the ability to detect true positives while the specificity of the score is the ability to detect true negatives. The positive predictive value is the ability of the test to detect true positives from total positives while the negative predictive value is the ability of the test to detect true negatives from total negatives. The accuracy of the test is the overall ability to identify or exclude the disease correctly (Baratloo, Hosseini, Negida, & El Ashal, 2015).

Dave et al reported that as score increases sensitivity decreases while specificity increases and positive predictive value increases while negative predictive value decreases (Dave et al., 2016). Similar findings were noted in this study. When the cutoff was set at a score of ≥ 4, then the sensitivity, specificity, PPV and NPV were 90.6%, 47.1%, 84% and 62.5% respectively. But when the cut-off for Alvarado score was set at ≥ 7, then the values were 48.4%, 90.4%, 93.93% and 36.5% respectively.

This shows that there is an inverse relationship between the cutoff points at the Alvarado score. At low cutoff point for the diagnosis of appendicitis, where the sensitivity is high but the specificity is low, few cases of appendicitis would be missed but the negative appendectomy rate would be high. When the cut off point for diagnosis is set higher on the Alvarado score, the sensitivity reduces but the specificity increases, thus there would be fewer cases of negative appendectomies but there would be more missed diagnosis for acute appendicitis hence higher rates of perforation.

The higher sensitivity at score of ≥ 4 is because the Alvarado score failed to detect only 6 patients who actually had appendicitis, but as the score increases at cut-off of ≥ 7, the sensitivity is very low because a bigger number (n=33) of patients who actually have appendicitis are missed. The low specificity when cut-off set at ≥ 4 can be explained by the fact that 11 patients were operated when they did not actually have appendicitis, meaning that the Alvarado score failed to detect true negatives in these patients. But as the score is set higher at ≥ 7, then the Alvarado score fails to detect only 2 true negatives thus the specificity is higher. Failure of the Alvarado score to detect true negatives could be due to other pathologies mimicking acute appendicitis at low scores. Clinicians should be wary of ruling-in acute appendicitis at very low

Alvarado scores. This study found the accuracy of the Alvarado score to be better at cut-off of ≥ 4 than at cut-off of ≥ 7.

Majority (95.5%) of the patients were sent for an ultra sound test in an effort to augment on the clinical diagnosis of acute appendicitis. Ultrasound examination on these patients was done by sonographers with basic skills in ultrasonography who would be available on duty at that particular time and not by the residents or consultants in radiology with higher training and experience. Three ultrasound machines with different make (Phillips HD11XE, Mindray UMT-300 and Aloka) were available for use. In this study, 72% of the ultrasounds were suggestive of appendicitis. The Sensitivity of the U/S was 70.5% and specificity was 30%. The sensitivity of the U/S in this study was considerably lower to what was found by Mwangi at KNH who reported the sensitivity of 93.5% and specificity of 26.7% (Mwangi, Ngugi, Oliech, & Ndaguatha, 2012). Despite having a variety of ultrasound machines, the accuracy was found to be low. This could be explained by the fact that it was being performed by many different sonographers and some may not be having much experience.

Study limitations

As for the limitations of this study, there could have been a selection bias at the time of diagnosis by the attending clinician at the accident and emergency department. Some patients who could be having acute appendicitis may not have been sent for surgery, rather treated medically and sent for follow-up through the clinics. This could have been countered by sending all patients for an abdominal CT scan which has been shown to have a high sensitivity and specificity in the detection of acute appendicitis

(Elghany & Ali, 2011). However, because of limited resources and also exposure to radiation in children and in pregnant women, this was not feasible in this study.

Also as a limitation was that the ultrasonography was not done by a qualified radiologist or the residents in radiology, rather, was being done by any sonographer who was on duty at that particular time when it was requested. Ultrasonography is a user-dependent modality, and, some sonographers might not have been very experienced. An experienced radiologist doing all the ultrasound scans may have given a better accuracy.

Another limitation was the assumption made that the histopathology diagnosis of the appendicular specimen was always accurate and considered the ‘gold standard’. This however, is not always true as there could be false negative reports on histopathology in cases of very early acute appendicitis if the whole specimen is not analyzed by the pathologist. Nevertheless, the strong point on histopathology was that it was always done by a qualified and experienced pathologist.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

1. Common symptoms and signs of acute appendicitis that the patients present with are RLQ pain, nausea or vomiting and RLQ tenderness.
2. The application of the Alvarado at cut-off of ≥ 4 is an effective system in helping to make a diagnosis of acute appendicitis. The sensitivity was 90.6% and specificity was 47.6%. Negative appendectomy rates reduced as the score increased. There is no standard operating protocol that is currently being followed for the diagnosis of acute appendicitis at MTRH.
3. The sensitivity of ultrasound at MTRH was 70.5% while the specificity was 30%. Ultrasonography cannot be relied upon on its own to make the diagnosis of acute appendicitis at MTRH.
4. Negative appendectomy rate at MTRH is 24.7%. Females had a higher negative appendectomy rate of 32.4% as compared to males with 18.7%.

6.2. Recommendations

1. Standard operating protocol should be developed to make use of the Alvarado score to make a diagnosis as it would reduce the negative appendectomy rates.
2. The patients in the score group of 7 – 10 should immediately be prepared for appendectomy while the patients with scores of 4 – 6 should be considered for appendectomy if no other pathology can be found and scores of 0 – 3 should be observed and re-evaluated before making a decision to operate.
3. Ultrasound, on its own, should not be heavily relied upon in diagnosis of acute appendicitis at MTRH.

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APPENDICES

Appendix 1: Questionnaire

Code……

1. IP NO…….....
2. Age ……
3. Sex: Male □ Female □
4. Duration of onset of symptoms ……..
5. Presenting symptoms

   Fever □ Migrating Pain □ Nausea/Vomiting □

   RLQ pain □ Anorexia□
6. Presenting signs on physical examination.

   RLQ tenderness □ Rebound Tenderness □

   Pointing sign □ Rovsing's Sign □ Psoas sign □

   Obturator sign □
7. Temperature on admission. …….
8. Pulse on admission……
9. Blood pressure on Admission …….
10. WBC count ……

    Neutrophil count ……

    Lymphocyte count ……. Alvarado score _____
11. Haemoglobin Concentration ……
12. Creatinine…….
13. Urea…….

14. Electrolytes. Na^+ …….. K^+ ……. Cl^- …….....

15. Urinalysis results (include PDT in females)

    ……

16. Any other investigations ordered and results.

    ……..…

    ……

17. Patient sent for Radiology. Yes □ No □ If yes, what was done?

    U/S □ CT scan □ MRI □

    Results : Suggestive of Appendicitis □

    Not suggestive of Appendicitis □

18. Intra-operative finding on the appendix.

    Grossly normal appendix □

    Grossly inflamed appendix □

    Supurative appendix □

    Appendicular abscess□

19. Histopathological finding on the specimen.

    Normal Appendix □

    Appendicitis □

Appendix 2: Consent Form
ENGLISH

TITLE: MODIFIED ALVARADO SCORE AND ULTRASONOGRAPHY IN THE DIAGNOSIS OF ACUTE APPENDICITIS AT MOI TEACHING AND REFERRAL HOSPITAL

INVESTIGATOR – DR. RIZWAN SALYANI.

TEL: 0721 983 183.

I …….……..…….

[Or in case of minor, the (parent/guardian) for ……...]

confirm that the purpose of this study and my role have been well explained to me by Dr. RIZWAN SALYANI (Or his appointed assistant). I agree to the conditions explained and give consent to be included in the study.

I have understood that the study is about correlating the clinical diagnosis of appendicitis made by the clinician with the actual histopathological findings made by the pathologist in the laboratory after I undergo appendectomy and my tissues are sent to the laboratory for evaluation. This study shall neither directly benefit me nor pose a risk of any kind, but would have a beneficial impact on the patients in future once the results have been analyzed.

I have understood that to participate in this study, I shall volunteer information regarding my illness and other co-morbidities and undergo medical examination. I am aware that I can withdraw from this study at any time without prejudice to my right of treatment at MTRH now or in the future.

I have also been assured that all information shall be treated and managed in confidence.

I have not been induced or coerced by the investigator (or his appointed assistant) to cause my signature to be appended in this form and by extension participate in this study.

Name……

Sign……..

IP No……....

Witness ……...

Sign…….

Date…….

SWAHILI

MADA: MODIFIED ALVARADO SCORE NA ULTRASONOGRAPHY KATIKA UCHUNGUZI WA UGONJWA WA TUMBO KATIKA HOSPITALI YA MTRH.

Mpelelezi - Dkt. RIZWAN SALYANI.

SIMU: 0721 983183.

Mimi……..…….[A u katika kesi ya mtoto, (mzazi / mlezi) kwa.....] nathibitisha kwamba nafasi yangu katika lengo la somo hili imefahamishwa vizuri kwangu na Dk. RIZWAN SALYANI (Au msaidizi wake maalumu). Mimi nakubaliana na hali alinielezea nakutoa idhini kwa kuhusiana katika utafiti. Mimi naelewa kuwa utafiti ni kuhusu uchunguzi wa kimatibabu wa tumbo yaliyotolewa na daktari na halisi matokeo yaliyotolewa na daktari katika maabara baada ya mimi kutolewa upande wa tumbo katika chumba cha upasuaji na tishu yangu kupelekwa maabara kwa ajili ya uchunguzi zaidi. Utafiti huu haitanifaidi mimi moja kwa moja wala kuhatarisha kwa aina yoyote, lakini itamanufaa wagonjwa katika siku zijazo ijapo matokeo kuchambuliwa.

Mimi naelewa kuwa kwa kushiriki katika utafiti huu,nami kujitolea habari kuhusu ugonjwa wangu na kufanyiwa uchunguzi wa matibabu. Nina tambua kwamba naweza kujiondoa katika utafiti huu wakati wowote bila ya kuathiri haki yangu ya matibabu katika MTRH sasa au katika siku zijazo.

Mimi pia nimepewa uhakika kwamba taarifa zote kuhusu ugonjwa wangu zitakuwa zimewekwa siri kwa watu wasiokuwa wanashughulika na utafiti huu.

Mimi sijalazimishwa na mpelelezi (au msaidizi wake maalumu) na kusababisha sahihi yangu kuwa umeongezewa katika fomu hii kushiriki katika utafiti huu.

Jina.....

Saini.....

IP No. .....

Shahidi.....

Saini.....

Tarehe.....

Appendix 3: IREC Approval

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET

Reference: IREC/2014/130
Approval Number: 0001245

25th August, 2014

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
25 AUG 2014
APPROVED
P.O. Box 4606-30100 ELDORET

Dr. Rizwan Ayoob Salyani,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

Ms. Dr. Salyani,

RE: FORMAL APPROVAL

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

"Correlation between the Clinical Diagnosis and Histopathological Findings in Appendicitis at Moi Teaching and Referral Hospital."

Your proposal has been granted a Formal Approval Number: ***FAN: IREC 1245*** on 25th August, 2014. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 24th August, 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

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2014/130
Approval Number: 0001245

3rd February, 2016

Dr. Rizwan Ayoob Salyani,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
APPROVED
P.O. Box 4606-30100 ELDORET

Dear Dr. Salyani,

RE: CONTINUING APPROVAL

The Institutional Research and Ethics Committee has reviewed your request for continuing approval to your study titled:-

"Correlation between the Clinical Diagnosis and Histopathological Findings in Appendicitis at Moi Teaching and Referral Hospital".

Your proposal has been granted a Continuing Approval with effect from 3rd February, 2016. You are therefore permitted to continue with your study.

Note that this approval is for 1 year; it will thus expire on 2nd February, 2017. 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	-	SOD
Principal	-	CHS	Dean	-	SPH
Dean	-	SOM	Dean	-	SON

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference IREC/2014/130
Approval Number: 0001245

4th October, 2016

Dr. Rizwan Ayoob Salyani,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
04 OCT 2016
APPROVED
P. O. Box 4606-30100 ELDORET

Dear Dr. Salyani,

RE: APPROVAL OF AMENDMENT

The Institutional Research and Ethics Committee has reviewed the amendment made to your proposal titled:-

"Correlation between the Clinical Diagnosis and Histopathological findings in Appendicitis at Moi Teaching and Referral Hospital".

We note that you are seeking to make an amendment as follows:-

1. To change sample size by adjusting for finite population from 113 respondents to 85 respondents.

The amendment has been approved on 4th October, 2016 according to SOP's of IREC. You are therefore permitted to continue with your research.

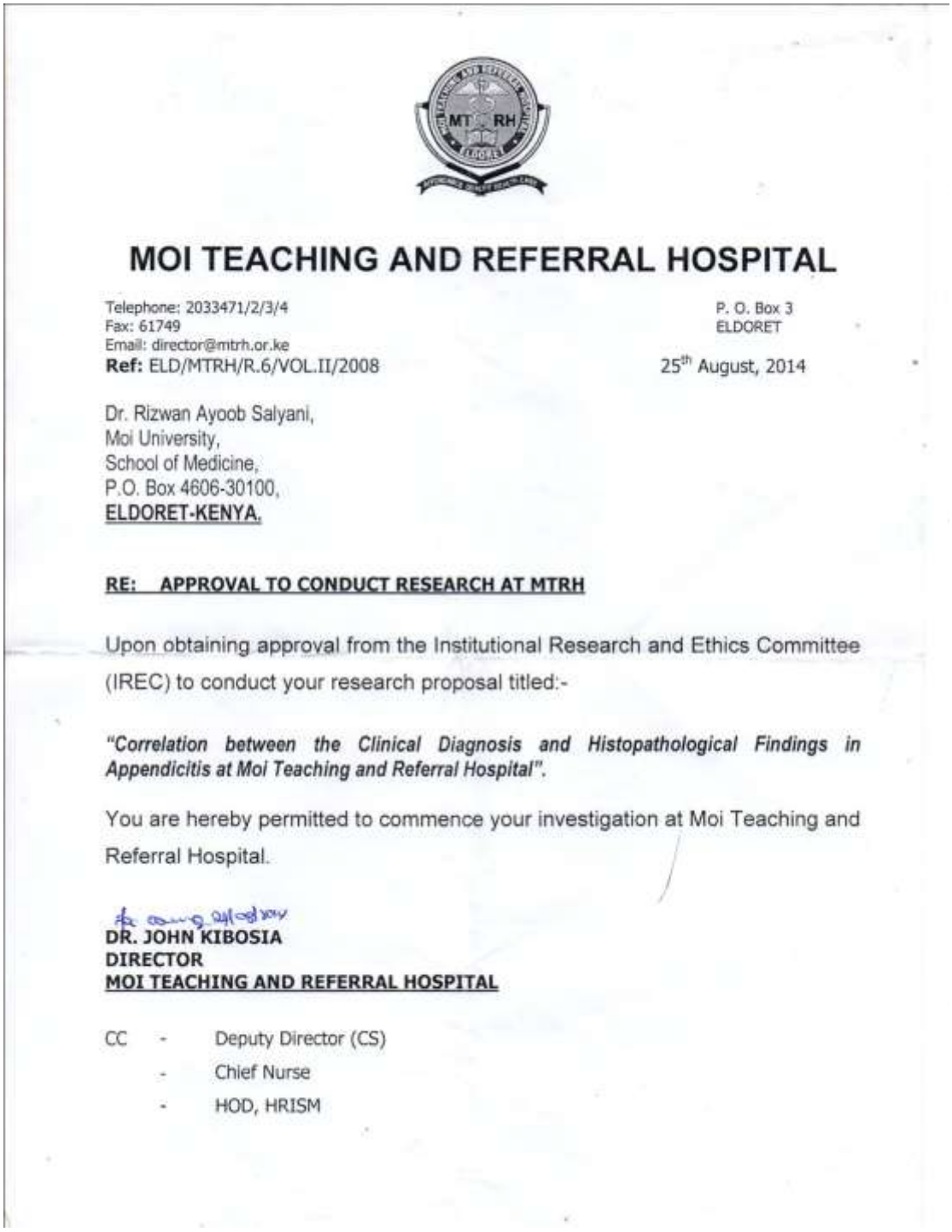
You are required to submit progress(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change(s) or amendment(s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive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

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc: CEO - MTRH, Dean - SPH, Dean - SOM
Principal - CHS, Dean - SOD, Dean - SON

Appendix 4: Hospital Approval



MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4
Fax: 61749
Email: director@mtrh.or.ke
Ref: ELD/MTRH/R.6/VOL.II/2008

P. O. Box 3
ELDORET

25th August, 2014

Dr. Rizwan Ayoob Salyani,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET-KENYA.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

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

"Correlation between the Clinical Diagnosis and Histopathological Findings in Appendicitis 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
- HOD, HRISM

Appendix 5: Study budget

It has been taken into consideration all the costs that have been met during the study period.

Item:	**Amount in KShs.**
Secretarial services	5,000
Printing	10,000
Photocopying	10,000
Binding	5,000
IREC Fees	1,000
Transport	10,000
Statistics	20,000
Miscellaneous	15,000
Total	**76,000**

Appendix 6: Study Timeline

Activity	**Duration**
Selection of topic – In December 2014	2 months
Literature review and proposal writing – In February 2014	6 months
Submission to IREC – In July 2014	1 month
Approval by IREC	1 month
Data collection from January 2015	18 months
Writing the thesis report	6 months
Submission of abstract and thesis reports	8 months
Oral defense of thesis	Done on 30th October 2018