

ACUTE  
APPENDICITIS  
AND  
NEGATIVE  
APPENDICECTOMY  
AT  
KENYATTA NATIONAL  
HOSPITAL

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**STUDY TOPIC**

**EVALUATION OF THE USEFULNESS OF  
MODIFIED ALVARADO SCORING SYSTEM  
REGARDING EARLY DIAGNOSIS OF ACUTE  
APPENDICITIS AND IN REDUCTION OF  
NEGATIVE APPENDICECTOMIES AT KENYATTA  
NATIONAL HOSPITAL: A PROSPECTIVE STUDY**

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A DISSERTATION SUBMITTED AS PART FULFILMENT  
FOR THE DEGREE OF MASTER OF MEDICINE (SURGERY).  
UNIVERSITY OF NAIROBI

2005

# DECLARATION

CANDIDATE:

I HEREBY DECLARE THAT THIS DISSERTATION IS MY ORIGINAL WORK AND HAS NOT BEEN SUBMITTED FOR A DEGREE AWARD IN ANY OTHER UNIVERSITY.

SIGNED.....



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DATE .....

30/05/05

SUPERVISOR

THIS DISSERTATION HAS BEEN SUBMITTED FOR EXAMINATION WITH MY APPROVAL AS THE UNIVERSITY SUPERVISOR.

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# **DEDICATION**

**This dissertation is dedicated to my beloved ones: KERUBO, BWARI, MWANGO, SEBE, BOSI and to my late mother who never lived long enough to see my progress in life.**

# **ACKNOWLEDGEMENTS**

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## SUMMARY

### ABSTRACT

#### AIM

The aim of the study was to evaluate the impact of the modified Alvarado score on the negative appendectomy rate in acute appendicitis.

#### SETTING

KNH emergency department, general and paediatric surgical units, Nairobi, Kenya..

#### MATERIALS AND METHODS

A prospective study was undertaken between June 30th, and December 30th, 2004 that included 116 patients who presented with a suspicion of acute appendicitis and underwent appendectomy. All the patients were examined and a sample for haemogram taken at the emergency department to facilitate the scoring. The patients were then followed up to the ward a decision to operate on them was made independent of the score, but based on the operator's clinical judgment. At surgery, all the 116 patients had their gross intra-operative findings noted, specimen taken for histopathological reporting. The histopathological findings were used to verify the true diagnosis of acute appendicitis.

#### RESULTS

A total of 116 patients aged between seven and fifty-five years with an average age of twenty-seven point zero one (27.03 ( 9.87) years had appendectomy and specimens taken for histopathological analysis. Seventy-nine patients were males whereas thirty-seven patients were females giving a ration of 2.1:1. All the 116 specimens were processed, 87 (75%) were reported as positive for acute appendicitis and the rest 29 (25%) as normal vermiform appendix. The patients who had a score 0-4 points were 20 out of which 16 (13.7)% patients had normal appendectomy and 4 (3.4%) had acute

appendicitis. Those who scored 5-6 points were 35 patients, and 27 (23.3%) had acute appendicitis whereas 8 (6.8%) had normal appendicectomy. Those who scored 7-10 points were 61 patients, and 56 (48.3%) had acute appendicitis whereas 5 (4.3%) had unnecessary appendicectomy. The overall negative appendicectomy rate (NA) was 25%, of which 21.5% of the males and 32.5% of the females had normal appendix removed. The modified Alvarado score adjusted NA rate was calculated to be 11.2%(p value of 0.000)

## **CONCLUSIONS**

The study showed a male preponderance ratio of 2.1:1, with a peak age incidence between 10-30 years. Twenty five percent of the appendicectomies were normal based on clinical judgment of the senior house officers. When Modified Alvarado score was applied in retrospect the negative appendicectomy rate reduced to 11.2% (p value of 0.000).

## INTRODUCTION

Acute appendicitis sometimes can pose a diagnostic challenge and various methods have been advocated to assist in clinical judgment of these cases so as to avoid surgery of removing otherwise a normal appendix as well as avoid a missed acute appendicitis. Radiological methods such as ultrasonography and CT-scan, as well as laparoscopy have been used and investigated. (1-3). Many diagnostic scores have been advocated but most are complex and hence difficult to apply in a clinical situation (4).

The Alvarado score, first described in 1986 and later modified, is a simple scoring system that can be instituted easily in the outpatient settings (5). Studies show that the modified Alvarado score is most accurate only at the extreme of the total score. However good clinical judgment remains the mainstay of correct diagnosis of acute appendicitis (6,7). General practitioners and casualty officers face a difficulty problem when presented with a patient with an equivocal right iliac fossa pain. The decision to admit or discharge these patients is not always straightforward. This is compounded by the relative lack of surgical experience by the junior doctors who may need to make this decision at the casualty/emergency room.

Studies have shown that patients with scores of less than 4 have no appendicitis (8). The modified Alvarado score can be used as a cost effective and objective way of selecting patients suspected to have acute appendicitis for admission.

This study is therefore designed to evaluate the local experience with the modified Alvarado score as an objective acute appendicitis admission criterion at the Kenyatta National Hospital (KNH) surgical units.

# LITERATURE REVIEW

## HISTORICAL BACKGROUND

Acute appendicitis is a clinicopathological entity as recognized by Reginald Fitz who helped establish importance of surgery in its cure (9). Morton T.C. did the first deliberately planned laparotomy for appendicectomy in 1887, thereafter surgeons routinely performed appendicectomy. In 1889 Charles McBurney described the point of maximum tenderness and the incision that bears his name (10,11).

## INCIDENCE OF ACUTE APPENDICITIS

Acute appendicitis is rare before age of 2 years, peaks in the second and third decades, thereafter gradually declines. The male: female ratio is 2:1 in older generation, however incidence of primary appendicectomy is approximately equal in both sexes. One in every seven people suffers acute appendicitis in their lifetime; hence appendicectomy is the commonest surgical emergency (12,13,14).

Reduction in incidence and mortality due to acute appendicitis has been significant over last 50 years, however mortality, length and cost of stay in hospital following perforated appendix still remains high (15,16).

## CLINICAL MANIFESTATIONS OF ACUTE APPENDICITIS

The classical clinical picture of acute appendicitis as described in standard textbooks comprises of gradual pain of vague, progressive, continuous periumbilical abdominal pain, which invariably within 1-12 hours localizes at McBurney's point as the inflammation involves the parietal peritoneum adjacent to the appendix.

Localization of somatic pain depends largely on anatomical position of the appendix. The pain may thus localize at the suprapubic area and tenderness in rectal digital examination in pelvic appendicitis; retroileal appendicitis in males present with testicular pain; right upper quadrant in pregnancy. True retrocaecal appendicitis simulates pyelonephritis and present with costovertebral angle pain and frank tenderness.

There may be low-grade fever in early disease (37.7( C); this increases to 40(C when perforated. Seventy-five percentage of patients are anorexic with about two thirds vomiting. The onset of pain and gastrointestinal upset is so constant that vomiting before pain makes acute appendicitis largely unlikely (12).

Children will mostly present with nausea, vomiting, refusal to feed, diarrhoea and irritability and these could be easily confused with gastroenteritis. Other childhood manifestations are fever, abdominal distention and constipation (17,18).

Right iliac fossa (RIF) pain is present in 96% of patients but is very nonspecific finding. The most specific signs are rebound tenderness, pain on percussion, rigidity and guarding. Rovsing sign (i.e., right lower quadrant pain with palpation of left lower quadrant), obturator sign (i.e., right lower quadrant pain with internal rotation of the flexed right hip), and psoas sign (i.e., right lower quadrant pain with hyper extension of the right hip); these signs are elicited in a minority of the patients with acute appendicitis. A positive cough sign (i.e. a sharp pain elicited at right lower quadrant area on a voluntary cough) may aid in making the clinical diagnosis of localized peritonitis. Pain elicited at the right lower quadrant in response to percussion at a remote quadrant of the abdomen or firm percussion of the patient's heel, suggests peritoneal inflammation. Literature is inconsistent whether rectal digital examination is helpful in making diagnosis; however non-performance of a rectal digital examination is considered as negligence.

## **DIAGNOSIS OF ACUTE APPENDICITIS**

Diagnosis of acute appendicitis depends on clinical judgment of the clinician, assisted by laboratory findings and in special cases by imaging techniques. However, diagnosis of acute appendicitis has remained elusive and is a common diagnostic problem in clinical surgery, with a negative appendectomy rate of 15-20% worldwide. This may go up to 36% in young inexperienced surgeons (19) and much higher if the patient is female (20). At KNH a range of 23.5% to 48.8% negative appendectomy rate has been documented. In efforts to reduce negative appendectomy rate, various scoring systems have been developed; namely Alvarado, Teicher, Christian, Fenyo and Lindberg scores (4,5,12).

The scoring systems take into consideration signs, symptoms and laboratory findings, each being assigned a numerical value.

Various researchers have tested the above scoring systems and the Alvarado score or its modifications have been shown to give consistently better results than the others. The real utility of the modified Alvarado score has been in the reduction of negative appendectomy rate and its relative simplicity to employ in a clinical set up (21,22,23,24).

The modified Alvarado is based on three symptoms, two signs and two laboratory findings as shown below.

### ***Modified Alvarado scoring system***

| <b>Features</b>                        | <b>score</b>     |
|--|------------------|
| <b>Symptoms</b>                        |                  |
| Migratory RIF pains                    | 1                |
| Nausea/vomiting                        | 1                |
| Anorexia                               | 2                |
| <b>Signs</b>                           |                  |
| RIF tenderness                         | 2                |
| Rebound pain in RIF                    | 1                |
| <b>Laboratory tests</b>                |                  |
| Leucocytosis of >10X10 <sup>9</sup> /L | 2                |
| Neutrophilia wjth left shift >75%      | 1                |
| <b><u>Total score</u></b>              | <b><u>10</u></b> |

Other diagnostic modalities that have been employed include computer-aided diagnosis (25), ultrasonography (26), helical CT-scan (27), radionuclide studies using technicium<sup>99</sup> labeled leucocytes (28) and laparoscopy (29). These additional modalities that have served to reduce negative appendectomy rate, but their limitation is cost and time in real emergency situations, more so in the developing world, where delay will inevitably lead to perforation; with attendant increased morbidity, mortality and cost of hospitalization.

Total and differential white cell counts have been documented to be important in diagnosis and exclusion of acute appendicitis. Leucocytosis of 11,000-17,000/ml is common in established appendicitis and when the count is >20,000/ml, it suggests perforation with or without abscess formation (30).

## **MANGEMENT**

The modified Alvarado score is a non-invasive, safe diagnostic procedure, which is simple, fast, reliable and repeatable, usable in all conditions, without expensive and complicated supportive diagnostic methods. The score is most sensitive at the extreme: score (1-4) no appendicitis, no admission and follow up, score (5-6) equivocal admit and observe and score (7-10) appendicitis highly likely so admit for surgery.

Patients diagnosed to have acute appendicitis should be prepared for appendicectomy, achieved either open or laparoscopically. Pre-operative preparation is carried out for four hours or so, in which dehydration and electrolytes imbalance are corrected, gastric decompression performed and pre-operative antibiotics given. Premorbid medical conditions are noted and addressed as well. Prophylactic antibiotics should be broad spectrum to cover both anaerobes and gram-negative bacteria; this has been shown to reduce post-operative wound sepsis, but less impact on reduction of intraabdominal sepsis (31,32).

The incision at open appendicectomy is important; when the diagnosis is not in doubt, a small transverse Lanz incision favoured by most surgeons is used. Gridiron and Rutherford-Morrison are alternative incisions. When the diagnosis is in doubt then a right lower Para median incision is best for adequate abdominal cavity accessibility.

In some centres appendicectomy is advised against when; i) the duration of presentation is more than 48 hours, ii) there is an appendicular abscess, iii) there is established appendicular mass. In these circumstances the standard treatment is the conservative Ochsner-Sherren regimen (33), however, this conservative management approach is inappropriate in children and the elderly.

Laparoscopic appendicectomy has been shown to offer a better post-operative course with lowered hospital stay from a mean of 4.1 days to 2.4 days. Comparative studies of both approaches establish that laparoscopic appendicectomy has distinct advantages i.e.

less analgesia, less pain, less wound sepsis, faster return to work, but the intra-operative costs are significantly increased (34,35).

## **COMPLICATIONS AND MORTALITY**

Complications vary from about 5% in an unperforated appendix to about 50% in perforated appendicitis (12). These include wound sepsis (10-70%)(36), faecal fistula, paralytic ileus, wound dehiscence and incisional hernia (37,12), portal pyemia, bleeding and deep venous thrombosis (DVT).

Overall mortality has over last five decades decreased to 0.2-0.8% for a nonperforated appendicitis and is attributable to complications of the disease rather than to surgical intervention (36, 12). Mortality rises to above 20% in patients older than 70 years, mainly due to diagnostic and therapeutic delay. Perforated appendicitis is associated high morbidity and mortality rates, especially so at the extremes of the ages (12).



## JUSTIFICATION OF THE STUDY

Peter Mungai Ngugi (14) in his study found out that acute appendicitis formed 37.5% of surgical emergency laparotomy at Kenyatta National Hospital (KNH). Sandeep K.C. (38) also found in his study based at KNH, a negative appendicectomy rate ranging from 23.5% for ages 20-39 years, 42.1% in paediatric age group to 48.8% at elective appendicectomy. KNH has diagnostic facilities and is endowed with presence of qualified surgeons; the above high negative rate cannot be justified, perhaps it may thus be due to lack of standardized diagnostic criteria.

Evaluation of the impact of the modified Alvarado scoring system at the KNH surgical emergency department was aimed at documenting the usefulness of the score to influence significant reduction of the high negative appendicectomy rate has demonstrated in the above cited studies. Therefore a prospective study was done covering the time of six months beginning June 30th to December 30th the year 2004

Data collected shall also form a base for future reference.

The study has demonstrated that use of modified Alvarado score as an admission criterion can reduce a high negative appendicectomy rate at KNH. The study results may help to formulate an objective admission policy to improve management of acute appendicitis at KNH.

## OBJECTIVES OF THE STUDY

### **BROAD**

To evaluate the impact and usefulness of the modified Alvarado score on acute appendicitis at KNH.

### **SPECIFIC**

1. To determine negative appendicectomy rate based on Modified Alvarado score.
2. To determine negative appendicectomy rate based on histological diagnosis.
3. To correlate the score negative rate and histological negative rate and determine the score impact.

## MATERIALS AND METHODS

### **STUDY DESIGN**

This was a prospective study analysis on consecutive patients suspected to have acute appendicitis and on their subsequent management.

### **STUDY POPULATION**

Patients aged between 5-65 years, suspected to have acute appendicitis presenting to the KNH casualty, general and paediatric surgical units.

### **STUDY METHODOLOGY**

The study was carried out by the principal investigator, based at KNH surgical units, in liaison with hospital laboratory and histopathology departments under supervision from department of surgery, University of Nairobi.

To avoid bias in this study, the score by the principal investigator remained unknown to the operator and the score outcome did not influence decision to operate or not

The scoring was undertaken at casualty and repeated at the ward since appendicitis is a progressive disease. To facilitate the scoring a standard medical history and examination,

blood for haemogram was undertaken. Preoperative measures were ensured to optimize surgical intervention.

At surgery various findings were noted and a tissue specimen for histopathology sampled, submitted for histopathology and followed up to ensure competent reporting. A questionnaire was used to collect data meeting specific objectives above and the data stored safely.

The principal investigator scored all the patients, and where necessary, with the help of a research assistant and other senior house officers.

## **DATA COLLECTION**

Data collection was done by interviewing, examining patients and for each total blood count ordered. Data was entered into a data collection proforma (Appendix I).

## **DATA MANAGEMENT AND PRESENTATION**

All data was collected and entered into the statistics package for social sciences (SPSS)/Excel computer software for processing. Data was analyzed and presented in tables; charts and tests of significance were applied where appropriate.

## **ELIGIBILITY CRITERIA**

### **INCLUSION**

1. Patients presenting with possible acute appendicitis
2. Patients aged 5 to 65 years
3. Informed consent to enroll in the study was obtained.
4. All the patients who were fully scored, had appendicectomy and histology reported as acute appendicitis.

### **EXCLUSION**

1. Patients aged <5 years and >65 years
2. Pregnancy
3. Patients awaiting interval appendicectomy
4. Presence of pre-existing condition giving unreliable clinical examination (e.g. inflammatory bowel disease).

5. Those patients who presented as acute appendicitis but histology reported other pathology (e.g. carcinoid tumours, mucocele etc) than acute appendicitis or normal appendix.

#### SAMPLE SIZE.

The minimum sample size calculation formula was employed as follows: -

$$N = \frac{Z^2 \times P(1-P)}{d^2}$$

Where by

N was the sample size

Z was the standard deviation of the 95th percentile = 1.96

P was the prevalence of 0.06 (i.e. 230 patients had appendicectomies out of 3685 patients who underwent general and paediatric surgical procedures at KNH in the year 2001)

D was the width of the confidence interval taken to be 0.05

Therefore

$$N = \frac{1.96^2 \times 0.06 \times 0.94}{0.05^2}$$

Hence the minimum sample size was 87 patients.

The actual sample size of 116 patients who met inclusion criteria was obtained within six months

## **ETHICAL CONSIDERATIONS**

Protocol for the study was submitted to the KNH ethical and research committee, and approval was given. The study was commenced with every participant giving informed consent. All information was treated with utmost confidence and used ONLY for intended purposes.

After this study is eventually approved to have met the dissertation requirements, future references and feedbacks shall be in consultation by the chief investigator.

## **STUDY LIMITATIONS**

1. Low incidence of acute appendicitis at KNH, affecting sample size within the study period.
2. Total blood count requests are not processed round the clock especially those who present at night.
3. Misplacement and loss of histopathological specimens and reports.

## **MINIMIZING ERRORS**

1. The principal investigator strictly undertook data collection.
2. The principle investigator did data recording. Any errors noted were addressed immediately.
3. Histology specimens were followed up closely and delivery ensured, constantly working with the resident pathologist for accurate and prompt reporting.
4. The principal investigator did data analysis and management and final presentation with expert help from statistician where appropriate.

## **STUDY TIME FRAME**

The study was completed within ten months after presentation of the proposal to the ethical and research committee.

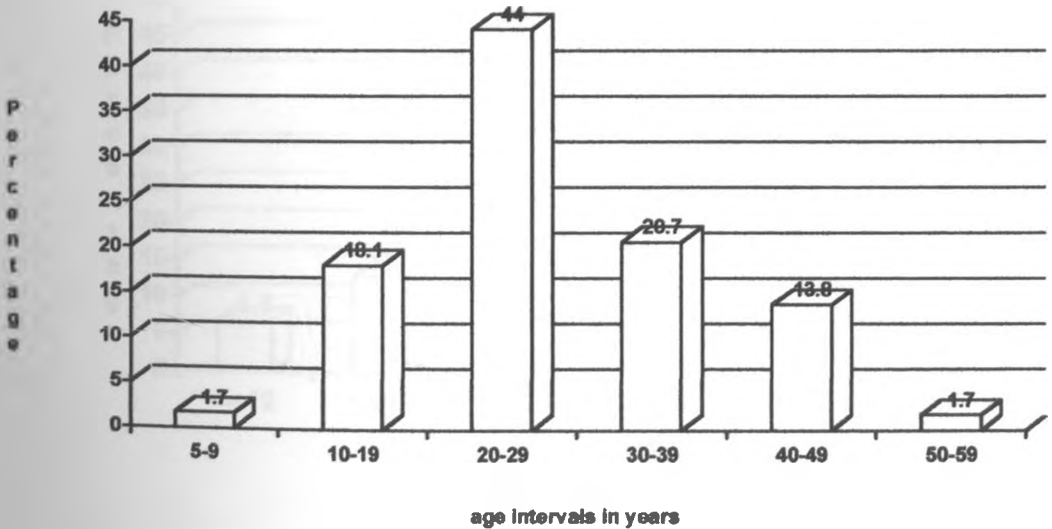
# RESULTS

## 1. AGE DISTRIBUTION (n=116)

The table below (table 1) shows age distribution in years for 116 patients evaluated in the study, the range was 7 to 55 years, mean 27.01 years, median 25.0 years, standard deviation 9.87, and peak age group 10-30 years were 80(62.9%) patients.

| Age intervals (years) | Number of patients | Percentage |
|-----------------------|--------------------|------------|
| < 9                   | 2                  | 1.7        |
| 10-19                 | 21                 | 18.1       |
| 20-29                 | 51                 | 44.0       |
| 30-39                 | 24                 | 20.7       |
| 40-49                 | 16                 | 13.8       |
| 50-59                 | 2                  | 1.7        |
| Total                 | 116                | 100        |

**Table 1 shows age distribution (n=116).**

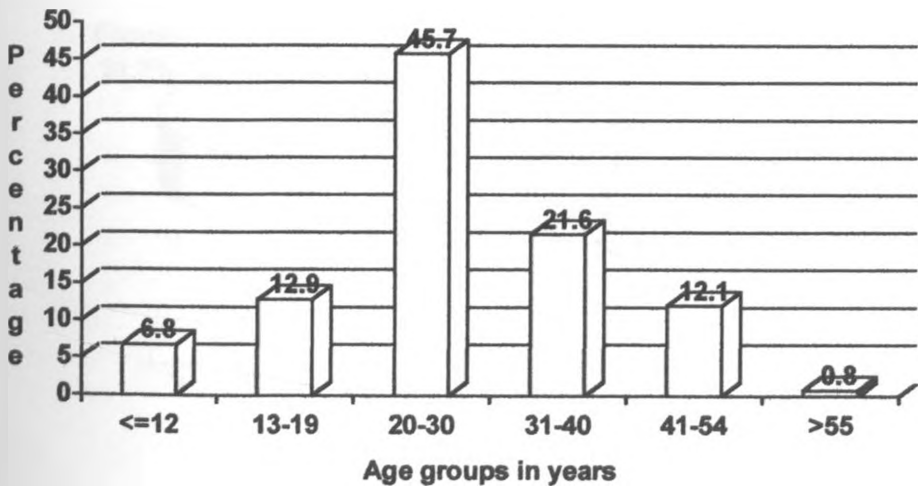


**Figure 1:Age distribution**

Table 2 below shows age distribution in age sets i.e. paediatric, adolescent, adults and elderly. Eight (6.8%) were in paediatric age groups 16 (12.9%) were adolescents, 53(46.7%) were young adults, 28 (24.1%) were middle aged and 1 (0.8%) patient was elderly.

| Age group (years)             | Number of patients | Percentage   |
|-------------------------------|--------------------|--------------|
| Paediatric ( $\leq 12$ years) | 8                  | 6.8          |
| Adolescent (13-19 years)      | 15                 | 12.9         |
| Adults (20-30years)           | 53                 | 45.7         |
| Adults (31-40 years)          | 25                 | 21.6         |
| Middle aged (41-54 years)     | 14                 | 12.1         |
| Elderly (55 years)            | 1                  | 0.8          |
| <b>Total</b>                  | <b>116</b>         | <b>100.0</b> |

**Table 2: Age group distribution in years (n=116)**



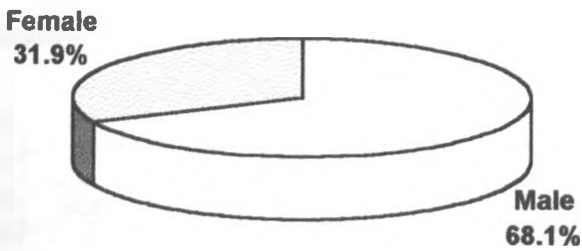
**Figure 2: Age distribution in years (n=116)**

## 2. SEX DISTRIBUTION (n=116)

The table below (table 3) shows sex distribution of the study group. Seventy-nine (68.1%) patients were males while thirty-seven (31.9%) patients of the study group were females giving a ration of 2.1:1

| Sex     | Number of patients | Percentage |
|---------|--------------------|------------|
| Males   | 79                 | 68.1       |
| Females | 37                 | 31.9       |
| Total   | 116                | 100        |

**Table 3: Sex distribution (n=116)**



**Figure 3: Sex distribution**

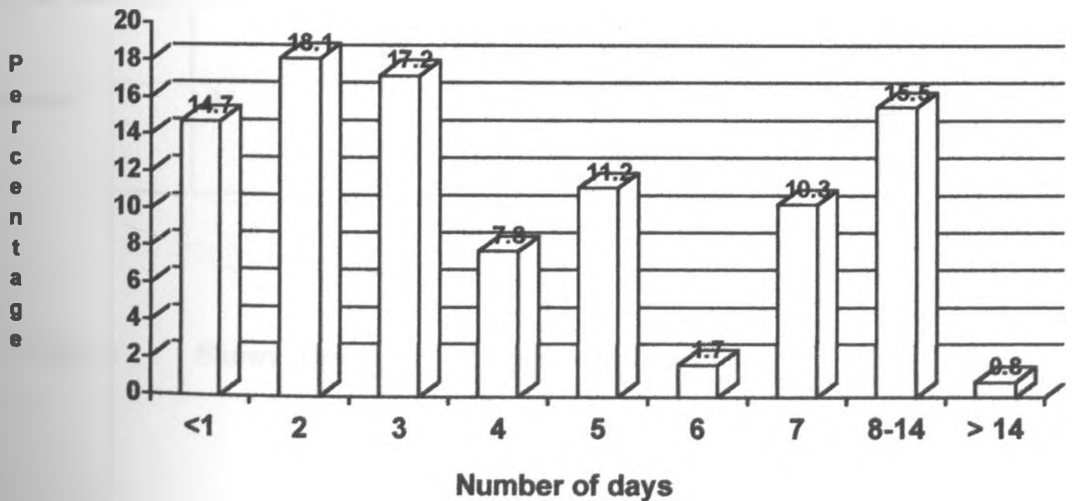


### 3. DURATION OF ILLNESS PRIOR TO ADMISSION

The table 4 below shows duration of illness prior to admission. Fifty-eighty (50.0%) of the patients with duration of illness of less 3 days (72 hours), 36 (31.0%) patients presented within 4-7 days whereas 18 (15.5%) presented between one to two weeks. One patient presented after 60 days.

| Duration of illness (days) | Frequency | Percentage |
|----------------------------|-----------|------------|
| ≤ 1 day                    | 17        | 14.7       |
| 2                          | 21        | 18.1       |
| 3                          | 20        | 17.2       |
| 4                          | 9         | 7.8        |
| 5                          | 13        | 11.2       |
| 6                          | 2         | 1.7        |
| 7                          | 12        | 10.3       |
| 1 - 2 weeks                | 18        | 15.5       |
| > 2 weeks                  | 1         | 0.8        |
| Total                      | 116       | 100.0      |

**Table 4: duration of illness in days (n=116)**



**Figure 4: Duration of illness in days (n=116)**

### 3. MODIFIED ALVARADO SCORE

#### i). Symptoms

The table 5 below shows symptoms of migration of pain, nausea/vomiting and anorexia of the study group. Eight-nine (74.4%) patients had migratory abdominal pains, 81 (69.8%) had nausea/vomiting and 90 (77.6%) had anorexia. The third column shows histology outcome whereby 83.1% of those with migratory abdominal pain had acute appendicitis, 80.2% of those with vomiting and 86.7% of those with anorexia

| Symptoms        | Number of patients |     | Number of patients with |               | Percentage |
|-----------------|--------------------|-----|-------------------------|---------------|------------|
|                 | NO                 | YES | -VE                     | +VE histology |            |
| Migratory pain  | 27                 |     | 14                      | 13            | 23.3       |
|                 |                    | 89  | 15                      | 74 (83.1%)    | 76.7       |
| Nausea/vomiting | 35                 |     | 13                      | 22            | 30.8       |
|                 |                    | 81  | 16                      | 65 (80.2%)    | 69.8       |
| Anorexia        | 26                 |     | 17                      | 9             | 22.4       |
|                 |                    | 90  | 12                      | 78 (86.7%)    | 77.6       |

**Table 5:** Shows Alvarado score symptoms (n=116)

## ii). Signs

The table 6 below shows signs of acute appendicitis considered in the score.

Out of 116 patients of the study group 111 (95.7%) had RIF tenderness and 79 (68.1%) had RIF rebound tenderness. The third column shows the histology outcome, whereby 76.6% of the patients with RIF tenderness had acute appendicitis and 82.3% of those with rebound tenderness had positive histology.

| Signs                  | Number of Patients |     | Number of patients with |               | Percentage |
|------------------------|--------------------|-----|-------------------------|---------------|------------|
|                        | NO                 | YES | -ve                     | +ve histology |            |
| RIF tenderness         | 5                  |     | 3                       | 2             | 4.3        |
|                        |                    | 111 | 26                      | 85 (76.6%)    | 95.7       |
| RIF rebound tenderness | 36                 |     | 15                      | 21            | 31.9       |
|                        |                    | 79  | 14                      | 65 (82.3%)    | 68.1       |

**Table 6: Shows modified Alvarado score signs (n=116)**

### iii). Laboratory findings

The table 7 below shows laboratory parameters used in the modified Alvarado score, which are; leucocytosis  $\geq 10 \times 10^9/L$  and neutrophilia  $\geq 75\%$ . Out of 116 patients 67 (59.5%) patients had leucocytosis of  $\geq 10 \times 10^9/L$  and 59 (54.8%) patients had neutrophilia of  $\geq 75\%$ . The third column showed positive histology for each parameter.

| Laboratory Parameter                   | Number of Patients | Number of patients with |               | Percentage |
|--|--------------------|-------------------------|---------------|------------|
|  |                    | -VE                     | +VE histology |            |
| Leucocytosis $\geq 10.0 \times 10^9/L$ | 67                 | 5                       | 62 (92.5%)    | 59.5       |
| Leucocytes $\leq 10.0 \times 10^9/L$   | 49                 | 24                      | 25 (51.0%)    | 40.5       |
| Neutrophilia $\geq 75\%$               | 63                 | 4                       | 59 (93.7%)    | 54.8       |
| Neutrophils $\leq 75\%$                | 53                 | 21                      | 32 (60.4%)    | 45.2       |

**Table 7: Shows Alvarado laboratory findings.**

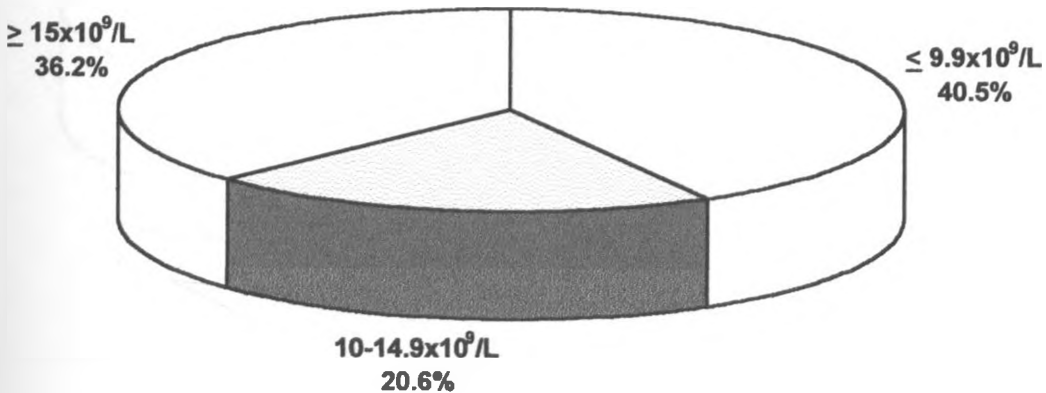
**iv). White cell count categorized**

The table 9 below shows total white count categorized as  $\leq 9.0 \times 10^9/L$ ,  $10.0-14.9 \times 10^9/L$  and  $\geq 15.0 \times 10^9/L$  with frequency of 49 (40.5%), 24 (20.6%) and 42 (36.2%) respectively. Of the total 66 (56.9%) patients had leucocytosis more than  $10 \times 10^9/L$ .

The third column shows positive histology for each group white cell count.

| White cell count          | Number of Patients | Number of patients with |               | Percentage % |
|---------------------------|--------------------|-------------------------|---------------|--------------|
|                           |                    | -VE                     | +VE histology |              |
| $\leq 9.9 \times 10^9/L$  | 49                 | 24                      | 25 (51.0%)    | 40.5         |
| $10-14.9 \times 10^9/L$   | 24                 | 2                       | 22 (91.6%)    | 20.6         |
| $\geq 15.0 \times 10^9/L$ | 43                 | 3                       | 40 (93.0%)    | 36.2         |

**Table 8: Shows leucocytes count categorized**



**Figure 5: shows leucocytes count subgroups**

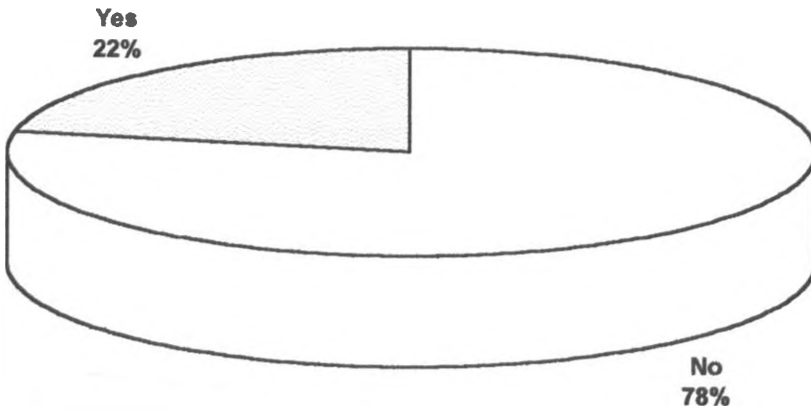
#### 4. IMAGING PERFORMED

##### i). Ultra-Sound performed

The table 11 below shows the ultrasound performed on admission. Out of the 116 patients in the study group 25 (22%) underwent Ultra-sound imaging study

| Ultrasound performed | Number of patients | Percentage |
|----------------------|--------------------|------------|
| Yes                  | 25                 | 22         |
| No                   | 91                 | 78         |

**Table 9: Ultrasound performed (n=116).**



**Figure 6: Ultrasound performed (n=116)**

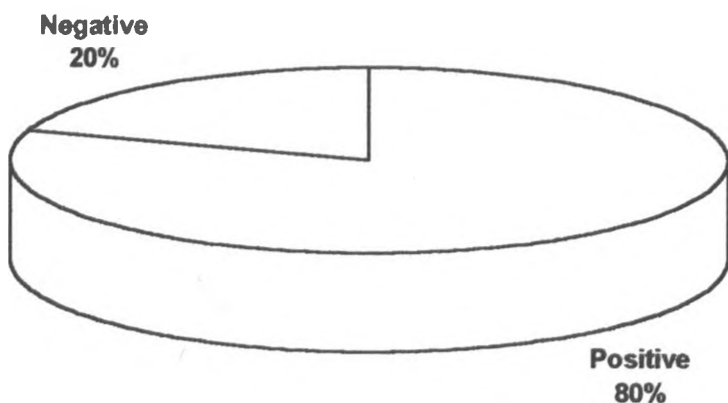
##### ii. Ultra-sound results

The table 12 below shows results as reported by Ultra-sound operator and histological correlation. Of the 25 patients, 20 (80%) patients had appendicitis whereas 5 (20%) were

reported normal. Of the twenty patients reported to have acute appendicitis on ultrasonography 15 (75%) patients were confirmed at histology. Hence U/S sensitivity of 75%

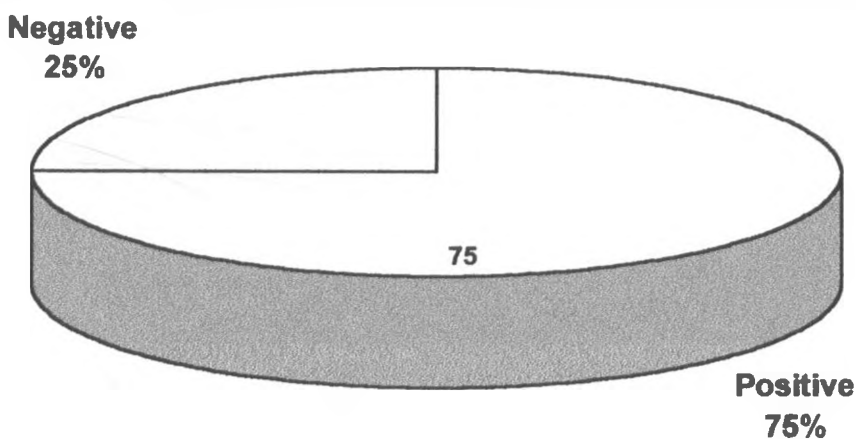
| Ultrasound report | Number of patients | Percentage | Number of patients with |               |
|-------------------|--------------------|------------|-------------------------|---------------|
|                   |                    |            | -VE                     | +VE histology |
| Normal            | 5                  | 20         | 1                       | 4 (80%)       |
| Appendicitis      | 20                 | 80         | 5                       | 15 (75%)      |

**Table 10: Ultrasound report (n=25).**



**Figure 7: Ultrasound report (n=25)**

The figure shows positive U/S report vs Histology. The U/S has 75% sensitivity



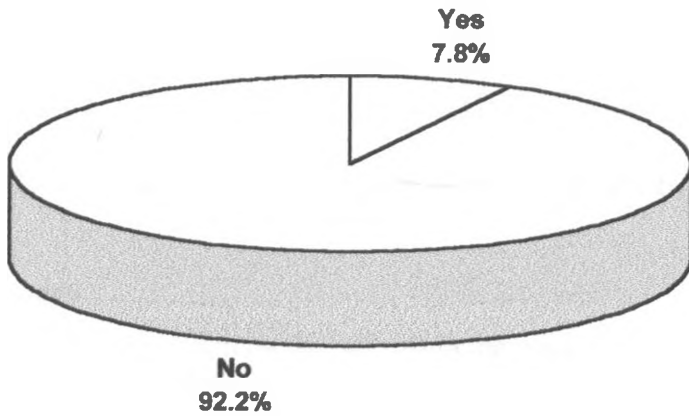
**Figure 8: U/S sensitivity**

**iii). Plain abdominal x-ray performed**

The table 13 below shows 9 (7.8%) had plain abdominal X-rays of which 1 out of 9 patients had fecolith reported.

| X- ray done | Number of patients | Percent |
|-------------|--------------------|---------|
| Yes         | 9                  | 7.8     |
| No          | 107                | 92.2    |

**Table 11: Plain abdominal X-ray performed n=116**



**Figure 9: Plain abdominal X-ray performed**



## 5. PATIENT MANAGEMENT

### i). Pre-operative management in ward

The table 14 shows the type of pre-operative medical treatment given to the patients while in the ward. Out of the 116 study patients, 100 (86.2%) were given fluids, mainly normal saline and dextrose, where as 104 (89.6%) were commenced on parenteral antibiotics, mainly crystalline penicillin, gentamycin, and metronidazole.

| Type of treatment | Number of patients |    | Percent |
|-------------------|--------------------|----|---------|
|                   | Yes                | No |         |
| Rehydration       | 100                |    | 86.2    |
|                   |                    | 16 | 13.8    |
| Antibiotics       | 104                |    | 89.6    |
|                   |                    | 12 | 10.4    |
|                   |                    |    |         |

**Table 12: Type of treatment given in the ward (n=116)**

### ii). Time taken in the ward

The table 15 below shows the time taken by the patients in the ward as they waited for surgery; the average waiting time was 13.1 hrs. Thirty patients (25.9%) were operated as emergency, 78 (67.2%) patients as delayed emergency and 8 (6.9%) patients after 24hrs.

| Time in ward | Number of patients | Percent |
|--------------|--------------------|---------|
| ≤ 6 hrs      | 30                 | 25.9    |
| 7-24 hrs     | 78                 | 67.2    |
| >24 hrs      | 8                  | 6.9     |
| ≥ 25 hrs     | 7                  | 6.1     |

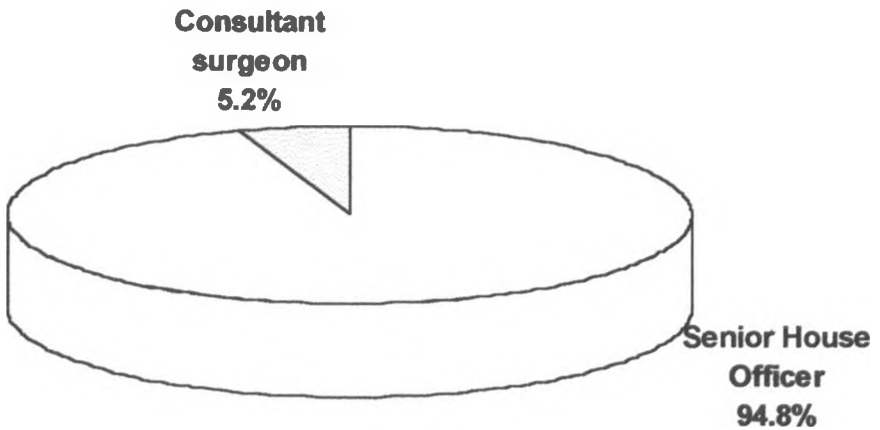
**Table 13: Time taken in the ward pre-operatively (n=116)**

### iii). Qualification of the operator

The table 17 below shows the qualification of the operator for the 116 patients who Underwent operative management. Out of 116 patients 110 (94.4%) were operated on by Senior House Officer (SHO) and the rest 6 (5.2%) patients by Consultant Surgeon.

| Qualification of operator | Number of patients | Percent |
|---------------------------|--------------------|---------|
| SHO                       | 110                | 94.4    |
| Consultant surgeon        | 6                  | 5.2     |

**Table 14: Qualification of operator (n=116).**



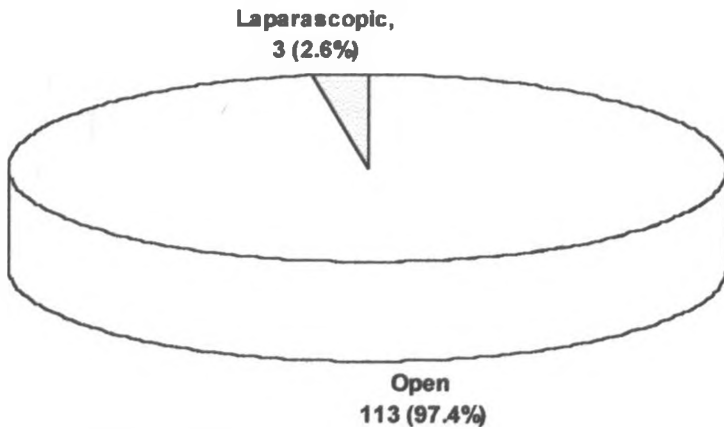
**Figure 10: Qualification of the operator**

**v). Technique used**

The table 18 below shows the technique used at surgery. 113 (97.4%) patients out of 116 underwent open appendicectomy while 3 (2.6%) underwent laparoscopic appendicectomy.

| Technique    | Number of patients | Percent |
|--------------|--------------------|---------|
| Open         | 113                | 97.4    |
| Laparoscopic | 3                  | 2.6     |

**Table 15: Technique employed for surgery (n=116).**



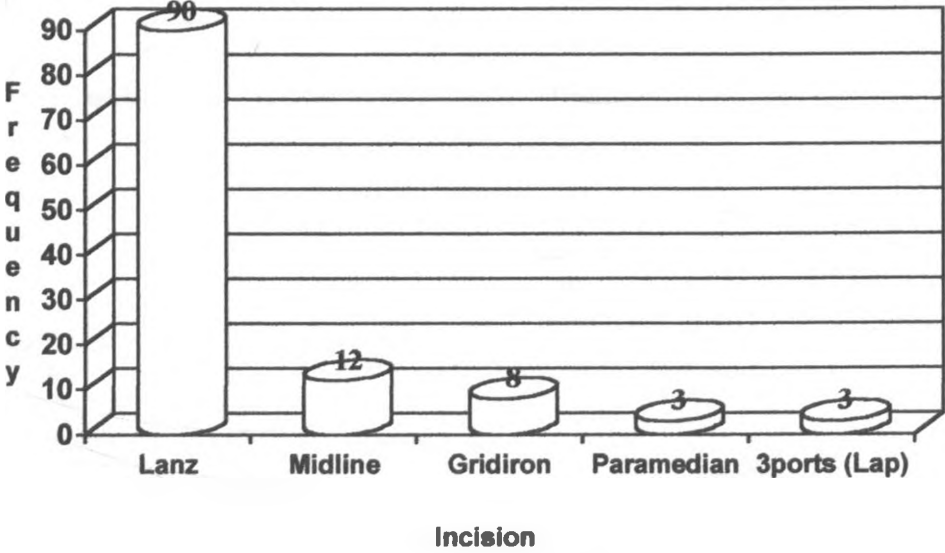
**Figure 11: Technique used**

**vi). Incision used**

The table 19 shows the incisions made in performing the 116 appendicectomies, Lanz was most popular incision at 90 (77.6%), followed by midline 12 (10.3%), then Gridiron 8 (6.9%), Para median and 3 ports incisions shared 2.6% each.

| Incision made | Number of patients | Percent |
|---------------|--------------------|---------|
| Lanz          | 90                 | 77.6    |
| Midline       | 12                 | 10.3    |
| Gridiron      | 8                  | 6.9     |
| Para median   | 3                  | 2.6     |
| 3 ports (Lap) | 3                  | 2.6     |

**Table 16: Incisions made at surgery**



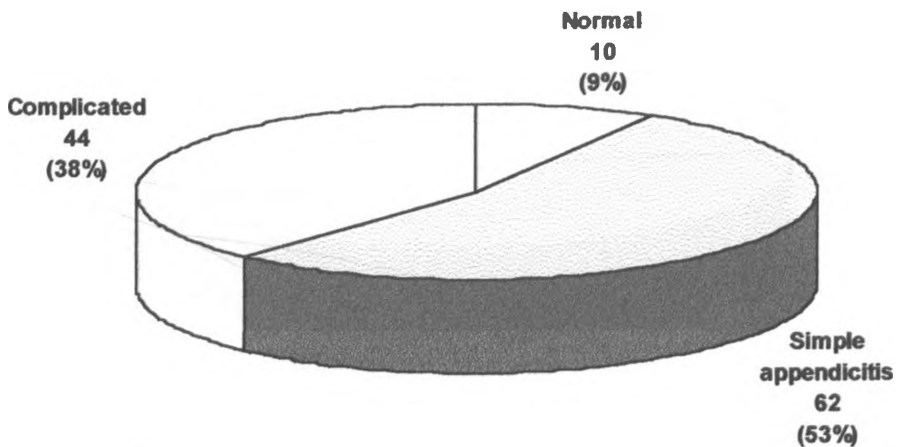
**Figure 12: Type of incision employed at surgery**

### vii. Intra-operative gross findings

The table 20 below shows intra-operative gross findings of the 116 patients done surgery. Of the 116 patients, 10 (8.6%) were described to have a normal appendix, 62 (53.4%) were described to have inflamed simple acute appendicitis and rest 44 (37.9%) of them had complicated acute appendicitis i.e. perforated, mass, abscess or generalized peritonitis. Therefore grossly, negative appendicectomy rate was 8.6% and positive rate at 91.4%. However when specimens were taken for histology, revealed that 16.4 % of the appendices thought to be inflamed were actually normal

| Gross findings            | Number of patients | Percent |
|---------------------------|--------------------|---------|
| Normal                    | 10                 | 8.6     |
| Simple acute appendicitis | 62                 | 53.4    |
| Complicated appendicitis  | 44                 | 37.9    |

**Table 17: Gross intra-operative findings**



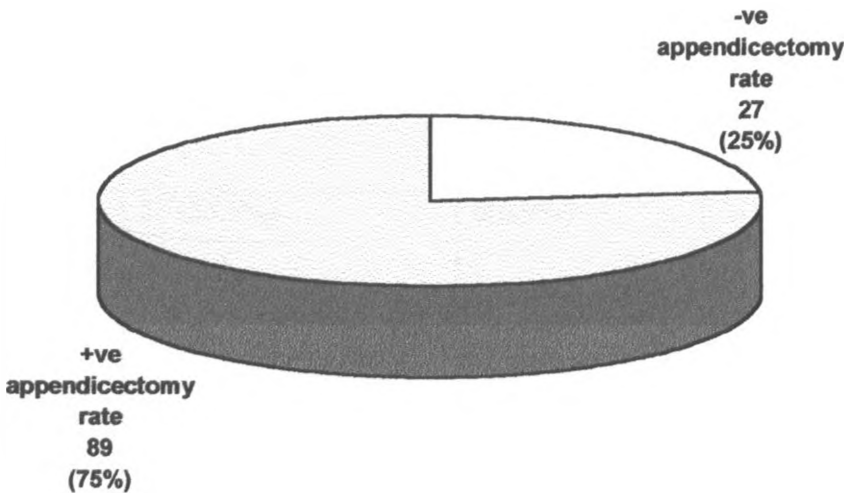
**Figure 13: Gross findings**

**viii). Histopathological findings**

The table 21 below shows histopathological findings. A total of 116 specimens were submitted for microscopic analysis, 87 (75%) specimens were confirmed to be appendicitis while 29 (25%) were confirmed as normal appendix. Hence true appendicitis was 75% while 25% of the patients underwent surgery for a normal appendix.

| <b>Histological findings</b> | <b>Number of patients</b> | <b>Percent</b> |
|------------------------------|---------------------------|----------------|
| Normal appendix              | 27                        | 25%            |
| Acute appendicitis           | 89                        | 75%            |
| Total                        | 116                       | 100            |

**Table 18: Appendicectomy rate**



**Figure 14: Appendicectomy rate**

## 6. OBJECTIVES ANSWERED

### i) Modified Alvarado score versus histopathologic outcome

The table 23 shows the Alvarado score as the test diagnostic tool versus the histopathological findings as the control diagnostic tool. A total of 116 specimens at appendicectomy were submitted for histology. Of the total 20 (17.2%) patients scored  $\leq 4$ ; 16 (13.8%) had normal appendix (the **true negative**) whereas 4 (3.4%) had simple appendicitis (the **false negative**). 61 (52.6%) patients scored  $\geq 7$ ; of which 56 (48.3%) had appendicitis (the **true positive**) and 5 (4.3%) had normal vermiform appendix (**false positive**). If you exclude 16 patients from the normal appendix column that leaves 8 patients who scored 5-6 points and 5 patients who scored 7-10 points who otherwise could have had appendicectomy, giving an eleven point two percent (11.2%) negative rate. This means that 4.3% of the patients who actually had acute appendicitis are at risk of complications. The chance that a patient who scored  $>7$  points had acute appendicitis was 56/61 (91.8%). The chance that a patient with a score 5-6 has acute appendicitis was 27/35 (77%). The chance that a patient with a score of  $<4$  points has acute appendicitis was 4/20 (20%).

| Score categorized | Histological findings                |   |       |
|-------------------|--------------------------------------|---|-------|
|                   | Number of patients with appendicitis | Number of patients with normal appendix | Total |
| 0-4               | 4 (4.3%)                             | 16 (13.8%)                              | 20    |
| 5-6               | 27 (23.3%)                           | 8(6.9%)                                 | 35    |
| 7-10              | 56 (48.3%)                           | 5 (4.3%)                                | 61    |
| Total             | 87 (75%)                             | 29 (25%)                                | (116) |

**Table 19: Modified Alvarado score vs. histopathology (n=116)**

**iii. Efficacy of Alvarado score**

The table 24 shows the efficacy of the modified Alvarado score as a diagnostic tool. In each cell is demonstrated the chance of getting either negative or positive appendicectomy for every case that present with a suspicion of acute appendicitis.

| Test              | Control       |               |
|-------------------|---------------|---------------|
|                   | +ve histology | -ve histology |
| Score > 7 points  | 56 (91.8%)    | 5 (8.2%)      |
| Score 5-6 points  | 27(77.0%)     | 8 (22.8%)     |
| Score <0-4 points | 4 (20%)       | 16 (80%)      |

**Table 20: Efficacy of test as diagnostic tool.**



**vi). Sex versus histopathological findings**

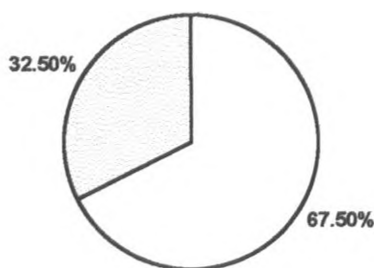
The table 25 shows sex versus histological findings demonstrating that 79 patients were males of whom 62 (78.4%) had positive appendicectomy, 17 (21.5%) had negative appendicectomy (NA). Of the 37 female patients, 25 (67.5%) had positive appendicectomy and 12 (32.5%) had negative appendicectomy. A higher negative appendicectomy rate in females (32.5%) than males (21.5%) was observed.

| Gender |       | Histology  |            | Total      |
|--------|-------|------------|------------|------------|
|        |       | +ve        | -ve        |            |
| Female | Count | 25 (67.5%) | 12 (32.5%) | 37 (100%)  |
|        |       |            |            |            |
| Male   | Count | 62 (78.4%) | 17 (21.5%) | 79(100%)   |
|        |       |            |            |            |
| Total  |       | 87 (75%)   | 29 (25%)   | 116 (100%) |

**Table 21: sex vs. histological findings**



**Figure 15: male NA rate (21.5%)**



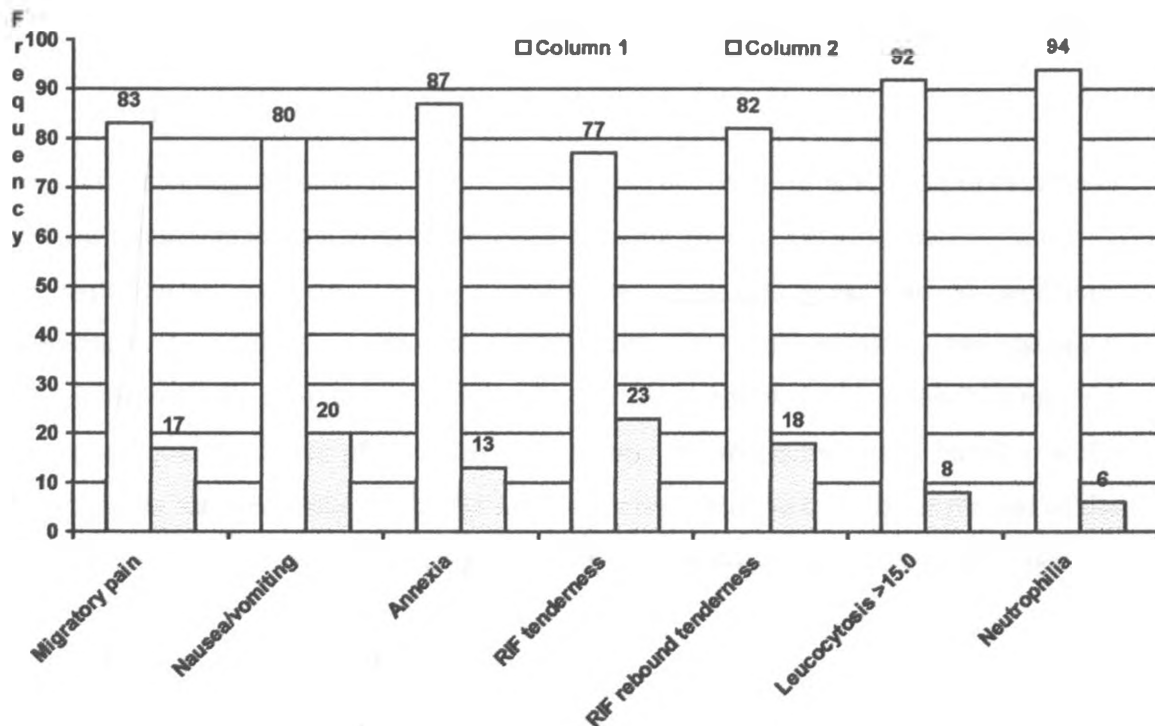
**Figure 16 Female NA rate 32.5%**

**viii). Individual Alvarado score parameters vs. histopathological findings**

The table 26 below shows each positive Alvarado score parameter versus the histological, findings. 83.1% of patients with migratory pain had appendicitis, 80.2% with nausea/vomiting, 86.7% had anorexia, 76.6% RIF tenderness, 82.3% RIF rebound tenderness 95.5% with leucocytosis and 94.2% with neutrophilia > 75%. Negative rate was 16.9%, 19.8%, 13.3%, 23.4%, 17.7%, 7.6% and 6.4% respectively

| Score parameter                              |                 | Histological findings |       | Total       |
|--|-----------------|-----------------------|-------|-------------|
|  |                 | +ve                   | -ve   |             |
| a. Migratory pain                            | No. of patients | 74                    | 15    | 89 (76.7%)  |
|  | Percentage      | 83.1%                 | 16.9% | 100%        |
| b. Nausea/<br>Vomiting                       | No. of patients | 65                    | 16    | 81 (69.5%)  |
|  | Percentage      | 80.2%                 | 19.8% | 100%        |
| c. Anorexia                                  | No. of patients | 78                    | 12    | 90 (77.1%)  |
|  | Percentage      | 86.7%                 | 13.3% | 100%        |
| d. RIF<br>tenderness                         | No. of patients | 85                    | 26    | 111 (95.7%) |
|  | Percentage      | 76.6%                 | 23.4% | 100%        |
| e. RIF rebound<br>tenderness                 | No of patients  | 65                    | 14    | 79 (68.7%)  |
|  | Percentage      | 82.3%                 | 17.7% | 100%        |
| f. Leucocytosis<br>> 10.0x10 <sup>9</sup> /L | No. of patients | 61                    | 5     | 66 (56.8%)  |
|  | Percentage      | 92.4%                 | 7.6%  | 100%        |
| g. Neutrophilia<br>> 75%                     | No. of patients | 59                    | 4     | 63 (54.8%)  |
|  | Percentage      | 93.6%                 | 6.4%  | 100%        |

**Table 22: Individual Alvarado score parameter versus the histological findings**



**Key :** Blue bar = positive histology rate  
 Red bar = negative histology rate

**Figure 17: Alvarado score parameter versus the histological findings**

UNIVERSITY OF BAHURA

## DISCUSSION

Acute appendicitis is one of the commonest surgical emergency, with an incidence of one in eight at Kenyatta National Hospital (KNH) (38). Elsewhere the incidence is reported to be one in seven (12,13).

A high negative appendectomy (NA) rate has been documented at KNH, and the reason has been thought to be lack of standardized diagnostic policy. The diagnosis is mainly by less experienced operators. It is a well-known fact that good clinical judgment, augmented by proper diagnostic scores and imaging studies, the negative appendectomy rate (NA) has tremendously reduced to below 10%. A low NA rate is a measure of quality of care given at any institution. A prospective study based at KNH surgical units was undertaken with the main objective being to evaluate if the use of the modified Alvarado score in early diagnosis of acute appendicitis can reduce this high NA (38).

A total of 116 cases with a suspicion of acute appendicitis were included in this study over a period of six months. Each case was evaluated clinically and a score assigned at casualty and follow up throughout all phases of subsequent management. The one hundred and sixteen patients underwent appendectomy and for each a specimen was submitted for histopathological studies. No mortality was encountered during the study period.

In this study, 79 (68.1%) were males whereas 37 (31.9%) patients were females giving a M: F ratio of 2.1:1. Male preponderance in acute appendicitis has been reported by other authors among the 10-30 years age group (39,40,41) and the M: F ratio levels out in older age groups.

The mean age was 27.1 yrs with standard deviation (SD) of 9.81 yrs. The range was between 7 and 55 yrs with peak age interval 10-30 yrs accounting for 62.1%. Review of other studies elsewhere showed similar incidences for age range, peak and sex distributions (38,39,40,41).

The mean duration of illness from onset of illness to time of admission was studied. Mean duration was 5.47 days, with shortest being 6 hrs, and longest duration observed was 21 days, though one patient come after 60 days of onset of illness. Fifty percent of the patients presented within three days (72 hrs). Duration of acute appendicitis is significant because after 24 hrs, complicated acute appendicitis rates increase proportionately (20,42,43,44). Surgery done after 24 hrs should be considered delayed. The causes of appendicectomy delay has been thought to be at three levels; patient and family delay in seeking medical care, or delay by the referral physician or surgeon, and delays while observing or investigating the patient (45). In some centres the surgeon's delay has been addressed successfully, but at KNH delayed appendicectomy at the three levels of delay still is unknown.

Acute appendicitis presents with equal likelihood in one's lifetime, and the key to treatment of acute appendicitis is to reduce attendant morbidity, mortality, especially due to NA. A Low NA rate is a function of operator's clinical judgment, a high index of suspicion, accurate and rapid diagnostic process that may include a scoring system and imaging studies. Various publications available on the Medline, Cochran updates etc websites and in print journals, authors have demonstrated that the use of clinical scores are cost-effective, non-invasive, rapid, reliable, repeatable diagnostic tools. However, in atypical appendicitis, more so in reproductive female age group, the use of Ultra Sound (US) and Computed Tomography (CT) scans improves diagnostic accuracy. (46)

All the 116 patients were scored at casualty, 746.7% had migratory periumbilical pain, 69.8% had nausea/ vomiting whereas 77.6% had anorexia; RIF tenderness were 95.7%, RIF rebound tenderness were 68.1%, leucocytosis  $10.0 \times 10^9/L$  were 59.5% and Neutrophils with left shift of  $>75\%$  were 54.8%. Various authors have reported 80% of the patients with acute appendicitis presents with migratory of abdominal pain from peri umbilical to RIF area. Nausea is present in 61 - 92%, anorexia 74 - 76%, RIF tenderness in 96%, but RIF tenderness in very non- specific symptom, RIF rebound tenderness is

very specific and is seen in 69%. Leucocytosis of  $\geq 10 \times 10^9/L$  and neutrophilia of  $\geq 75\%$  are reported between 70- 90 % by other investigators (47,48).

Ultra-sound (U/S) scans were performed in 25 of the 116 patients and 20 (80%) of the reported U/S showed acute appendicitis. After surgery histology confirmed 15 (75%) patients had a positive appendicitis and 5 (25%) patients had a normal appendix. In this study U/S sensitivity was 75%.

While in the ward awaiting further management, 100(86.2%) patients got intravenous fluids therapy mainly normal saline and 5%-dextrose, and 109(87.2%) patients got parenteral antibiotic therapy. This is well recommended.

Majority of the 116, 113(97.4%) underwent open appendicectomy (OA) and rest 3(2.6%) laparoscopic appendicectomy (LA). OA group, 110(94.4%) patients were operated on by Senior House Officer (SHO) and 5.2% of the patients by a consultant surgeon. The Lanz incision was the most popular access at 77.6% followed by midline 10.3% then Gridion 6.9% Para median 2.6% and 3 ports (2.6%).

Of the 116 patients, 10(8.6%) of them had grossly normal looking vermiform appendix, whereas 62(53.4%) had simple acute appendicitis and 44(37.9%) complicated appendicitis i.e. perforated, abscess, mass or peritonitis. There was observed a significant 16.1% rate reporting a normal looking appendix as inflamed by the operators. **Kavoo** in his study at KNH from 1994 – 998 documented a 64.8% complicated acute appendicitis rate, where as **Sundeep** in his study at KNH during the 2000-2001 period documented complicated acute appendicitis rate of 36.9% (38, 49). Complicated acute appendicitis rate in this particular study was seen to be 44 (38%). (Table 22).

All the 116 patients who underwent surgery had specimens taken were submitted for histopathological studies. Slides were prepared, reported by a resident and final report confirmed by a consultant pathologist. Of the 116 specimens, 87(75%) were confirmed positive for acute appendicitis and 29(25%) were confirmed to be a normal vermiform

appendix. This documents a NA rate of 25% in this study. This rate reflects the SHO's clinical acumen and quality of care for more than 90% of cases of acute appendicitis that presented during the study period. Previous studies based at KNH showed NA rates of 23.5% in 20–39 years young adults, 42% paediatrics and 48% females (38). Elsewhere in the world NA rates has been documented to range between 8–15% in specific hospitals and when applied to the general population the NA rates rise to 20%. When confounded by increasing age and sex, NA rates approach 40%(50). There is a general consensus that NA rates should be maintained between 10–15%, to reflect a good quality of care (39). In this particular study NA in males was 21.5%, females (32.5%).

A score of 0- 4 in this study was taken to mean low probability of a patient having acute appendicitis; hence no surgery is necessary and close follow up and use of antibiotics is recommended. A score of 5- 6 means intermediate probability of having acute appendicitis, hence should be admitted for observations and further workups were necessary. A score of 7 –10 means a high probability of having acute appendicitis hence surgery should be performed without further delay. Patients in each 0-4, 5-6, and 7–10 clinical score category were evaluated and compared with intra-operative findings and histopathological findings.

The histopathological findings after appendicectomy gives the true state of appendix. The clinical modified Alvarado score was compared with histopathology and analyzed. Histopathology showed a 75% positive appendicectomy and 25% NA rate for the 116 patients. Of the 116, 20(17.2%) patients scored 0-4 of which 16(13.8%) showed a NA. The 4(3.4%) patients who scored less than 4 points had true acute appendicitis and it is hoped that the condition be picked up during the follow up or abate with use of antibiotics. If the modified Alvarado score was strictly applied to make decision it means that 16(13.3%) of the total 116 patients could be excluded from surgery. Sixty-one (52.6%) patients who scored 7–could have undergone surgery without further delay but 5 (8.2%) patients had unnecessary appendicectomy, whereas 56 (91.8%) patients had true appendicectomy. Thirty-five patients had a score of 5–6, of whom 27(77.1%) had true appendicectomy and 8 (22.9%) patients unnecessary appendicectomy. However since this

being the observation group then the 27 patients with acute appendicitis could be subjected to unnecessary delay. This is the weakness of the Alvarado score and reduces its utility. Hence eight patients from 5-6 score group and five patients from 7-10 group makes 13 (11.2%) NA rate if modified Alvarado score were used as admission criteria. The usefulness of the score is seen at both extremes of the scale. From this study a sensitivity of 91.8%, 77.7%, and 80% was noted for 7-10, 5-6 and 0-4 score groups of patients respectively. (Table 19, 20)

Sex versus histopathological findings showed males had a 21.5% NA rate and females a 32.5% NA rate. (Table 21)

Individual modified Alvarado score parameters in this study were cross tabulated with pathological findings and demonstrated sensitivity as follows: Migratory pain (83.1%) Nausea/vomiting (80.2%), Anorexia (86.7%), RIF tenderness (76.6%), RIF rebound tenderness (82.3%), Leucocytosis (91.0%) and neurophilia (93.6%). (Table 22)

Study articles that incorporate modified Alvarado score were sourced from the Medline and Cochrane updates Internet sites and printed journals were retrieved and reviewed for comparison. **Bathacharjee P.K.** et al. at Kar Medical College Hospital, Calcutta India, in a prospective study found out that a high score > 7 was dependable for males and children for early diagnosis but not in females, who they found to have high false negative rate (51). Other authors similarly found that the use of the score at the emergency department is simple, non-invasive, fast, reliable, repeatable and cost effective, especially at both ends of the scale in males and children (8, 22, 52,54,55).

**Crnogorac S. et al** found a sensitivity of 87%, and average specificity of 60% with a diagnostic value of 82.7% (53). **Chan MYP et al.** recommends use of the modified Alvarado score as an objective criterion in selecting patients for admission in the emergency department settings (56).



A combination of Ultra-sound and CT imaging modalities and modified Alvarado score in an atypical appendicitis presentation reduces NA rates and complications in this equivocal group (22,57).

However some investigators have queried the usefulness of the score. **Ohmann et al** in a multicentre meta-analysis of already published prospectively data based in Germany concluded a poor performance of the score and recommended large scale controlled clinical trials (4).

## CONCLUSIONS

1. This study demonstrated a male preponderance of 2.1:1, majority being adolescents and young adults. Mean duration of illness was 5.47 days; with 50.0% patients presenting after 3 days (72 hrs) showing a significant pre-hospital delay. Mean pre-operative duration of 13.1 hours was observed, with 25.9% of the patients undergoing emergency appendectomy and 67.2% of the patients undergoing delayed emergency appendectomy. Complicated acute appendicitis rate of 38% was observed. This could probably be attributed to pre-hospital delay compounded with a mean preoperative duration of 13.01 hrs.
2. A negative appendectomy rate was documented at 25%. If the modified Alvarado score were used as an admission criterion at casualty: those who scored 0-4 could have been excluded from surgery from the onset. Meaning that the 16 patients who otherwise had a normal appendectomy could have been excluded from the 29 patients hence leaving only 13 (11.2%) with normal appendectomy. Those who scored 7-10 points had a false positive for 5 (4.3%) patients.
3. This study showed a high female normal appendectomy rate of 32.5%.
4. Patients who presented with migratory abdominal pain, 83.1% had positive histology, nausea/vomiting (80.2%), anorexia (86.7%), RIF tenderness (76%), RIF rebound tenderness (82%), leucocytosis (91.0%) and neutrophilia (93.6%). When all were combined in form of a score sensitivity of 88.8% was observed, giving negative appendectomy rate of 11.2%.
5. Sixteen percent of the patients thought to have acutely inflamed appendix at surgery are actually histologically normal appendix

## RECOMMENDATIONS

1. Modified Alvarado score should be used as a selection criterion for admission of patient with acute appendicitis at KNH emergency. It is cheap, fast, and repeatable and showed a low appendicectomy rate of 11.2%. Some studies have demonstrated as low as 8% NA rate (25, 26).
2. A well-designed controlled clinical trial on prospective use of the modified Alvarado score should be undertaken to correlate with officers' clinical acumen at KNH emergency department.
3. Female patients with a suspicion of acute appendicitis and equivocal findings should undergo Ultrasound evaluation in combination with the score will greatly reduce the high negative appendicectomy rate observed in this group of patient.
4. A study should be undertaken to address the factors associated with a high rate of complicated acute appendicitis at KNH.

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## APPENDIX I

### DATA COLLECTION FORM

IP/OP NO. \_\_\_\_\_

1. Age \_\_\_\_\_
2. Gender \_\_\_\_\_
3. Duration of illness \_\_\_\_\_
4. Modified Alvarado score at casualty/emergency department

| Symptoms                             | score        |
|--------------------------------------|--------------|
| Migration of pain (1)                | _____        |
| Nausea/vomiting (1)                  | _____        |
| Anorexia (2).                        | _____        |
| <b>Signs</b>                         |              |
| RIF tenderness (2)                   | _____        |
| Rebound tenderness at RIF (1)        | _____        |
| <b>Laboratory findings</b>           |              |
| Leucocytosis $>15 \times 10^9/L$ (2) | _____.       |
| Neutrophilia $>75\%$ (1)             | _____        |
| <b><u>TOTAL SCORE</u></b>            | <b>.....</b> |

5. Is patient admitted/discharged (*tick where applicable*)?

If discharged, is patient reviewed 24 hours later (YES/NO)

6. Any other imaging technique performed (*tick where applicable*).

Ultrasound /CT-scan/Abdominal X-ray/Technicium99/

MRI scan.

7. Alvarado score repeated in the ward

| <b>Symptoms</b>                         | <b>score</b> |
|---|--------------|
| Migration of pain (1)                   | _____        |
| Nausea/vomiting (1)                     | _____        |
| Anorexia (2)                            | _____        |
| <b>Signs</b>                            |              |
| RIF tenderness (2)                      | _____        |
| Rebound tenderness at RIF (1)           | _____        |
| <b>Laboratory findings</b>              |              |
| Leucocytosis >15x10 <sup>9</sup> /L (2) | _____        |
| Neutrophilia >75% (1)                   | _____        |
| <b><u>TOTAL SCORE</u></b>               | <b>.....</b> |

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8. Preoperative resuscitation procedures in the ward (*tick where applicable*)

- i). Dehydration (Yes/No)
- ii). Electrolytes/fluid replacement (Yes/No)
- iii). Antibiotic administration (Yes/No)
- iv). Preoperational time taken in ward .....

9. Type of management given to the patient (*tick where applicable*).

Conservative/Surgery

10. Intraoperative variables (*tick where applicable*)

- i). Qualification of surgeon: -( registrar/surgeon)
- ii). Type of surgery: -( open/laparoscopic)
- iii). Incision made: - (Lanz/ Gridiron/paramedian)
- iv). Findings: -( inflamed/perforated/mass/abscess/peritonitis)

11. Histopathological findings

Negative appendicitis.....

Positive appendicitis.....

## APPENDIX II

### CONSENT TO PARTICIPATE IN A RESEARCH STUDY

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#### EXPLANATION

I am Dr. Neford Ongaro of P.O. BOX 6127, ELDORET, and a student at the university of Nairobi. I am undertaking a study on the usefulness of the Modified Alvarado scoring system regarding early diagnosis of acute appendicitis at KNH. The study is aimed at documenting the value of the score in lowering negative appendectomy rate in our local set up.

After agreeing to participate in this study you shall answer a few relevant medical history questions, undergo an ordinary physical medical exam and necessary blood samples for basic investigations required for diagnosis and pre-operative preparations be taken. Information obtained in this study will remain strictly confidential and used only for this study. Finally your participation in this study is entirely voluntary and you are free to withdraw from this study without affecting or jeopardizing your present or future medical care in this institution.

#### CONSENT

I \_\_\_\_\_, hereby, agree to enroll in this study on the evaluation of modified Alvarado score on acute appendicitis as seen at KNH. I have been explained to fully and I understand the same and all questions raised satisfactorily answered. I further understand that all information collected in this study is strictly confidential and whatever decision I make now or later will not affect my treatment now or in future in this hospital.

Signature/Thumb print.....Date.....

**(Patient or Guardian)**

Witness: Name.....Sign.....Date.....

Investigator.....Date.....

**(DR N. ONGARO)**