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U29/2770/2009

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DEPARTMENT OF PHARMACEUTICS

SCHOOL OF PHARMACY

UNIVERSITY OF NAIROBI

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF PHARMACY, IN THE UNIVERSITY OF NAIROBI

2013
DECLARATION

I declare that this proposal is my original work and has not been submitted elsewhere for examination, award of a degree or publication.

Signed: ___________________________ Date: ___________________________

OSCAR LIVOI

U29/2770/2009

This project has been submitted with my approval as a university supervisor

Signed: ___________________________ Date: ___________________________

DR. J.M. BURURIA
DEDICATIONS

To my beloved family, my dad, my mum, and my siblings for their constant prayers and resolute support which has seen me through this far.
ACKNOWLEDGMENTS

Many people have contributed unselfishly their precious time and knowledge to aid in completion of this project. In a special way, I would like to acknowledge the following people and institutions for making it possible to compile this research project report:

Dr. J.M. Bururia, my supervisor for his constant advice and constructive criticism without which this work would never have been a success.

Members of the KNH Microbiology Laboratory for their constant guidance and assistance in the data collection exercise.

My friends and classmates for their support and constant encouragement during the project work.

Almighty God whose providence for me has been above and beyond measure.
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ABSTRACT

Background: *Streptococcus pneumoniae* infections are a concern to the stakeholders in the healthcare sector not only because of their expanding spectrum of resistance but also because of their propensity to affect the most vulnerable members of the population; the paediatrics and the geriatrics. What makes the matter even worse is that the microorganism mode of resistance evolves rapidly such that it even becomes resistant to the newest drugs in the market.

Study Objective: To study the patterns of *Streptococcus pneumoniae* resistance, then make comparisons between the year 2011 and 2012.

Study Design: A retrospective study based on secondary data collected from patient records, both hospital files and electronic data bases (dispensing tools).

Subjects: Streptococcus pneumonia infected persons, both paediatrics and geriatrics from January, 2011 to December 2012.

Study Site: Kenyatta National Hospital (KNH)

Main Outcome Measures: Documented drug resistance levels over a 2 year period.

Results: All *S. pneumonia* patients’ records were reviewed. Of the 19 cases identified, 10 (52.6%) were found to be resistant. Generally cases of resistance were higher in 2011 (31.6%) than in 2012 (21.1%). Age group ≤2-15yrs accounted for most of the resistant cases in 2011(57.1%) followed by group 16-50 years (42.9%), while age group 16-50 years accounted for most of the resistant cases in 2012 (66.7%). Age group of people ≥60years had the least number of resistant cases (zero in 2011 and 16.7% in 2012). In 2011 *S. pneumonia* was most resistant to co-trimoxazole (57.1%), followed by tetracycline 28.6%, and levofloxacin at 14.3%.
In 2012, the organism was most resistant to co-trimoxazole (50%), followed by tetracycline (33.3%) and Co-amoxyclov (16.7%).

Conclusion: Levels of resistance to *S. pneumoniae* were lower in 2011, than 2012 but were still high within the age group <2-15 years and amongst cotrimoxazole and tetracycline. Pneumonia was prevalent amongst children and other age groups. Therefore concerted efforts should be directed towards ensuring complete eradication of its causative organisms.
LIST OF ABBREVIATIONS

*S. pneumoniae* - *Streptococcus pneumoniae*

GAVI - Global Alliance for Vaccine and Immunisation

HIV - Human Immunodeficiency Virus.

KNH - Kenyatta National Hospital

MLS - Macrolide Lincosamide Streptogramin
CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction:

*Streptococcus pneumoniae* has a broad spectrum antibiotic resistance and is involved in many infections those especially associated with the immunocompromised, the young and the elderly (Feldman and Klugman, 1997). Initially, the scope of this resistance was limited to the beta lactams especially penicillins but it was later noted that the spectrum of this resistance was broadening (Doern *et al*, 2005). Resistance has further been shown to have expanded to include the macrolides, ketolides, lincosamides and streptogramin B class of antimicrobial drugs, limiting the course of effective therapy (Stanek *et al*, 2011).

1.2 Epidemiology:

*S. pneumoniae* infections show a uniform and distinct distribution in the population with the paediatrics and the geriatrics being the most affected age groups. According to Robinson *et al*, (2001) the incidence of streptococcal infection, is especially high in children below the age of 2 years (19.3%) and members of the geriatric population above 65 years (28.6%). This can be attributed to the fact that *S. pneumoniae* is more likely to spread from the nasopharynx of these individuals to other locations within the body and cause an infection or disease (Siemieniuk *et al*, 2011). Global Alliance for Vaccines and Immunisation (GAVI) estimated that pneumococcal disease killed about 30,000 children in 2008; a mortality rate of 16%, making it the second leading cause of mortality amongst children under the age of five years in Kenya (GAVI Alliance, 2011).
1.3 Management of *S. pneumoniae* infections

Non invasive pneumococcal infections such as sinusitis are self limiting and heal within a week of infections. Intake of plenty of water and over the counter painkillers like paracetamol can be used to alleviate the symptoms (NHS, 2012). Invasive pneumococcal infections such as pneumonia on the other hand, are treated using antibiotics such as penicillin, chosen based on the costs and availability (Grimwood *et al*, 1997).

*Streptococcus pneumoniae* resistance limits the effectiveness of the therapy. It is mediated by a variety of mechanisms which can be described genotypically or phenotypically (Edelstein, 2002).

1.4 Mechanisms of *Streptococcus pneumoniae* Resistance

a) Mef (A)-mediated resistance. This type of resistance involves the efflux pump in the bacterial cell membrane which actively pumps out intracellular amounts of the drug. It confers low level of resistance to the drug and can be overcome by increasing the drug concentration. Drugs involved are mostly the macrolides.

b) Erm (B)-mediated resistance. It involves alteration of the bacterial ribosomal subunit (23s), conferring conformational change to the binding site of the macrolides. It confers a high level of resistance to the macrolides.

c) MLS resistance. Bacterial 50s ribosome is methylated at a single adenine residue, making macrolides, lincosamides and streptogramin B to bind to the same site. This renders them inactive thereby causing resistance.
d) Penicillin-Binding-Proteins mutations. It is common amongst beta lactamases especially penicillin. These particular mutations normally lead to a reduced affinity to drugs of the beta lactam class.

1.5 Prevalence of *S. pneumoniae* resistance

It has been noted that *S. pneumoniae* shows emergence of resistance which depends so much on the age of a given drug in the market. There is marked resistance to drugs used for long to manage the pneumococcus infection such as tetracycline and penicillins. According to a study carried out on serotypes and antibiotic susceptibilities of *Streptococcus pneumonia* in Nairobi, Kenya (Paul, *et al.*, 1996) over a 2 year period, the resistance was highest in tetracycline (34%) followed by penicillin (25%), chloramphenicol at 0.4% and erythromycin at 0%. Earlier, in 1993, it had been noted that 26% of pneumococcal isolates from Nairobi’s outpatient clinics, were resistant to penicillin (Kell *et al.*, 1993). A study conducted in 2007 amongst children under the age of 5 years, at the Moi Teaching and Referral Hospital in Eldoret, Kenya established that, of the nasopharyngeal isolates of *Streptococcus pneumoniae*, 52% were resistant to penicillin, 25% to ampicillin and 78% to cotrimoxazole (Nyandiko *et al.*, 2007). Another study was conducted by the Pan African Link through Microbiology, in a multicentric surveillance of streptococcal antibiotic resistance in nine African countries, Kenya included, from January 1996 to December, 1997 (Benbachir *et al.*, 2001). Results showed that resistance by *Streptococcus pneumoniae* isolates from the Cerebrospinal fluid and blood was highest in tetracycline (38.3%) followed by cotrimoxazole (36.4%), penicillin (30.4%) and then rifampin (2.1%). The study also noted that *Streptococcus pneumoniae* antimicrobial susceptibility was highest in amoxicillin at 96.3% followed by 3rd generation cephalosporins at 92.7%.
The existence of a relationship between resistance and the HIV status of patients infected with *S. pneumoniae* has been established. For example Madhi *et al.*, (2000) noted that HIV positive children are 40 times more likely to contact the antibiotic resistant strains of pneumonia than the HIV negative children. Other studies include one conducted by Rusen *et al* in 1997 and another carried out by Scot *et al* in 1998. Scot *et al* (1998) conducted a study on the serotype distribution and prevalence of benzyl penicillin resistance in *Streptococcus pneumoniae* isolates in people living along the Kenyan coast indicated that serotype 1 accounted for 44% of pneumococcal infections among HIV seronegative patients and about 5% of the infections in the seropositive. Out of this, about 98% of the serotype was susceptible to benzyl penicillin. Campbell and Silberman, (1998) also noted that children below 5 years were most likely to be infected with drug resistant strains of *S. pneumoniae*. This because they were the group exposed more to the frequent use of empirical antimicrobial therapy. On the other hand, a study on nasopharyngeal pneumococcal colonization of children living in Kenya established the antibiotic resistance, the strains of *Streptococcus pneumoniae* involved and the association of this resistance with HIV type I (Rusen *et al*., 1997). It noted that of the 94 isolates collected, 60% were resistant to penicillin, 28% to tetracycline but all the isolates were susceptible to erythromycin, chloramphenicol, rifampin and clindamycin.

1.6 Prevention of *S. pneumoniae* infections

*S. pneumoniae* prevention entails vaccination against different serotypes of the organism. Currently there are over 80 serotypes of the organism, 23 of which are covered for by the vaccine. Two types of vaccines have been used to prevent pneumococcal disease. They include the pneumococcal polysaccharide vaccine used mainly in geriatrics and pneumococcal conjugate vaccine, designed to reduce the nasopharyngeal carriage of the microorganism across all
susceptible individuals (Morbidity and Mortality Report, 1997). The latter was introduced in Kenya in the year 2011 (Waweru, 2011).

1.7 PROBLEM STATEMENT

It has been established that *Streptococcus pneumoniae* resistance to different antibiotics exists. However, most of these studies were carried out in the past and do not reflect on the resistance patterns to drugs such as the extended spectrum cephalosporins, used in current therapies. There is therefore need for more recent studies, designed to reflect on the recent state of *S. pneumococcal* resistance among the new antibiotics and the more conventional ones in use.

1.8 JUSTIFICATION

Pneumococcus disease is the second leading cause of mortality amongst children under the age of five years in Kenya with the burden being especially high for children living with HIV/AIDS. Studying the patterns of *S. pneumoniae* resistance in Kenya could therefore help in predicting them and as a result, aid in development of more effective treatment guidelines.

1.9 OBJECTIVES

Broad statement: To study the *Streptococcus pneumoniae* resistance to antimicrobial agents in children and geriatric patients at Kenyatta National Hospital.

Specific Objectives

1. Describe trends of resistance to *Streptococcus pneumoniae* between the 2011 and 2012.
2. Determine the drugs *S. pneumoniae* is most resistant to.
3. Determine the age most affected by *S. pneumonia* resistance.
CHAPTER 2: METHODOLOGY

2.1 Study Design

The project utilized data retrieved from patient records including the laboratory records and hospital files of patients who had suffered from the pneumococcal disease. Patient records were studied between January 2011 and December 2012. The information in these records was scrutinized to identify patients who had pneumococcal disease and drugs used in their management.

2.2 Setting and study population

The study was based at Kenyatta National Hospital in Nairobi Kenya in the medical wards. Study population was comprised of all patients who had been treated for pneumococcus disease at the hospital between the years 2011 and 2012. The patients were included from initiation of treatment to pneumococcus disease resolution.

2.3 Inclusion criteria

All patients admitted and treated for \textit{S. pneumoniae} infection between January 2011 and December 2012.

2.4 Exclusion Criteria

Patients whose files do not have relevant laboratory records.

Patients not admitted for more than 2 days at the hospital as it would have been difficult to establish the effectiveness of their therapy.
2.5 Sampling method and sample size

Patient files and laboratory records for patients who had been treated for pneumococcal disease at KNH from 2011 to 2012 were scrutinized randomly. Patient records from the year 2011 to 2012 gave the most recent data on the topic being researched, demonstrating the current trend on this particular issue. Sample size determination was done using the equation below (Corlein et al, 2003).

\[ SS = \frac{Z^2 \times P \times (1 - P)}{C^2} \]

SS = Sample size

Z = Z Value (e.g. 1.96 for a 95% confidence level)

P = Estimated prevalence of antimicrobial resistance (45%)

C = confidence interval expressed as 6.89% (standard value of 0.0689)

\[ SS = \frac{1.96^2 \times 0.45 \times (1 - 0.45)}{0.0689^2} \]

\[ = 200.29 \approx 200 \]

However, due to the limited number of pneumonia cases due to \textit{S.pneumoniae}, all cases in the study years (2011 and 2012) were considered.
2.6 Data Collection and Analysis

Data was obtained randomly from all the available patient and laboratory records from January 2011 to December 2012. This entailed an audit of files and laboratory records of patients treated for any *S. pneumoniae* infection. Patient files for age groups specified above were retrieved with the aid of the hospital staff, and laboratory records, doctor notes and diagnoses used to select files for specific patients treated for pneumococcal infection. Information regarding the patient’s age, sex, pneumococcal infection, laboratory records including the culture and sensitivity tests, and drug information including the type and dosage administered were recorded. A data collection form as provided in appendix 1 was used to collect the data.

The occurrence of resistance to *S. pneumoniae* within this particular period was recorded and the data entered in Microsoft Excel data sheet. Statistical Package for Social Sciences software (SPSS) was used to analyse this data.

**Ethical issues**

An approval from the Kenyatta National Hospital, and the University of Nairobi Research and Ethics Committee was sought. A copy of the approval letter has been attached. Care was also taken to ensure that information used in this study did not in any way link to a given patient, meaning the patient’s real names, ward and bed numbers were not and will not be disclosed.

**Presentation of Results**

Graphical methods and charts where applicable were used to analyse the collected data. Other statistical averages such as the mean and median were used.
2.7 Limitations of the Study

The limited time did not allow for the inclusion of other recent years such 2010 and 2009 in this study, which may probably serve to reduce the margin of error.

Other limitations included incomplete patient files and delays in retrieving the patient files for the study.
CHAPTER 3: RESULTS

*Streptococcus pneumoniae* was the causative organism for only 19 pneumonia patients sampled between 2011 and 2012. Thus, data analysis was done and based on these 19 files. Resistance was noted in 10 out of the 19 cases of *S. pneumonia* related pneumonia sampled representing 52.6% (6 in 2011 and 4 in 2012). *S. pneumonia* was resistant to were 4 types of drugs namely; tetracycline, cotrimoxazole, levofloxacin, co-amoxyclav

Table 1: Results

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AGE GROUP</th>
<th>DRUG RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>≤2-15 yrs</td>
<td>2SXT TEC LVX</td>
</tr>
<tr>
<td></td>
<td>16-50 yrs</td>
<td>3SXT</td>
</tr>
<tr>
<td></td>
<td>51-≥60 yrs</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td>≤2-15 yrs</td>
<td>SXT</td>
</tr>
<tr>
<td></td>
<td>16-50 yrs</td>
<td>SXT 2 TEC COX</td>
</tr>
<tr>
<td></td>
<td>51-≥60 yrs</td>
<td>SXT</td>
</tr>
<tr>
<td>Key</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>TEC-</td>
<td>Tetracycline</td>
<td>LVX-</td>
</tr>
<tr>
<td>SXT-</td>
<td>Co-trimoxazole</td>
<td>COX-</td>
</tr>
</tbody>
</table>

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3.1: 2011 RESISTANCE DATA

### Table 2: Age Group

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2-15years</td>
<td>4</td>
<td>57.1</td>
<td>57.1</td>
</tr>
<tr>
<td>Valid 16-59years</td>
<td>3</td>
<td>42.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### Table 3: Drug Resistance

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracycline</td>
<td>2</td>
<td>28.6</td>
<td>28.6</td>
</tr>
<tr>
<td>Cotrimoxazol</td>
<td>4</td>
<td>57.1</td>
<td>85.7</td>
</tr>
<tr>
<td>Valid e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>1</td>
<td>14.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Figure 1: Pie Chart of Age Groups

Figure 2: Pie Chart of Drug Resistance
Figure 3: A Graph of Frequency of Resistance against Age Groups in 2011
### 3.2: 2012 RESISTANCE DATA

#### Table 4: Age Group

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2-15years</td>
<td>1</td>
<td>16.7</td>
<td>16.7</td>
<td>16.7</td>
</tr>
<tr>
<td>16-59years</td>
<td>4</td>
<td>66.7</td>
<td>66.7</td>
<td>83.3</td>
</tr>
<tr>
<td>&gt;60years</td>
<td>1</td>
<td>16.7</td>
<td>16.7</td>
<td>100.0</td>
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<tr>
<td>Total</td>
<td>6</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 5: Drug Resistance

<table>
<thead>
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<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracycline</td>
<td>2</td>
<td>33.3</td>
<td>33.3</td>
<td>33.3</td>
</tr>
<tr>
<td>Cotrimoxazol</td>
<td>3</td>
<td>50.0</td>
<td>50.0</td>
<td>83.3</td>
</tr>
<tr>
<td>Coamoxiclav</td>
<td>1</td>
<td>16.7</td>
<td>16.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>100.0</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
Figure 4: Pie Chart of Age Groups

Figure 5: Pie Chart of Drug Resistance
Figure 6: A Graph of Frequency of Resistance against Age Groups in 2012
CHAPTER 4: DISCUSSION, RECOMMENDATIONS AND CONCLUSION

4.1: Discussion

Levels of resistance to antibiotics amongst patients infected with *S. pneumoniae* still remain high at 52.6%. However, these levels were lower in 2012 than 2011. In 2011 alone, resistance was noted in 6 out of the total number (19) of patients identified (31.2%) compared to the 4 (21.1%) in 2012. The year 2011 is the year the Government of Kenya in coordination with the GAVI alliance introduced the Pneumococcal Conjugate Vaccine (PCV-10). This vaccine works predominantly against strains of *S. pneumoniae* and therefore the decrease in rates of resistance can be attributed to its effectiveness. The resistance levels were however still high in children with the age group <2-15 years (57.1% in 2011 and 16.7% in 2012). As explained earlier, this is the group which contains persons who are still immunologically immature and it is also the group highly exposed to frequent empirical therapy with antibiotics. Campbell and Silberman did identify frequent use of antimicrobial agents for empirical therapy as a major risk factor for cases of drug resistant *S. pneumoniae*. This can therefore be considered to be a reason for the high incidence of resistance in this particular age group. However, the study did find that adults between age groups 16-59 years were more prone to resistance (42.9% in 2011 and 66.7%) than those who are 60 or above 60 years (zero in 2011 and 16.7% in 2012). This is not in line with most of the literature reviewed. Therefore, these particular findings should be interpreted with a lot of caution. Admissions or rather referral for those adults between 16-59 years could have been more, providing a larger sample size compared to those who are 60 and above. These results could also mean that more emphasis on vaccination was put on children in the age group; ≤5months-15yrs and the elderly ≥ 60 years, who were thus responding well to the Pneumococcal Conjugate Vaccine while little or no emphasis was put on adults between the age of 16-59 years,
thus their high number, especially in 2012 of 66.7%. Consequently, conclusions establishing the risk of resistance to be higher in the age group; 16-59 years would rather be misleading and inappropriate. The same would be true for conclusions establishing the risk to be higher in males than in females as identified in the study results.

*S. pneumoniae* resistance to cotrimoxazole was the highest compared to other drugs studied that is; 57% in 2011 and 50% in 2012. The trend shows a decline in manner that cannot be certainly concluded. It was followed by tetracycline at 28.6% in 2011 and 33.3% in 2012. This is in line with studies conducted by both Nyandiko *et al* in 2007 and Benbachir *et al* in 2001. Of the other remaining drugs, only one case of resistance was noted for each, giving levels of 14.3% in Levofloxacin in 2011 and 16.7% for co-amoxyclav in 2012. As explained earlier and as noted by Paul *et al*, resistance and drug use are to a great extent related. Cotrimoxazole and tetracycline are antibiotics that have been in the market for long, they are also readily available in most hospital institutions and therefore widely used in empirical therapy. All these factors relatively contribute to *S. pneumoniae* high resistance levels to these particular antibiotics compared to other drugs. By the mere fact that resistance patterns could be repeated over the two years for drugs like levofloxacin and co-amoxyclav, makes it hard to conclude anything about them.
4.3: Conclusion

This study has established *S. pneumoniae* levels of resistance to various drugs and amongst various age groups. These levels of resistance were higher in 2011 than 2012 and also still high within the age group <2-15 years. It is worth mentioning that *S. pneumonia* resistance still remains a challenge amongst children and other age groups. Therefore concerted efforts should be directed towards ensuring complete eradication of its causative organisms.

4.2: Recommendations

Results have shown a decrease in *S. pneumonia* related cases. However, pneumonia generally still remains a major cause of death amongst children. Therefore, more efforts should be directed towards finding ways of eradicating other pneumonia causative organisms such as *Haemophilus influenzae*, *Moraxella catarrhalis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and many others. Secondly, drugs to which *S. pneumoniae* still shows high levels of resistance such as co-trimoxazole and tetracycline should be exempted from therapy and only used as a last resort when other treatment options are very limited. The vaccination programme should be expanded to cover the entire population to eradicate all cases of pneumonia due to *S. pneumoniae*. The study population was also very small thus likely to give inadequate data for valid conclusions. In future therefore, such studies should be expanded to include neighbouring hospitals, or other pneumonia causative organisms in the same hospital set up for collection of adequate data.
4.4 References


Available from [http://www.standardmedia.co.ke/?articleID=2000027627&pageNo=1](http://www.standardmedia.co.ke/?articleID=2000027627&pageNo=1) on 18th September, 2013
4.5 APPENDICES

Appendix 1: Sample data collection Sheet

<table>
<thead>
<tr>
<th>Patient Initials</th>
<th>Pneumococcal Infection</th>
<th>Age</th>
<th>Admission Dates</th>
<th>Drugs Used</th>
<th>Resistance (Yes/No)</th>
<th>Alternative Drugs</th>
<th>Resistance (Yes/No)</th>
</tr>
</thead>
</table>

Appendix 2: Ethics approval Letter.

Attached

Appendix 3: Microbiology Laboratory Approval Letter

Attached
Ref: KNH-ERC/UA/66

Oscar ivoi
School of Pharmacy
College of Health Sciences
University of Nairobi.

Dear Oscar


Your above proposal refers.

This is to inform you that permission has been granted by the KNH/UON-Ethics & Research Committee to carry out research on study titled “A STUDY OF STREPTOCOCCUS PNEUMONIAE RESISTANCE PATTERNS AT KENYATTA NATIONAL HOSPITAL BETWEEN JAN AND DEC (2011-2012)”

By a copy of this letter, I am requesting the relevant persons to accord you the professional support and other materials that may be useful to your research.

Yours faithfully,

PROF. M.C. CHINDIA
SECRETARY, KNH/UON-ERC

cc: Prof. A.N. Guantai, Chairperson, KNH/UoN-ERC
The Deputy Director CS, KNH
The Principal, College of Health Sciences, UON
AD, Health Information, KNH
Supervisor: Dr. J. M. Bururia

“Protect to Discover”
Oscar Livoi
School of Pharmacy
University of Nairobi
12th August, 2013

AD-LAB Medicine

KNH

Dear Sir/Madam,

RE: USE OF DATA IN MICROBIOLOGY LABORATORY

I am a final (4th) year Bachelor of Pharmacy student undertaking a project titled “A STUDY OF STREPTOCOCCUS PNEUMONIAE RESISTANCE PATTERNS AT KENYATTA NATIONAL HOSPITAL BETWEEN JAN AND DEC (2011-2012).”

Attached is an ethics approval letter (Ref no. UP292/5/2013) giving me the permission to carry out the project.

It is in this regard that I would like to request your permission to use data, especially on culture and sensitivity tests, contained in the microbiology laboratory. This data will be vital for the completion of my final year project.

Yours faithfully

Oscar Livoi

0710726264