UNIVERSITY OF NAIROBI

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF CLINICAL MEDICINE AND THERAPEUTICS

ASSESSMENT OF GUIDELINE CONCORDANT ANTIBIOTIC PRESCRIBING FOR PATIENTS WITH COMMUNITY ACQUIRED PNEUMONIA AT THE KENYATTA NATIONAL HOSPITAL MEDICAL WARDS.

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Proposal presented in partial fulfillment of the degree of Master of Medicine in Internal Medicine, University of Nairobi.

DECLARATION

I hereby certify that this is my original work. All resources and materials used or quoted have been indicated and acknowledged by means of reference. This work has not been presented for the award of a degree in any other Institution.

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To God almighty, without whom none of this would have been possible.

DEDICATION

I dedicate this study proposal to my parents Mr. K. Rintari and Dr. Nancy Rintari.

LIST OF ABBREVIATIONS

AIDS ATS	Acquired Immuno Deficiency Syndrome Thoracic Society
BD BUN	Bi (Twice) Daily Blood Urea Nitrogen
CAP CAPO	Community Acquired Pneumonia Community-Acquired Pneumonia Organization
COPD	Chronic Obstructive Pulmonary Disease
CURB65	Confusion, elevated Urea >17mmol/l, Respiratory rate >30breaths/minute, Blood pressure<90/60mmHg, age >65years
CXR	Chest X-ray/ chest radiograph
DBP	Diastolic Blood Pressure
GPs	General Practitioners
Hb	Hemoglobin
HIV /AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
ICU	Intensive Care Unit
ID	Infectious Disease
IDSA	Infectious Disease Society Of America
KNH	Kenyatta National Hospital
MDR MRSA	Multi Drug Resistant Methicillin Resistant Staphylococcus Aureus
NICE	National Institute for Health and Care Excellence
OD	Once Daily
PSI	Pneumonia Severity Index
SBP SPSS	Systolic Blood Pressure Statistical Package for the Social Sciences
TB TID	Tuberculosis Thrice In a Day
URTI	Upper Respiratory Tract Infection
VAP	Ventilator Associated Pneumonia

DEFINITION OF KEY TERMS

Guidelines: Guidelines are outlines of conduct or policy that are usually evidence based, intended to enable users make informed decisions concerning appropriate interventions.

In the clinical setting, clinical practice guidelines assist both the healthcare professional and the patient make decisions on screening, prevention and management of specific health conditions.(1)

Adherence to guidelines: Adherence to guidelines denotes the degree of conformity between the knowledge, cognition and/or action of an agent with the recommendations of a guideline(2)"

Clinical audit: The clinical audit consists of measuring a clinical outcome or a process, against well-defined standards set on the principles of evidence-based medicine in order to identify the changes needed to improve the quality of care(3)

Pneumonia: According to the National Heart Lung and blood institute, pneumonia is a bacterial, viral, or fungal infection of one or both sides of the lungs that causes the air sacs, or alveoli, of the lungs to fill up with fluid or pus. There is no consensus on the definition and classification of pneumonia. This causes major issues where related but heterogeneous pathologies and clinical phenotypes are poorly classified. The absence of clear classification results in difficulty with clinical decision making and a potential for poorly formulated research. The magnitude of this problem is clearly evident in the common inability to identify the infectious organism(s) causing lung infection, necessitating empiric antibiotic therapy(4)

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ABSTRACT

Background: Pneumonia is a major cause of morbidity and mortality globally. Despite the proven benefits of guideline concordant antibiotic prescribing, research has shown that adherence to clinical guideline recommendations is dismal.

Objectives: The study aims to determine utilization of Kenyatta National Hospital antibiotic guideline titled 'The KNH guide to empiric antimicrobial therapy 2018' in the management of community acquired pneumonia in the Kenyatta National Hospital medical wards and the perceived barriers towards the utilization of this guideline.

Study site: Kenyatta National Hospital general medical wards.

Study design: Cross- sectional study.

Study participants: Medical records of patients 18 years and above admitted with community acquired pneumonia at the Kenyatta National Hospital medical wards and the doctors who prescribe antibiotics at admission for these patients (Internal medicine registrars and medical officers in the Outpatient department).

Materials and methods: A check list derived from the Kenyatta National Hospital guide to empiric antimicrobial therapy 2018 was used to assess guideline concordance based on seven quality indicators: empiric antibiotic, dose and route of administration, switch to oral antibiotics, duration of antibiotics (at least 5 days), collection of microbiological samples before initiating antibiotics, review of antibiotics at 48 hours and once the culture results are out. Online self-administered questionnaires were used to determine attitude and perceived barriers towards utilization of the KNH guideline among the Internal Medicine registrars and medical officers.

Analysis: Descriptive statistics were applied in the representation of each of the seven quality indicators. These were then compared with the guideline recommendations and adherence to the guideline for each parameter was expressed as a percentage of the total number of patients admitted with community acquired pneumonia. These were then graded into the following categories based on the level of concordance: Good >90%, Intermediate 60- 90%, poor <60%.

Questions on the attitude and the perceived barriers towards KNH guideline utilization were answered using a 5 point Likert scale. Perceived barrier statements that were positively formulated were then recorded so that a lower score meant a lower level of the perceived barriers and vice versa. Percentages were then calculated for the total number of doctors that agreed or strongly agreed that the barrier was applicable. An open ended question on the top 3 barriers to the KNH guideline utilization was also included in the questionnaire.

Significance of the research project: Enforcement of good antibiotic stewardship with the aim of reducing antibiotic resistance and improving patient outcomes.

Results: For each of the other quality indicators, adherence to the KNH guideline for patients with community acquired pneumonia was as follows: empiric antibiotic choice 48%, collection of samples for culture prior to antibiotic administration 0%, review of antibiotics at 48hours 26.4%, review of antibiotics with culture results 45.8%, total duration of antibiotics 28.8% and time to switch to oral antibiotics 3.6%. The top 3 barriers towards guideline utilization among the doctors were: unavailability of drugs (52.7%), inaccessibility of the KNH guideline (45.1%) and lack of or delay of investigations (34.1%).

Conclusion: This study has demonstrated that the level of adherence to the 7 quality indicators from the KNH guide is poor with the overall adherence being 35.5%. The recommendation least adhered to was collection of microbiological samples before initiation of empiric antibiotics. The most commonly identified barriers to utilization of the guideline were external and guideline related barriers.

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CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

Pneumonia remains one of the leading causes of hospitalization among adult patients in low and medium income economies despite advancement in the approach to disease prevention and management (5).

The absence of a microbiological etiology when antibiotics need to be administered, the vast array of available antibiotics and increasing antimicrobial resistance have led different infectious disease societies to publish antimicrobial guidelines to help in the selection of the appropriate initial antibiotic regimen, taking into account individual patient parameters(6).

Broad-spectrum guideline-concordant empiric therapy increases the possibility of prompt initiation of the appropriate antibiotics and has been shown to be comparable in efficacy to a pathogen-directed approach(7). Adherence to pneumonia treatment guidelines has also been shown to reduce 30 day mortality and length of hospital stay(8). Empiric antimicrobial therapy that is not concordant to pneumonia guidelines has been found to be an independent factor associated with early deaths in patients with severe pneumonia.

Adherence to guidelines for the treatment of pneumonia has been found to be alarmingly low. A study done in Garissa provincial general hospital, Kenya, reported 27.7% adherence to the Ministry of Health pneumonia guidelines(9). This is in contrast to studies in other countries that have reported adherence levels of 61- 97%(10).

In line with evidence based practice, the 'Kenyatta National Hospital (KNH) guide to empiric guide to antimicrobial therapy' antibiotic guideline was launched in 2018. Utilization of this guideline in the management of pneumonia is yet to be audited.

1.1 Problem statement

Antimicrobial therapy that is in line with clinical guidelines has been associated with shortened time to clinical stability, reduced length of hospital stay and decreased in-hospital mortality(11). Despite these proven benefits of upholding antibiotic guidelines, research has demonstrated that there exists wide variability in the prescription of antibiotics for patients

hospitalized with pneumonia(12). There is also evidence that data on the adherence to guidelines in the management of pneumonia is lacking(13).

CHAPTER 2: LITERATURE REVIEW

2.1 Disease burden

2.1.1 Morbidity and mortality

Globally, in 2015, lower respiratory tract infections were estimated to have caused 2.74 million deaths worldwide with pneumonia accounting for 55.4% of these, with a reported 3.2% rise in mortality between 2005 – 2015 (14). Pneumonia has been shown to be the most frequent source of infection related mortality among adults worldwide and has been linked to age, HIV infection and cigarette smoking. In low and middle income nations, where the life expectancy is much lower, the prominent risk factors are HIV and exposure to smoke(5).

A study done in Kenya in 2017 reported 21,584 deaths secondary to pneumonia(15).

According to the KNH statistics department, in 2018, there were a total of 1,815 patients admitted due to pneumonia with 367 (20.2%) succumbing to the illness that year(16).

2.1.2Economic burden

In a study done in Japan, pneumonia health-care related costs were estimated to be; about $346 per outpatient encounter versus $4851 per an inpatient episode. Drug expenses and laboratory test accounted for 82% of the outpatient CAP episode costs, while 61% of inpatient treatment expenditure were related to the duration of hospital stay(17).

In Kenya, from the healthcare provider perspective, the average cost for each pneumonia admission among children at the Kenyatta national hospital was US $177.14 (18). In a study done in Barcelona, the estimated cost of guideline adherent treatment was 1665.5 compared to 1710.5 euros for non-concordant treatment. This translated to the fact that heeding to treatment guidelines reduced cost by 1,121 Euros per patient cured in comparison with non-adherence(19).

2.2 Guidelines and rationale

2.2.1 Clinical Guidelines

Guidelines are used to convert evidence from clinical research and specialist views into direction for the everyday practical work of medical personnel. In spite of the numerous widely available clinical guidelines, their use in practice is often not translated into

practice. This is determined by a variety of factors. Studies indicate that guidelines are not utilized in most cases. Lack of adherence to guidelines may lead to unnecessary diagnostic tests and suboptimal or even insufficient treatment. It is postulated that about 30%–40% of patients receive treatment that is not evidence based, and a fifth to a quarter of these patients get unnecessary or potentially harmful medication(20). A Cochrane review of 27 studies, reported that the length of hospital admission was the most frequently used outcome measure with most of the studies reporting significant decline by applying clinical guidelines. However, successful guideline enactment depends on a number of factors mostly, the attending doctors perception or attitudes towards guidelines and perceived barriers to implementation of the recommendations(21).

2.2.2 Region specific pneumonia treatment guidelines

Distinct CAP treatment guidelines exist worldwide. Guidelines, suited to the regional, national, or local experiences are crucial due to the fact that one global guideline is not sufficient to meet the special demands of every practice region. The prime facets guiding the requirement for regional rather than global guidelines, stems from differences in socioeconomic factors, health care organizational contexts, regional hospitalization standards, and differences in antimicrobial agent availability(22).

The differences between the regions when it comes to the pathogenic micro-organisms, aside from the places with widespread presence of mycobacterium tuberculosis infection presenting as pneumonia, remotely explain the differences contained in the varying recommendations.

A crucial aspect where the differences between regional guidelines become very pertinent is where special thought is given to variation in economic and social attributes, such as poor nutrition and the frequency of infection with HIV/AIDS. Both of which are known to play a crucial role in the genesis CAP. In the countries with high incidence of HIV/AIDS, *Pneumocystis carinii* and other opportunistic infections that are linked to AIDS tend to make a greater contribution to the microbiological etiology of pneumonia(23)

A study done to determine CAP pathogens in different regions globally, including: United States, Europe, Latin America, Africa and the Asia, and the Pacific area, found negligible

difference worldwide in the pathogenic micro-organism associated with CAP, but with varying treatment options, that on the other hand, correlated with mortality(24).

2.2.3 Commonly used pneumonia treatment guidelines

The three main elements that determine the initial choice of therapy are: how severe the illness is at first encounter and presence of comorbidities or advanced years(25) The two commonly referenced guidelines in clinical practice are the ATS and IDSA guidelines for pneumonia. Due to confusion arising from differences in the guidelines, a joint committee was convened to come up with consensus guidelines.

2.2.3.1 ATS/ IDSA consensus guideline recommendations for the management of pneumonia

Key guideline recommendations include: use of objective severity assessment tools like CURB 65 or PSI supplemented with the physicians subjective view of the patient to determine site of treatment, investigation of specific causative pathogen where positive identification would significantly alter empiric treatment, combination empiric treatment for severe CAP (with addition of Ertapenem in specific patients as a suitable alternative for gram negative cover except *pseudomonas aeruginosa*) and the use of a fluoroquinolone or B- lactam antibiotic plus a macrolide agent in patients with high risk of developing drug resistant pneumococcal species (comorbidities like longstanding heart, liver or kidney disease, asplenia, suppressed immunity and diabetes among others). For in- patient non – ICU patients, the consensus guideline recommends use of a fluoroquinolone or Beta lactam antibiotic plus a macrolide antibiotic. Appropriate B- lactam antibiotics are ceftriaxone, cefotaxime and ampicillin among others. In the management of ICU patients' combination of a Beta lactam plus azithromycin or fluoroquinolones (like levofloxacin/ moxifloxacin/ gemifloxacin) especially in patients with penicillin allergy. *Pseudomonal* ICU treatment with piperacillin/ tazobactam, imipenem /cefepime or meropenem plus ciprofloxacin or levofloxacin with the alternative of Beta lactam plus an aminoglycoside plus azithromycin is advocated. While in patients with MRSA addition of linezolid or vancomycin is recommended(26).

Once the etiology of CAP is determined, therapy is then to be tailored to the specific organism. Rather than set a timeline for initial antibiotic administration, the committee recommended that optimal first dose administration would be in the emergency department, a departure from the previous 6 – 8hour timeline. Switch from intravenous to oral antibiotic is guided by clinical improvement, hemodynamic stability, ability to take orally and a normally functioning gastrointestinal system(26).

The minimum duration of antibiotic use should be 5 days and decision to discontinue antibiotics is based on fever free duration of 48 – 72 hours and clinical stability(26).

2.2.3.2 Recommendations of the KNH guide to empiric antimicrobial therapy 2018 in the management of pneumonia

The guideline recommends early diagnosis of pneumonia and initiation of antibiotics after collection of microbiological specimens(27).

Empiric antibiotics should be given to patients who are clinically unstable or suspected to have severe pneumonia. The antibiotic choice is based on the risk stratification and CURB 65 criteria, age of the patient, attendant renal and hepatic dysfunction, drug interactions, hypersensitivity reactions, pregnancy and lactation. The specific patient factors should also be considered in determination of the drug dosage(27).

The need for antimicrobial therapy should be reviewed at 48 hours and regularly thereafter. If the investigations done do not suggest infection, the antibiotics should be stopped and other appropriate treatment commenced. A duration of 5 days of antibiotics is considered adequate except in MRSA or *pseudomonas aeruginosa* infection(27).

Once the culture and sensitivity results are available, the clinician should then step down to the narrowest spectrum, most efficacious and cost effective option. The guideline also recommends the interpretation of cultures based on the clinical context so as to differentiate true infection, contamination and colonization(27).

The guideline classifies patients into 4 risk groups to help in the choice of empiric antibiotics as outlined in *table 1* below(27).

Category one: patient with no history of contact with the healthcare system in the last 90 days and no prior antibiotic treatment, young patient with no comorbidities or organ failure.

Category two: patient with recent hospital admission, multiple comorbidities, recent invasive procedure(s) or exposure to antibiotics

Category three: long hospitalization with invasive procedure performed, recent and multiple antibiotics or severe neutropenia.

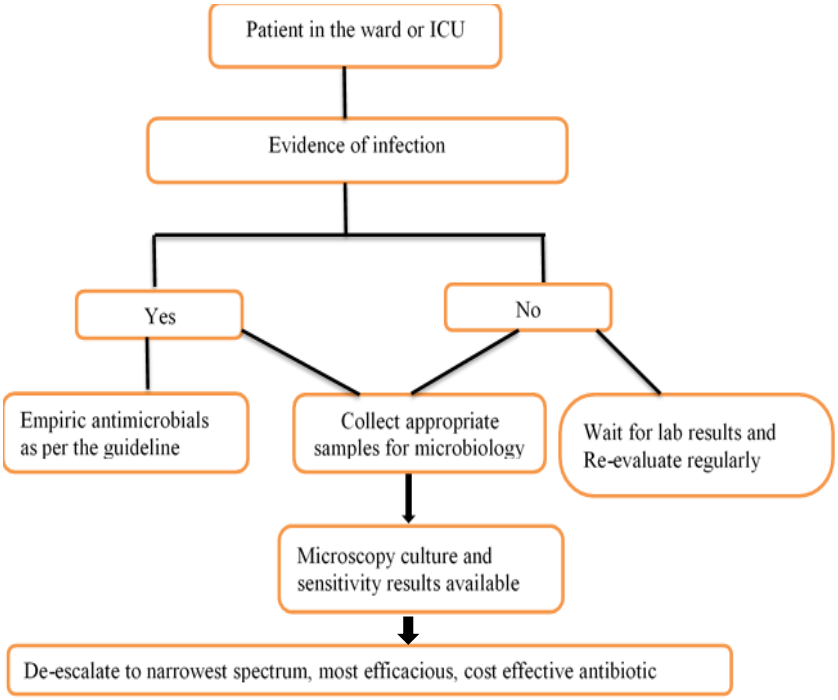
Category four: patient who is unresponsive to antibacterial agents

Table 1 empiric antibiotics for pneumonia as per the KNH guideline

Category	Common pathogens	Empiric therapy
1	*Streptococcus pneumonia* *Staphylococcus spp.*	Outpatient: amoxicillin or amoxicillin+ clavulanic acid Inpatient: amoxicillin+ clavulanic acid or cefuroxime or ceftriaxone + macrolide.
2	*Escherichia coli* *Klebsiella pneumonia*	Piperacillin/ tazobactam or Ceftazidime+ amikacin
3	*Acinetobacter spp.* *Klebsiella pneumonia* *Pseudomonas spp.*	Imipenem/ cilastatin or Meropenem or Piperacilin / Tazobactam or Cefepime + amikacin ** consult ID team if suspecting MRSA for use of vancomycin/ teicoplanin/ linezolid.
4	MDR organisms Invasive *candida* infections	** must have ID consult

The guideline further outlines an antibiotic prescribing algorithm. This is a series of steps to be followed in the ward when managing a patient with suspected infection as shown in *figure* 1 below.

Figure 1 antibiotic prescribing algorithm.



2.3 Adherence to pneumonia treatment guidelines

Adherence to broad spectrum initial antibiotic guidelines for the treatment of patients with CAP has been found to reduce death from pneumonia, morbidity, shorten the length of hospital stay per admission as well as healthcare expenditure (28). However, there is considerable evidence to indicate that national guidelines on the management of CAP are often dismally followed in clinical practice(9). It has been shown that outpatient antimicrobial audit reports over-estimate guideline adherence since they only address drug choice rather than the entire prescribing criteria. Appropriate antimicrobial stewardship should consider the whole spectrum of prescribing criteria including: drug dose, frequency of administration, duration and route of antibiotic administration to wholly assess guideline utilization. Consideration of drug dose and duration has been found to further reduce the reported level of guideline concordance(29).

An analysis of 37 studies published between 2010 and 2016, showed worldwide inconsistencies in the antibiotics prescribed for CAP, with utilization of guidelines ranging from 0% to more than 91% and with significant heterogeneity even within the same country(30).

Specific aspects of non-adherence to pneumonia treatment guidelines identified in studies include: mild CAP managed with two antibiotics, mild CAP treated with intravenous antibiotics, no additional coverage of atypical pathogens in moderate to severe CAP, no extra coverage for gram negative bacteria in severe pneumonia, giving an antibiotic despite documented allergy and the administration of discordant antibiotic, inappropriate route and dose(31).

In a study done in the Garissa provincial General hospital to assess the level of and factors affecting utilization of the ministry of health pediatric protocols for management of pneumonia among children aged 2 to 59 months. The results indicated that adherence to recommended treatment was 27.7%(9). A summary of studies done globally is shown on *table 2* below.

Table 2 Studies on adherence to pneumonia treatment guidelines

Author/year	**Guideline audited**	**Study type**	**Sample size**	**Adherence**
Al Abri S.et, al. 2012(12)	Gulf cooperation council guidelines, Oman	Retrospective study	342	67% adherence
Huijts S M 2013(32)	Dutch working group antibiotic policy	Prospective observational cohort study, multicenter	1758	30.5% -62.9% adherence
Alyacoubi, et, al. 2018(33)	NICE/ American Thoracic Society guidelines	Retrospective cross sectional	141	49% adherence
Reyes. S.et, al 2007(34)	Spanish national guidelines	Prospective observational, multicenter	425	76.5% adherence
Mutinda. C,et,al 2014(9)	Ministry of Health pediatric protocols, Kenya	Retrospective cross sectional	90	27.7% adherence

2.4 Perceived barriers towards adherence to the pneumonia treatment guidelines

Adherence to the recommended pneumonia treatment guidelines has been found to be sub-optimal. A good understanding of barriers to adherence is essential for planning effective change(35). Non-adherence may be related to the specific patient, the attending physician, the organization, and the sociocultural aspects of the healthcare system(36).

Often, the barriers to adherence are classified according to the framework of cabana(*table3 below*) into knowledge, attitude, external barriers, patient and guideline related barriers(37). In the study done to determine factors affecting utilization of the Ministry of Health pediatric protocols in the management of pneumonia among children aged 2 – 59 months, 27 doctors and clinical officers in different cadres from consultant pediatricians to medical officer interns, clinical officer interns and nurses were interviewed. 81.2% were trained on clinical guideline use while 93% were aware of the existence of the ministry of health pediatric protocols. Intention to adhere to the guideline was based on 3 parameters: attitude towards the task, behavioral control and subjective norm. 77.8% reported that the hospital and peers encouraged use of the guideline, >68% felt they were in control of guideline use and >85% felt that the guidelines are very useful(9).

Table 3 Framework of cabana(38)

Knowledge barriers
Absence of awareness or familiarity : GPs not aware of the specific contents of the guideline
Attitude barriers
disagree with the guideline due to absence of the scientific basis or poor applicability of the recommendations generally or to specific patients inability to perform what the guideline recommends due to lack of experience or training the belief that following the recommendations in the guideline will not affect outcome of patients inertia of past practice: difficulties changing old habits or lack of motivation to change
Individual patient factors :Ability to marry the patient preferences or demands with the guideline requirements
Guideline barriers
The belief that the guideline is either equivocal, incomplete or very complex
Environment related factors, Time pressure, lack of resources or financial constraints, organizational issues

Commonly identified barriers to guideline utilization include, lack of awareness of the guidelines, availability of conflicting guidelines, lack of guideline utility as well as patient factors such as the presence of comorbidities and multi-lobar disease. Studies done are shown in *table 4* below.

Table 4 sample studies on perceived barriers to proper antimicrobial prescription/ guideline utilization

Author / year	**Data collection tool**	**Sample size**	**Main perceived barriers**
Mol et, al 2004 Netherlands(39)	In-depth interviews plus A case scenario	12 Registrars and consultants	Poor guideline dissemination and lack of credibility Insufficient knowledge among residents Supervisor autonomy/ routine prescribing Different guidelines between departments
Halm, et,al 2000(40)	Chart reviews Plus Validated questionnaire	150 Physicians and house officers	Patient factors: age >65years, comorbidities, multi-lobar involvement, male, employed. Physician factors: primary physician involvement in admission,
Lugtenberg, et al 2011(36)	Validated questionnaire based on the framework of cabana	264 GPs	External factors: patient factors 30% Lack of applicability of guideline recommendation generally 22% and to individual patients 25% .
Genga et, al 2017(41)	Questionnaire (with case scenarios)	107 residents and specialists	40% unfamiliar with KNH guidelines 95.6% of participants cited inadequate antimicrobial training courses.

2.5 Audit studies

Clinical audits are part of the continual quality refinement processes. They consist of the measurement of patient outcomes against clear-cut standards based on the standards of evidence-based medicine. The focus of the audit is to clearly outline the discrepancies between actual practice and what is standard in order to identify the changes required to upgrade the quality of care(3).

The audit cycle as shown in *figure 2* below, consists of six steps that involve: problem identification, defining the set standards, data collection, analysis, implementing change and re-audit(42).

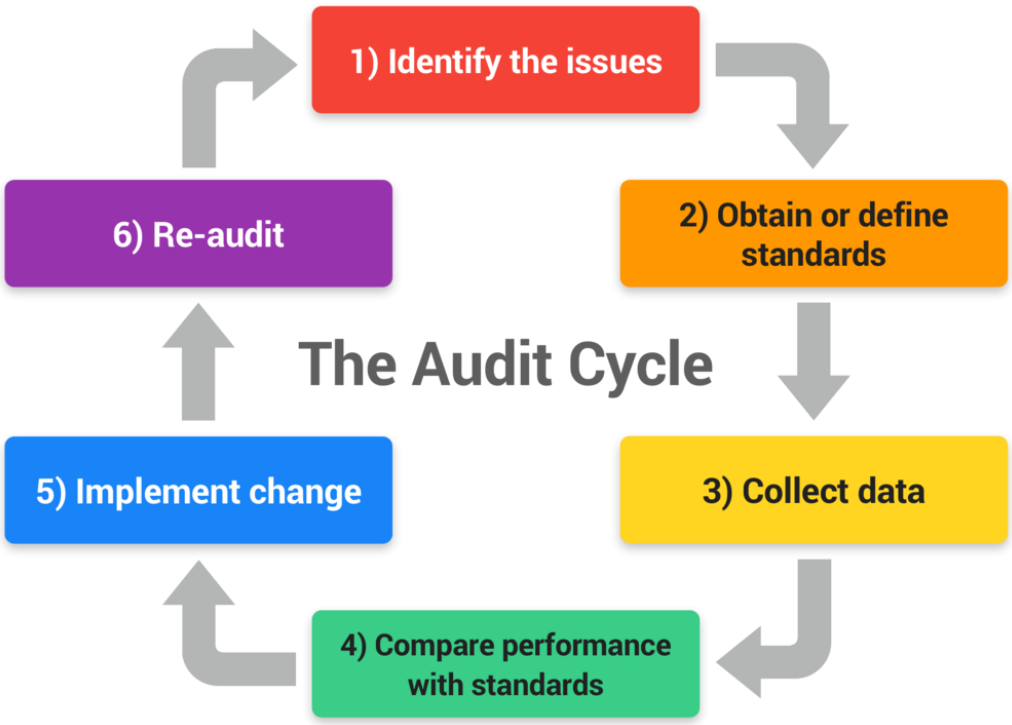


figure 2 audit cycle

2.6 Study Justification

Community acquired pneumonia is a serious global health problem associated with significant morbidity and mortality(43).

Studies have shown that appropriate management of community acquired pneumonia based on clinical guidelines will result in reduced morbidity, mortality and health related costs(44). Health care professionals contribute to the increase in antimicrobial resistance when their prescribing patterns are not evidence based (46).

The KNH guideline titled 'The KNH guide to empiric antimicrobial therapy' was circulated in 2018 to all clinicians who prescribe antibiotics to guide them in the management of commonly encountered infections including pneumonia. Having been operational for the last 1 year, its use in management of community acquired pneumonia in KNH is yet to be audited.

2.7 Study significance

The aim of this study is to determine the level of concordance with the KNH guideline in the management of CAP and the barriers to utilization of this guideline. The results of this audit study will be used to improve the quality of care given to pneumonia patients.

2.8 Study purview

This research was conducted to assess the full antibiotic prescribing criteria for patients with community acquired pneumonia in the KNH medical wards. A study pro-forma used to get the patients demographics while a checklist was used to abstract data on the prescribing criteria. Additionally, a validated self-administered questionnaire was used to identify attitudes and perceived barriers towards the utilization of the "KNH guide to antimicrobial therapy 2018" among the internal medicine registrars and medical officers in the casualty department.

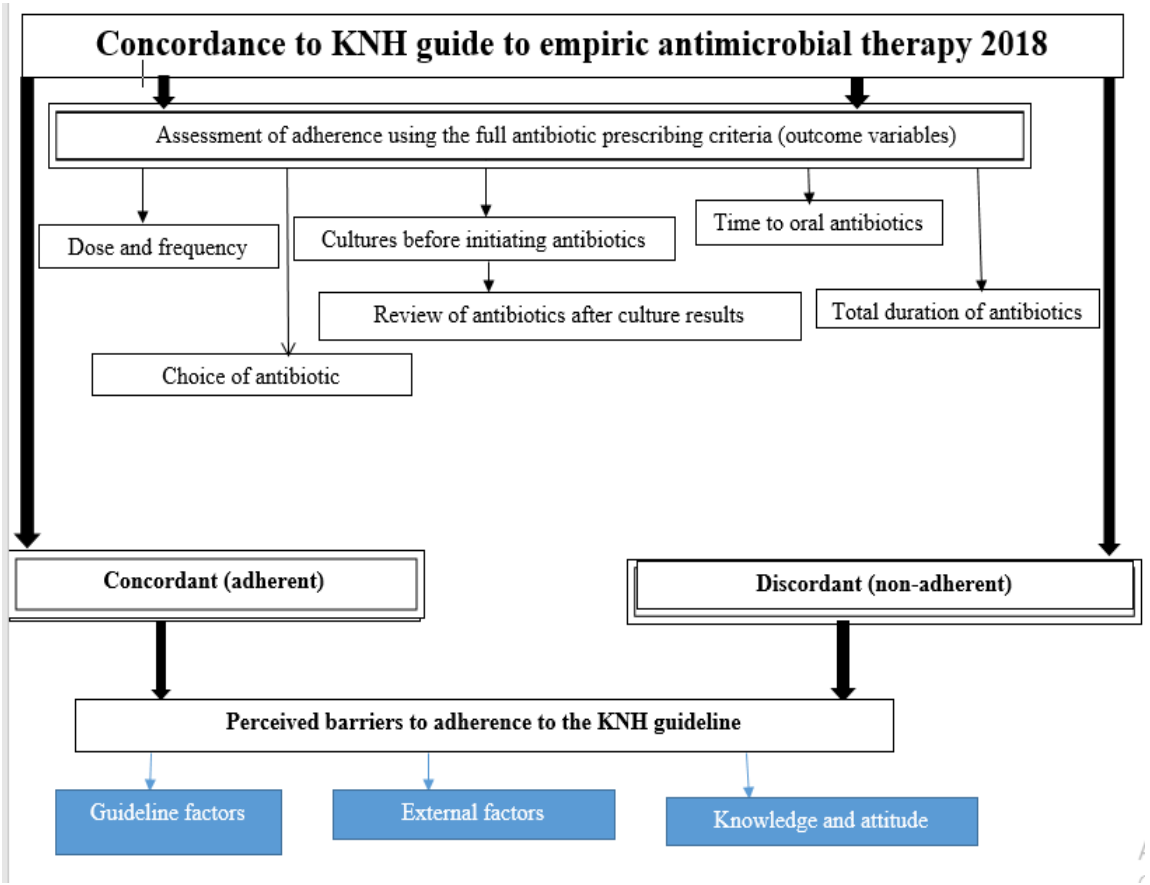
2.9 Conceptual framework

2.9.1 Conceptual framework narrative

Concordance to the KNH antimicrobial guideline in the management of community acquired pneumonia will be determined by assessing the full antibiotic prescribing criteria

as well as all the steps outlined in the antibiotic prescribing algorithm. Execution of guidelines is a composite process that is hindered by numerous barriers. A systematic review that included 76 studies identified a variety of barriers. These barriers were classified into three main classes: barriers related to lack of knowledge (e.g., lack of awareness of the guideline contents and lack of conversancy with the guidelines), barriers that affect physicians' approach to the guideline (e.g., lack of agreement with aspects of the guideline and lack of stimulus from prior use) and external factors (20).

2.9.2 Conceptual framework schematic (*Figure 3 conceptual framework*)



2.10 Research Question

What is the current clinical practice in the management of community acquired pneumonia in the KNH medical wards?

2.11 Broad Objective

To determine the utilization of the KNH antibiotic guideline in the management of community acquired pneumonia in KNH medical wards.

2.12 Specific Objectives

2.12.1 Primary objective

1. To determine empiric antibiotic concordance with the KNH antibiotic guideline in the management of community acquired pneumonia at the KNH medical wards.
2. To identify the perceived barriers toward utilization of the KNH antibiotic guideline in the management of community acquired pneumonia at the KNH medical wards

CHAPTER 3: STUDY METHODOLOGY

3.1 Study design

Cross sectional study.

3.2 Study site

The study was conducted in the Kenyatta National Hospital (KNH) which is the biggest teaching and referral facility in Kenya. It has a bed capacity of 1800 patients. The study was conducted in the six general medical wards. Each general medical ward admits new patients once a week on rotation basis.

3.3 Study population

a) Records of patients with pneumonia

The records of patients with a working diagnosis of community acquired pneumonia at the KNH medical wards were used to abstract information on patients' sociodemographic history, previous hospitalization in the last 90 days, length of hospital stay in the current admission, comorbidities, empiric antibiotic choice, dose and frequency, timing of microbiological sample collection, review of need for continued antibiotics at 48 hours, review of antibiotics upon receipt of culture results, time to change to oral antibiotics and total duration of antibiotics.

b) Doctors

The second study population are the doctors involved in the prescription of antibiotics in the KNH medical wards. Majority of the antibiotic prescriptions at admission are done by internal medicine registrars and medical officers in casualty about 100 in total. Sampling was done in a ratio of 7:3 based on the expected proportions (70 Internal medicine registrars / 30 medical officers in casualty).

3.4 Pneumonia case definition

All patients admitted to the medical wards in KNH with a working diagnosis of pneumonia were included in the study. Community acquired pneumonia was defined as a clinical syndrome with at least one of these "major" clinical features: or temperature > 37.8° C,

cough, or sputum production, or at least two of the listed "minor" clinical features: dyspnea, deranged mental status, pleuritic chest pain, consolidation on chest examination, or leukocytosis of >12,000mm with chest x-ray showing features suggestive of pneumonia at admission or within 24 hours (25).

3.5 Eligibility

3.5.1 Inclusion criteria

Patients with a diagnosis of community acquired pneumonia in the medical wards 18 years and above.

3.5.2 Exclusion criteria

Patients with community acquired pneumonia admitted in the specialized medical wards (oncology, chest, dermatology and ICU).

Patients admitted who tested positive or treated for Pulmonary Tuberculosis

Patients with an admitting diagnosis of hospital acquired pneumonia.

Elderly patients >80 years, with multiple comorbidities (category 2/3 patients in the KNH guide to empiric antimicrobial therapy 2018).

3.6 Sample size calculation

a**) Records of patients with community acquired pneumonia**

To estimate the sample size, Cochran's formula (1977) was used, with modification for small population : [$n = (z^2 xpxq)/d^2$] then $n = \frac{n_0}{1 + \frac{(n_0 - 1)}{N}}$

Where: n = The desired sample size

p = expected proportion of patients treated according to guidelines (proportion of adherence 0.277 in a study done in Kenya(9)), while N is the population of patients admitted with pneumonia in KNH in the year 2018 which was 1448 patients

q = 1-p

z = confidence level set at 1.96

d = Desired level of Precision set at 5% **Patient sample size 250**

b) Doctors

sample size was calculated using Cochran's formula with modification for small known population

$[n = \frac{z^2xpxq}{d^2}]$ then $n = \frac{n_o}{1 + \frac{(n_o - 1)}{N}}$

Where: N= population size, total number of registrars and medical officers in casualty 100 (70 registrars: 30 medical officers in casualty)

n = The desired sample size

p = expected prevalence or proportion of health workers adhering to guidelines

q = 1-p

z = confidence interval 1.96

d = The level of precision set at 5%

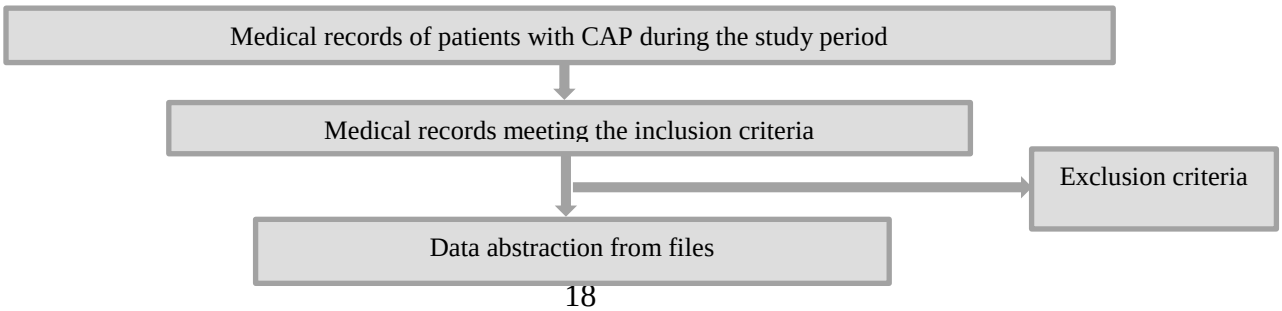
Doctors sample size =75 (53 Internal Medicine registrars/ 22 medical officers)

3.7 Medical record sampling method

The principal investigator and research assistant abstracted data from files of patients with community acquired pneumonia recruited at admission and followed up for 7 days. The files were used to obtain data for each of the quality indicators. The procedure is illustrated on *figure 4* below.

3.7.1 Recruitment procedure for the records of patients with pneumonia

Figure 4: Patient recruitment procedure



3.8 Doctors sampling method

The total population sample was taken from the internal medicine registrars, medical officers in casualty and medical officer interns. This was done in a ratio of 7:2:1 based on the expected proportions Enrollment was by consecutive sampling. Informed consent was sought and validated self-administered questionnaires will be filled in hard or soft copy. The investigator was available for any clarifications required.

3.8.1 Doctors recruitment procedure

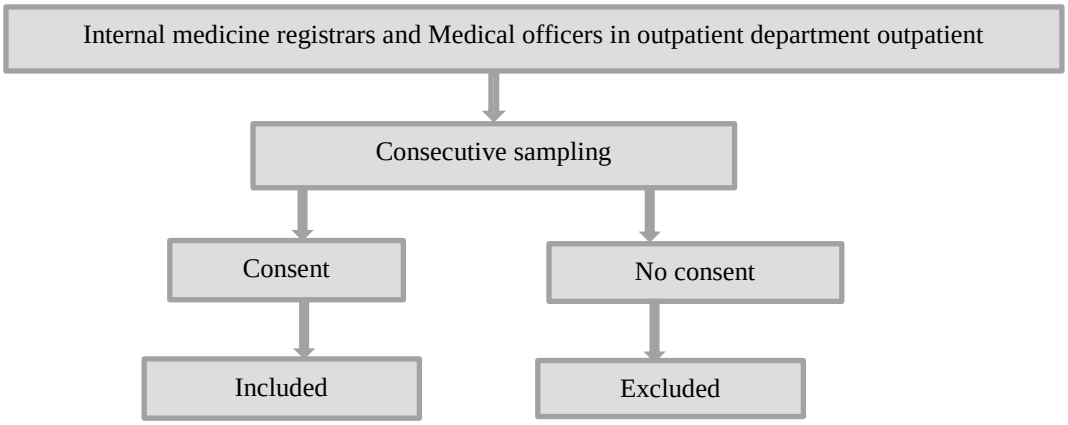


Figure 5 doctors' recruitment procedure.

3.9 Data collection methods

3.9.1 Study pro-forma

Data was extracted from the patients' files using the study pro-forma. Information was obtained concerning their age, sex, length of hospital stay, past or current smoking history, comorbidities and hospitalization in the last 90 days.

3.9.2 Checklist to assess adherence to guidelines

The check list consisted of 8 statements derived from the antibiotic prescribing algorithm. The domains that were assessed include: documented evidence of pneumonia, collection of microbiological samples before initiation of antibiotics, guideline concordant choice of antibiotics, review of antibiotics after reviewing results of microscopy, culture and

sensitivity, time to switch to oral antibiotics and the total duration of antibiotic administration. Documentation of the evidence of pneumonia diagnosis was confirmed by ticking the positive clinical features and a chest radiograph suggestive of pneumonia. A yes or no response was given for each step concordant with the guideline. The reason for deviation was also documented under the following domains: type of antibiotic, appropriate dose and route to fully assess guideline concordance. The duration of antibiotics and time to switch to oral antibiotics was entered in days. The patients were followed up for a total duration of 7 days.

3.9.3 Doctors' questionnaires

Soft copies were availed to each study participant. The questionnaire consisted of three parts: physician demographics, questions on attitude to guidelines in general and perceived barriers to clinical guideline utilization(45). It had a total of 20 questions. The questions assessing attitude and barriers to guideline utilization were answered using a 5 point Likert scale with the options being strongly agree, agree, neutral, disagree and strongly disagree. One open ended question is also included, where the respondents are expected to list their top 3 barriers to utilizing the KNH guideline 2018 in the management of pneumonia.

3.10 Outcome variables

Table 5 study variables.

Variable	**Concordant**	**Discordant**
Empiric antibiotic choice Dose and frequency of the antibiotic Collection of blood culture samples before starting antibiotics. Review of antibiotics in 48 hours after initiation Review of antibiotics after receiving culture results Duration of antibiotic use in days. Time to switch to oral antibiotics in days		
Perceived barriers to guideline utilization		

3.11 Data collection and rationale

Data was collected by the primary investigator and the research assistant every morning from Monday to Friday in the admitting medical ward. The role of the principle investigator was: assembling files that are eligible for use in the study from patients admitted with pneumonia, filling the checklist and study pro-forma with data abstracted from the files, entering cleaned data into excel sheets and subsequently into the SPSS software, inspecting filled questionnaires for completeness, recruiting and training the research assistant by providing information regarding the KNH guideline recommendations for management of community acquired pneumonia. The research assistant helped in abstracting data from patients file as well as administering the consent form to the patients whose records were used for this study. The research assistant was a holder of a diploma in clinical medicine, at least one-year post internship, registered under the clinical officers' board of Kenya. They were taken through the KNH guide to empiric antimicrobial therapy 2019 recommendations on management of pneumonia as well as familiarization with the data collection checklist and study pro-forma. A self- administered soft copy questionnaire was used to interview the doctors who gave consent to participate in the study. The quality of data was assured at all levels by performing data cleaning during data collection and entry. Cleaned data will then be entered into the SPSS software version 21.0.

3.12 Data analysis

Descriptive statistics were used to represent patient demographics, evidence of pneumonia expressed at least two positive clinical features and a chest radiograph suggestive of pneumonia, empiric antibiotic regimen chosen, timing of collection of microbiological samples, dose, time to oral antibiotics and the total duration of antibiotic administration as well as the review of antibiotics at 48 hours and upon reception of culture results. These were then compared with the guideline recommendations. Adherence to the guideline for each parameter was expressed as a percentage of the total number of patients admitted with a community acquired pneumonia.

The questionnaire consists of 2 parts: a general section on the professional characteristics of the doctors which was summarized by descriptive statistics, and a guideline specific part on the attitude towards the guideline and the perceived barriers towards guideline utilization which was answered using a 5 point Likert scale to rate the degree of agreement or vice versa. Perceived barrier statements that were positively formulated were then recorded so that a higher score meant a greater level of perceived barriers and the reverse also applied. Percentages were then calculated for the total number of doctors that agreed or strongly agreed that the barrier was applicable.

3.13 Data storage

The primary data in hard copy was stored in a locked cabinet within a room with restricted access and kept confidential. The key remained in the sole custody of the principal investigator. The information obtained was used to fulfil the objectives of this study only and quality improvement in the management of community acquired pneumonia in the KNH medical wards. The secondary data in soft copy was password protected and only the primary investigator was privy to it. Both primary and secondary data will be stored for 5 years and thereafter destroyed. Hard copies of the primary data will be shredded and disposed of while soft copies of the derived secondary data will be permanently erased.

3.14 Quality control and assurance

The quality assurance was run concurrently with the data entry. The research assistant was appraised on the process of data abstraction before the start of the project work. Every week the principal investigator, randomly inspected the data entry sheets for outliers or missing data.

3.15 Control of errors and bias

Recruitment of patients at discharge to reduce observer bias. Coding the self-administered questionnaires with numbers to ensure the questionnaires are answered anonymously with no victimization. Use of validated questionnaires that were assessed for completeness of

data by the principal investigator. The principal investigator oversaw the data collection, entry and analysis.

3.16 Ethical considerations

Enrollment of patients and healthcare workers was voluntary after obtaining informed consent. Each study participant was assigned number at enrollment for identification and to help in data analysis. Confidentiality was upheld, and anonymity was ensured. The patients did not incur any additional costs by participating in the study. Secure storage of the written and digital data was ensured to protect that information from all unauthorized access, inappropriate use, modification of any kind, or loss

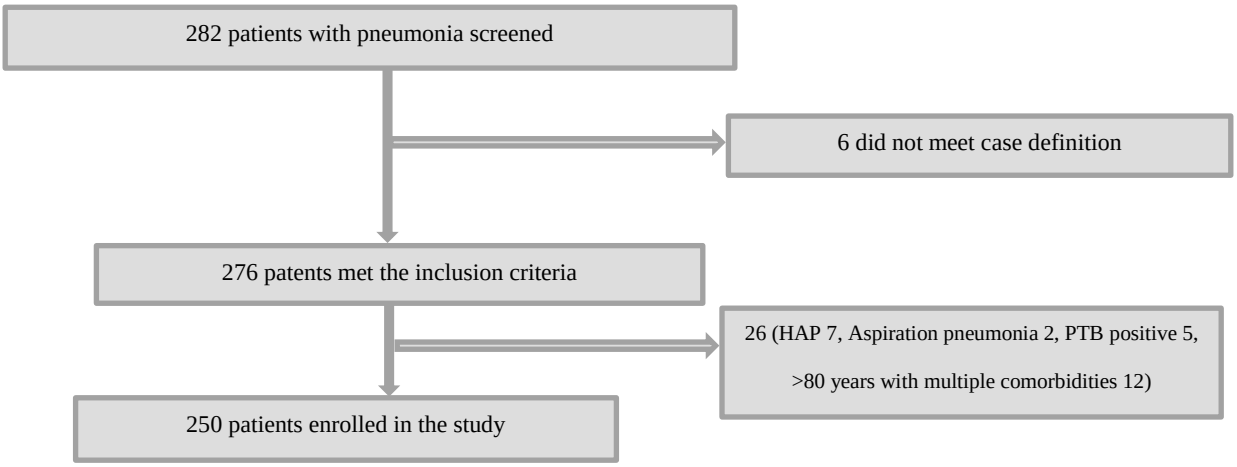
The study was only conducted after full approval by the department of clinical medicine and therapeutics and the Kenyatta National Hospital / University of Nairobi Ethics and research committee

CHAPTER 4: RESULTS

4.0 PATIENT ENROLLMENT

During the study period, Jan 2020 to April 2020, a total of 282 patients admitted with Pneumonia were screened for eligibility and were considered for the study. 6 of these patients did not meet the case definition while 26 patients were excluded from the study due to the following reasons: 7 had healthcare associated pneumonia, 2 were treated for aspiration pneumonia, 5 tested positive for pulmonary tuberculosis while 12 patients were over 80 years of age with multiple comorbidities. *Figure 6* below is a summary of the enrollment procedure.

Figure 6: Flow chart showing study enrollment of pneumonia patients in the KNH medical wards.

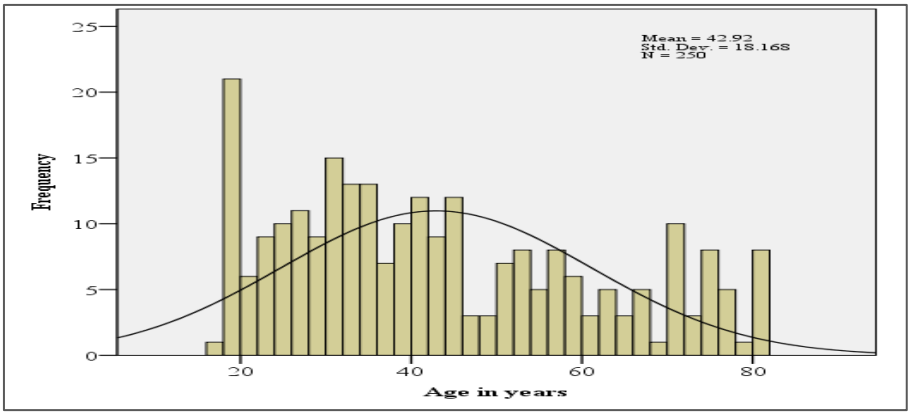


4.1 PATIENT SOCIODEMOGRAPHIC CHARACTERISTICS

The mean age of the study patient population at the time of this study was 42.9 (±18) years. There was a slight male preponderance with male patients being 52.4% (119). Majority, (78.8%) of the patients, were aged between 18 - 60 years. Extremes of age, represented by patients under 20 years and over 70 years were 8.4% (21) and 14% (35) respectively.

Notably, patients aged 18 years contributed to the bulk of patients under 20 years 7.2% (18). *Figure 7* below summarizes the age distribution of patients admitted with CAP in KNH medical wards during the study period.

Figure 7: Summary of age distribution of the patients with community acquired Pneumonia



Past or current smoking history was reported in 55 (22%) of the study participants, predominantly male. Among the smokers, only 17 (6.8%) had a documented duration of cigarette smoking with the total number of sticks per day, giving an average of 12.29 pack years of smoking. Majority, 177 (70.9%) of the patients had at least one concurrent chronic illness. The two commonly reported comorbidities were heart failure 20(11.8%) and HIV 17 (10.1%). Baseline characteristics of the study cohort are represented in *table 6* below.

Table 6: sociodemographic characteristics of hospitalized patients with CAP

Variable	**n=250** **n (%)**
Past or current smoking history	
Yes	57 (22.8)
No	193 (77.2)
Comorbid conditions	
Diabetes	10 (5.9)
HIV	17 (10.1)
Heart failure	20 (11.8)
Asthma	3 (1.8)
COPD	9 (5.3)
Other	56 (33.1)
None	54 (32.0)

Gender Male female	 128 (51.2) 122 (48.8)

4.2 LENGTH OF HOSPITAL STAY

The length of hospital stay was defined as the time between admission into the medical ward and documentation of discharge in the patients file. The average length of hospital stay for patients admitted with CAP was 6.5 days. Majority of the patients stayed in hospital for at least 7 days (93.6%) as illustrated on *figure 8* below**.** Only 11 patients were discharged within 5 days of hospitalization.

Figure 8: Summary of the total length of hospital stay

Length of hospital stay in days	Number of patients (%)
2	1 (0.4)
3	1 (0.4)
4	2 (0.8)
5	6 (2.4)
6	4 (1.6)
≥ 7	236 (94.4)

4.3 ASSESSMENT OF GUIDELINE CONCORDANCE

Assessment of concordance to the KNH guideline was done using 7 quality indicators namely: Empiric antibiotic choice, dose, route and frequency of administration, collection of blood culture samples before starting antibiotics, review of antibiotics in 48 hours after initiation, review of antibiotics after receiving culture results, total duration of antibiotic use and time to switch to oral antibiotics in days. The degree of concordance was then graded using the following cut-offs as used in similar CAP adherence studies into: Good >90%, Intermediate 60 – 90% and poor <60%. Each of the quality indicators will be discussed below.

4.3.1 EMPIRIC ANTIBIOTIC CONCORDANCE

The choice of antibiotic, route, dose and frequency were taken into account to fully assess the full prescribing criteria. The dose, route and frequency of administration was concordant to the KNH guideline in majority of the patients 241 (96.4%). The main reason for lack of adherence in this indicator was the erroneous dosage of Ceftriaxone and Ceftazidime in 9 patients. 2 patients received Ceftriaxone 1g OD, 4 received Ceftriaxone 2g BD while the remaining 3 got Ceftazidime 2g TDS. There was no documented reason for the dose adjustment in these patients.

The KNH antimicrobial therapy (2018) recommends the use of either Ceftriaxone, Cefuroxime or Amoxicillin- Clavulanic acid in combination with a macrolide for the management of hospitalized patients with CAP. The empiric antibiotic choice was guideline concordant in 48% (120) of the patients. These patients received a combination of Amoxicillin- Clavulanic acid or ceftriaxone with either clarithromycin or azithromycin.

The most commonly prescribed empiric antibiotics were Ceftriaxone (33.2%) and Amoxicillin- Clavulanic acid 55.6% either as monotherapy or in combination. Amoxicillin-clavulanic acid and Ceftriaxone monotherapy was prescribed in 42.5% and 35.4% respectively, while dual therapy with macrolides was given in 64.4% and 23.3% respectively. Broader spectrum antibiotic use was seen in 3.6% (9 patients), where Ceftazidime, Meropenem, and Piperacillin tazobactam were used. Besides the combination with macrolides, a number of other antimicrobials were used in a small percentage of patients, with Metronidazole being the most common 4.8% (12 patients).

Table 7 below illustrates the empiric antibiotics used in the KNH medical wards for the treatment of CAP. The frequency of use either as single or dual therapy is also indicated on this table.

Table 7: Empiric antibiotics used for CAP

Antibiotics used	**Number (%)**
Single agent	113 (45.2)
Combination therapy	137 (54.8)
Single agent	
Ceftriaxone	40 (35.4)
Amoxicillin-Clavulanic acid	48 (42.5)
Ceftazidime	16 (14.2)
Cefuroxime	3 (2.7)
Meropenem	2 (1.8)
Piperacillin tazobactam	4 (3.6)
Combination therapy	
Augmentin+Clarithromycin	85 (62.0)
Augmentin+Azithromycin	3 (2.2)
Augmentin+ Metronidazole	2 (1.5)
Augmentin+Ciprofloxacin	1 (0.7)
Ceftazidime+Clarithromycin	3 (2.2)
Ceftriaxone+Azithromycin	7 (5.1)
Ceftriaxone + Clarithromycin	25 (18.2)
Ceftriaxone+ Metronidazole	10 (7.3)
Ceftriaxone+Gentamycin	1 (0.7)

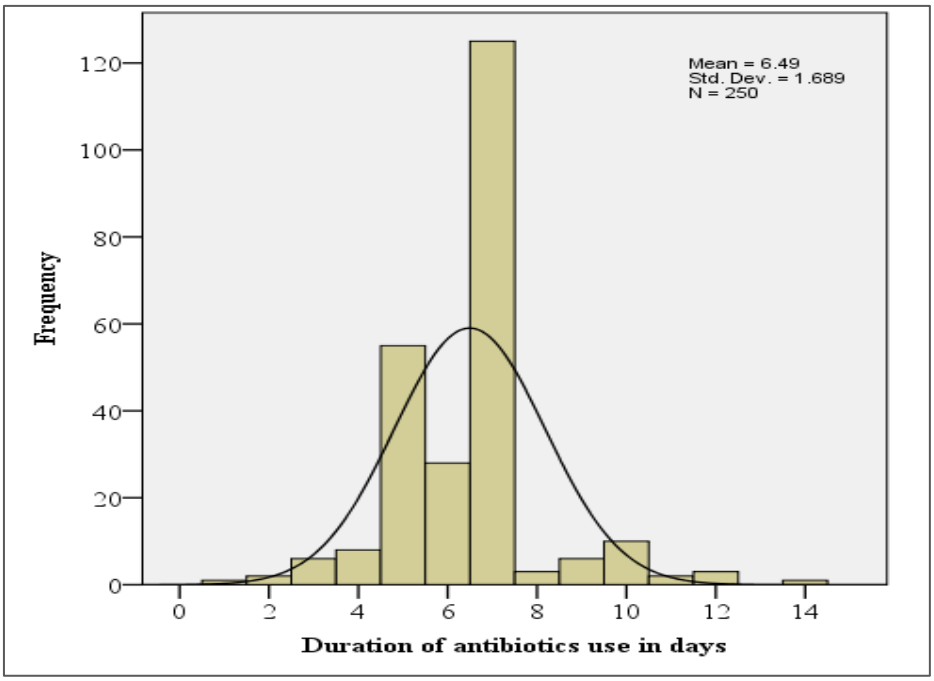
4.3.2 REVIEW OF ANTIBIOTICS DURING THE COURSE OF ADMISSION

Adjustment of antibiotics after 48 hours was done for 66 (26.4%), but only 9 (3.6%) patients were reviewed with the aim of switching to oral antibiotics at 48 hours as recommended by the KNH guideline. Review of antibiotics was done mainly with the aim of adding atypical cover 65 (26.2%), with addition of clarithromycin, azithromycin or metronidazole. 98 (39%) of patients had a complete change of antibiotics, with majority 45 (46%) being changed from Ceftriaxone to Amoxicillin- Clavulanic acid.

During the course of the in-patient stay, 25 (10%) patients received oral antibiotics, with the median time to oral antibiotics being 6 days. Only 9 (3.6%) of these patients received oral antibiotics within 48 hours of admission, in line with the KNH guideline.

The average duration of antibiotic administration was 6.5(1.7) days, longer than the recommended 5 days of treatment. Guideline concordance for duration of antibiotics was only achieved in 28.8% of the study participants. 236 (93.6%) of the patients received more than 7 days of antibiotics as illustrated in *figure 9* below. 118 (47.2%) had comorbidities.

Figure 9 Total duration of antibiotic administration



4.3.3 COLLECTION OF MICROBIOLOGICAL SAMPLES

The KNH antimicrobial guideline recommends the collection of blood culture and sputum for TB analysis (gene Xpert) for all patients admitted with CAP. In the study cohort blood culture and sputum samples for gene Xpert test were collected for 19% (48) and 38.4% (96)

respectively. 81 (32.4%) of the admitted patients presented with dry cough. There was no documentation of any attempt to induce sputum therefore no sputum sample collected.

However, none of these microbiological samples were collected before the initiation of antibiotics. These samples were collected from day 2 of admission onwards.

Among the samples collected, over 50% of the results were not available in the patients file by day 7 therefore not reviewed. For the individual samples, blood culture results were reviewed for 43.8% (21) while sputum gene Xpert results were only reviewed for 46.9% (45) of the patients by day 7. Overall compliance to this quality indicator was 45.8%.

The yield from these cultures was low, with 95.2% blood cultures and 93.3% sputum results being reported as negative for TB.

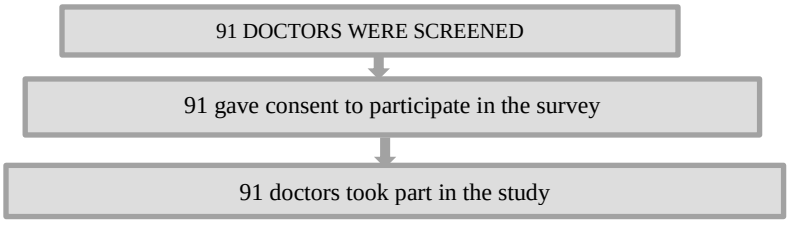
4.4 ASSESSMENT OF ATTITUDE AND BARRIERS TOWARDS IMPLEMENTATION OF THE KNH GUIDELINE

4.4.1 ENROLLMENT PROCEDURE

A total of 91 doctors took part in the survey. All the participants gave informed consent and proceeded to fill the online questionnaires.

Figure 10 below summarizes the doctor's enrollment procedure

Figure 10: Flow chart showing study enrollment of doctors



4.4.2 DOCTORS SOCIODEMOGRAPHIC CHARACTRERISTICS

73 Internal medicine registrars, 18 medical officers and 1 medical officer intern fulfilled the inclusion criteria and proceeded to fill in the online questionnaires. Majority 59 (64.9%) of the internal medicine registrars who took part in the study were in their second and third year of training while the medical officers work in the outpatient department. Over half 48 (52.7%) the respondents reported to have worked for more than five years after graduation and only 7 (7.7%) reported to have been in practice for less than 2 years.

50 (54.9%) of the respondents reported that they prescribe antibiotics at least once a day while only 1 (1.1%) prescribe antibiotics at least once a week.

Table 8 below summarizes the sociodemographic characteristics of the doctor

Table 8: sociodemographic characteristics of the doctors

Variable	**Frequency (%) n=91**
Years worked after school	
1-2 years	7 (7.7)
3-4 years	17 (18.7)
4-5 years	19 (20.9)
More than 5 years	48 (52.7)
Current position held at KNH	
Internal medicine Resident	73 (80.2)
Medical officer	17 (18.7)
Medical officer intern	1 (1.1)
Year of training for Internal Medicine Residents	
Year 1	14 (15.4)
Year 2A	20 (22.0)
Year 2B	39 (42.9)
Not applicable	18 (19.8)
Times prescribed antibiotics in work week	**Number (%)**
More than once a day	50 (54.9)
Once a day	9 (9.9)
3-5 times per week	23 (25.3)
1-2 times per week	8 (8.8)
Less than once a week	1 (1.1)

4.4.3 ATTITUDE TOWARD THE KNH GUIDELINE

To assess the attitude of the respondents towards the KNH guide to antimicrobial therapy 2018, 4 questions with options ranging from strongly agree to disagree were included in the survey as shown in *table 9* below. 81 (89.1%) of the doctors felt that the guideline is evidence based while 1(1.1%) disagreed with this statement. 74 - 84% of the participants find the guideline a useful tool in choosing the initial antibiotic, convenient and easy to find information required. 3 (3.3% of the respondents however, felt that the guideline is not useful in improving the quality of treatment given to patients with community acquired pneumonia.

Question (N 91)	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Guidelines are evidence-based	37 (40.7)	44 (48.4)	9 (9.9)	1 (1.1)	0
Useful and help improve quality of treatment	40 (44.0)	36 (39.6)	11 (12.1)	3 (3.3)	1 (1.1)
Good tool for choosing initial treatment	48 (52.7)	36 (39.6)	7 (7.7)	0	0
Convenient to use and easy to find information	36 (39.6)	38 (41.8)	9 (9.9)	8 (8.8)	0

Table 9: Attitude of the doctors towards KNH antimicrobial guidelines

4.2.4 BARRIERS TOWARDS GUIDELINE IMPLEMENTATION

The most commonly identified barrier toward implementation of the KNH guideline was lack of medical resources as reported by 56.1% of the respondents. The doctors reported that there the guideline is accessible (67.1%), does not reduce their autonomy (61.5%) or

limit treatment options (53.9%). 31.9% however, felt that the KNH guideline is complicated and difficult to find information.

This data is presented on *table 10* below.

Table 10: Barriers to use of KNH empiric antimicrobial guideline among the doctors

Question	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
Hard to implement in daily practice due to lack of medical resources	19 (20.9)	32 (35.2)	13 (14.3)	24 (26.4)	3 (3.3)
Hard to implement in daily practice due to a lack of resources for patients	17 (18.7)	28 (30.8)	14 (15.4)	29 (31.9)	3 (3.3)
There is no time to search for information	3 (3.3)	16 (17.6)	12 (13.2)	45 (49.5)	15 (16.5)
Treatment guidelines are not accessible	4 (4.4)	15 (16.5)	11 (12.1)	42 (46.2)	19 (20.9)
Too complicated and it is difficult to find the information	5 (5.5)	24 (26.4)	20 (22.0)	35 (38.5)	7 (7.7)
Treatment guidelines reduce doctors' autonomy	3 (3.3)	16 (17.6)	16 (17.6)	49 (53.8)	7 (7.7)
Treatment guidelines limit treatment options	2 (2.2)	23 (25.3)	17 (18.7)	43 (47.3)	6 (6.6)
Treatment guidelines limit flexibility and individual approach	1 (1.1)	2 (2.2)	2 (2.2)	40 (44.0)	46 (50.5)
There is no need for treatment guidelines as treatment routines exist	0	1 (1.1)	12 (13.2)	42 (46.2)	36 (39.6)

4.2.5 RESPONSES TO THE OPEN ENDED QUESTION

The survey utilized an open ended question asking the respondents to list their top 3 barriers to the utilization of the KNH guideline in treating CAP. The respondents cited unavailability of drugs 48 (52.7%), inaccessibility of the guideline (45.1%) and lack investigations or delay of results 31 (34.1%) as the most common barriers. Time constrains

8 (8.8%) and exposure to antibiotics prior to admission 7 (7.7%) were also listed among the barriers, albeit in a small percentage of respondents as shown on *table 11* below.

Table 11: summary of barriers towards utilization of the KNH guideline

Barriers	**Frequency (%) n=91**
Inaccessibility of guidelines	41 (45.1)
Unavailability of drugs	48 (52.7)
Lack or delay of investigative results	31 (34.1)
Conformity to routine treatment regime	10 (11.0)
Cost to the patients	12 (13.2)
Time constraints	8 (8.8)
Exposure to antibiotics prior to admission	7 (7.7)

CHAPTER 5

5.1 DISCUSSION

This audit was looking at the different aspects of adherence to the KNH guide to microbial therapy 2018 in the management of in-patient community acquired pneumonia. The quality indicators studied were: appropriate empiric antibiotic choice taking into account the dose, route, frequency of antibiotic administration, time to change to oral treatment, total duration of antibiotics and the timely collection of microbiological samples. Additionally, the attitude and barriers towards the KNH guideline were investigated.

Overall, adherence to the 7 quality indicators was poor at 35.5%, with only the route, dose and frequency of antibiotic administration achieving good adherence (96.3%).

The KNH guideline recommends the use of Amoxicillin- Clavulanic acid, cefuroxime or Ceftriaxone with a macrolide in admitted patients with community acquired Pneumonia. The main reason for discordance in the empiric antibiotic choice was the prescription of Ceftriaxone or Augmentin as monotherapy. Multiple studies are in favor of combination

therapy with macrolides for atypical cover as this regimen has been shown to reduce both length of hospital stay and 30day mortality of patients admitted with CAP(46). The use of monotherapy may also contribute to the increasing antimicrobial resistance in Africa, with the resistance of *Streptococcus Pneumoniae* to Penicillin reported at 26.7% by 2017(47).

The adherence to the recommended antibiotic in this audit (48%) was higher than the audit done in Garissa County Hospital in 2014 that revealed adherence of 27.7% to the National Pediatric protocols(9). This may be attributed to various factors including: the greater availability of antibiotics in a referral facility like KNH compared to a remote county hospital like Garissa, the adult versus pediatric population, retrospective versus prospective study design as well as the extensive continuous medical education on antibiotic stewardship.

Globally, there is a lot of variation in the level of adherence to empiric antibiotics. Our adherence data are in agreement with other studies that investigated compliance to treatment guidelines in patients admitted with pneumonia and reported adherence rates of between 41% and77%(28). The level adherence is even lower in African counties with Sudan reporting up to 82% non-adherence to pediatric guidelines(48) while South Africa reported as low as 8%(49).

The study also looked at the full prescribing criteria, and it showed that the route, dose and frequency was appropriate in majority of the patients (96.4%). However, review of intravenous antibiotics at 48 hours with the aim to change to oral treatment was only done for 9 patients (3.6%). In this audit study, only 10% of the patients received oral antibiotics during their course of hospital admission, with the median time to initiation of oral antibiotics being 6 days. This is despite the fact that the 48-hour review of antimicrobials

with the aim to switch to oral treatment is a critical component of antimicrobial stewardship programs to improve judicious antibiotic use and has been shown to reduce both length of hospital stay and health care related costs(50). A study done in Venezuela as part of the CAPO study revealed that switch to oral antibiotics at 48 hours was poorly adhered to at 15%(51). Globally, the recommendation for switch to oral antibiotics is poorly adhered to and some of the reasons that have been cited include: lack of poorly stated recommendations in the clinical practice guidelines, the clinician's perception regarding patient outcome with oral antibiotics and the absence of protocols to monitor switch criteria during daily ward rounds.

The average total duration of antibiotics was 6.5 days (± 1.7) which is above the recommended duration of 5 days. This is likely as a result of the delay in early initiation of oral antibiotics as well as the patients' comorbidities. Studies done globally have shown that patients with CAP are treated with a 10 – 14day course of antibiotics, inclusive of 6 to 8 days of oral antibiotics(52). Research done has shown that withdrawal of antibiotics after 5 days is not inferior to previously recommended fixed timelines in terms of clinical success(53). Additionally, studies have found that needless prolongation of the duration of antibiotic administration is likely to select for antibiotic resistance(54). With multiple studies favoring short courses of antibiotics for patients with CAP, the thinking is now shifting to "less is more" with regard to in-patient care of pneumonia (55).

In terms of microbiological samples, the KNH guideline recommends that both blood cultures and sputum samples for gene Xpert are taken to rule out tuberculosis due to the high prevalence of Mycobacterium Tuberculosis in Kenya. Blood cultures were collected for 48 (19.2%) of the patients, while sputum was collected for 96 (38.4%) of the study

population. The fact that over one third of the patients with CAP 118 (32.4%) presented with a dry cough contributed to the reduced number of sputum samples collected. There was no documentation of any attempt at sputum induction in the sample population. Studies have shown that sputum induction is safe and increases the yield on sputum specimens by about two fold among HIV infected patients and admitted patients(56).

Despite over half the patients having at least either blood or sputum collected, none of these samples were collected prior to the initiation of empiric antibiotics as recommended by the KNH guideline. A similar finding was reported in a study done between 2013 to 2016 in KNH that found that the median duration of hospital stay before specimen collection for cultures was 4 days(57). The turnaround for culture results was noted to be high with results only (43.8%) and (55.2%) blood culture and sputum gene Xpert respectively available in the file by day 7. This was despite the fact that on average, blood culture results are out in about 48 hours while sputum gene Xpert test takes less than 2 hours. Factors that could explain the delay in getting the results may include a lack of initiative among the staff to follow up results, inertia from many negative blood cultures, large numbers of samples collected in a day in the referral facility leading to a back log of unattended to samples, and logistical factors like lack of reagents to run the tests.

This study also explored the factors affecting the utilization of the KNH guideline, specifically focusing on the attitude and perceived barriers among the doctors who frequently prescribe the antibiotics for patients admitted with CAP in the KNH medical wards. The participants, Internal medicine residents (80.2%), medical officers in out-patient (18.7%) and medical officer Interns (1.1%) reported that they routinely prescribe antibiotics for pneumonia patients, with 54.9% prescribing antibiotics at least once a day.

Overall, the attitude towards the KNH guideline is good. This was evidenced by the fact that, 89.1% felt that the KNH guideline is evidence based, a good tool for choosing initial treatment (84%) and it is convenient to use and easy to find information (84%). This is similar to what has been found in other studies, as most studies assessing clinical practice guidelines have reported a good attitude among the users(58). The reasons for the positive attitude include: the portability of the KNH guideline, the fact that it captures the commonly encountered infections not forgetting that each infection is summarized in one page for ease of reference.

In line with the overall good attitude towards the KNH guideline, it was noted that external, rather than individual barriers were cited as the main barriers to utilization of the KNH guideline. The top 3 barriers identified were: unavailability of drugs (52.7%), lack of guideline accessibility (45.1%) and lack or delay of investigations (34.1%). Other factors that featured prominently as hindrances to guideline utilization were: conformity to routine (11%), time constraints (8.8%) and previous use of antibiotics (7.7%).

The perceived barriers in our setting were different from those studied in the developed countries as patient and physician factors featured more prominently compared to KNH where external and guideline factors were cited more.

In one study done in the U.S.A, the doctor was likely to disregard the guideline if the patient was severely ill with multi-lobar disease or multiple comorbidities, male, age >65 years. Physician factors that played a key role in non-adherence include: the presence of the primary physician at the emergency department at the time of admission and the physicians level of experience(59). In the study done on adherence to the national Pediatric protocols

in Garissa County hospital, it was reported that the presence of comorbidities did not affect adherence to the guidelines while the disease severity led to greater adherence(9).

5.2 STUDY LIMITATIONS

The choice of empiric antibiotic and time to de-escalation may have be affected by other factors other than non-adherence to the KNH guideline. These include: type of antibiotic available in the hospital pharmacy, the available investigations and their turn- around time as well as comorbidities and exposure to antibiotics prior to hospital admission.

Poor documentation had direct impact on the information abstracted from patients' files and may have affect the quality of data obtained as anything not documented was considered not done.

The Hawthorne effect (observer bias) was likely to have increased the rate of compliance to the empiric antimicrobial guideline and therefore positively skewed the results.

Due to the large number of patients in KNH medical wards who are elderly and have comorbidities, it was not possible to exclude all of them as required under Category 1 of the guideline, we included only patients will one comorbidity and those over 80 years were excluded from the study.

5.3 CONCLUSION

This study has demonstrated that the level of adherence to the 7 quality indicators from the KNH guide is poor with the overall adherence being 35.5%. The recommendation least adhered to was collection of microbiological samples before initiation of empiric

antibiotics. The attitude towards the KNH guideline among the doctors was good. The most commonly identified barriers to utilization of the guideline were: unavailability of drugs, inaccessibility of the guideline and lack of or delay of results.

5.4 RECOMMENDATIONS

The recommendations from this audit study include:

1) Ensure availability of the recommended antibiotics for management of in-patient community acquired pneumonia so as to enhance guideline concordance.

2) Complete documentation of all the processes of care including: reason for choice or change of antibiotics, extended duration of antibiotics or hospitalization and assessment and Pneumonia severity.

3)Enhance KNH guideline accessibility by providing soft copies of the KNH guideline to all the doctors in the KNH outpatient department as well as all Internal Medicine registrars.

4). A checklist based on the antibiotic prescribing algorithm from the KNH antimicrobial guideline to be attached to every patient file as a reminder of the expected standard of care. This should lay emphasis on collection of blood culture and sputum for gene Xpert prior to initiation of antibiotics.

5) A follow up study to determine the relationship between adherence to guidelines in CAP and outcomes (Death and Length of Hospital stay).

CHAPTER 6: REFERENCES

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CHAPTER 7: APPENDICES

7.1 PARTICIPANT INFORMATION SHEET (PATIENT)

Study title –Assessment of guideline concordant antibiotic prescribing for patients with community acquired pneumonia in KNH medical wards.

Name of investigator and institution: Dr. Pauline Nkirote Rintari (University of Nairobi).

Name of sponsor: self

Introduction

You are invited to participate in the study because you are on management for pneumonia as an in-patient in the Kenyatta National Hospital. It is important that you understand why the research is being done and what it will involve. Please take time to read through and consider the information carefully before you decide whether to participate. Ask the study staff if anything is unclear and if you need additional information. Once you are satisfied that you have understood the information given and you wish to take part in the study, you must sign the consent form. To take part in the study you may be required to give consent for us to access your health records (admission file). Your participation in this study is voluntary. If you volunteer for the study, you may withdraw at any time but the information you have given will still be used for the study. Your refusal to participate or withdrawal from the study will not affect medical benefits to which you are otherwise entitled.

Purpose of the study

The purpose of the study is to find out whether the antibiotics administered for treatment of pneumonia are in line with the KNH guideline titled 'The KNH guide to empiric antimicrobial therapy 2018'. This information will be used to improve the quality of care given to pneumonia patients in KNH. A total of 249 other patients in Kenyatta national hospital will also participate like you. The study is expected to take 2 months but your participation in the study is one day.

Benefits for the participant

This study will not require you to do any tests or additional payment whatsoever. We will obtain information from your file regarding the documentation of your age, smoking history, any chronic illnesses that you suffer from, and details on the treatment you have received in this admission for community acquired pneumonia. The information gathered will be evaluated for adherence to the KNH treatment guidelines to ensure that you are receiving the recommended treatment.

Risks: The study will utilize your medical admission file to obtain details on the treatment you received for community acquired pneumonia. The information obtained from your KNH admission file regarding your illness will be kept confidential and you shall not be victimized or discriminated based on the information obtained. This study does not pose any risk or additional to you.

Procedure

If you agree to participate in the study your KNH admission file will be used to access your health information.

Confidentiality

The information we obtain from you will be treated with utmost confidentiality. You will be assigned unique numbers linked to your name. Thus your name and file number will not appear on any data form.

Role of the Kenyatta National Hospital/University of Nairobi Ethics and research committee

This study will only be conducted after obtaining approval from the Kenyatta National Hospital/University of Nairobi research Ethics review committee. This is the research governing body that ensures that research is carried out with integrity and ensures that your rights, dignity and safety is upheld during the study period.

If you have any questions you can contact: -

Principal Investigator

Dr. Pauline Nkirote Rintari)

P.O BOX 45299-00100, Nairobi or Tel 0720501406

Or

The Chairman, KNH/UON – Ethics and Research Committee

P.O BOX 20723-00202, Nairobi or Tel. 020 2726300 ext. 44355

Or

My research supervisors:

1) Prof. Omondi Oyoo,

Professor, department of clinical medicine and therapeutics, University of Nairobi.

P.O BOX 19676 – 00200 Nairobi, Kenya

2) Prof Erastus Amayo,

Professor, Department of Clinical medicine and Therapeutics,

University of Nairobi.

P.O BOX 19676 – 00200 Nairobi, Kenya.

3) Dr Loice Achieng,

Senior lecturer, Department of clinical medicine and therapeutics,

University of Nairobi

P.O BOX 19676 – 00200 Nairobi, Kenya.

4) Dr Wanjiku Kagima,

Kenyatta National Hospital

P.O BOX 20723 Code 00202, Nairobi, Kenya

7.2 CONSENT TO PARTICIPATE IN THE STUDY

I have read and understood the information in the consent form and it has been explained to me. My questions have been answered. I am also aware that participation is voluntary and I can withdraw from the study at any time without consequences. I have agreed to participate in the study.

Name of the participant / guardian_____

Date_____

Signature of Participant/Guardian_____

I confirm that I have explained the details of the research to the participant.

Researcher's Name _____

Date _____

Signature of Researcher_____

7.1 (A) KIAMBATISHO CHA SITA: FOMU YA HABARI KWA WANAO SHIRIKI

Utafiti: Utafiti huu ni kuhusu jinsi mapendekezo ya kutibu ugonjwa wa Pneumonia yanavyozingatiwa katika wadi za wagonjwa kwenye hospitali kuu ya Kenyatta.

Mtafiti mkuu: Dr. Pauline Nkirote Rintari

Mfadhili: mtafiti mkuu atabeba gharama zote za utafiti huu.

Utangulizi

Umekaribishwa kushiriki katika utafiti huu kwa sababu unatibiwa ugonjwa wa Pneumonia kwenye hospitali kuu ya Kenyatta. Ni muhimu uelewe chanzo cha utafiti huu. Tafadhali chukua muda kusoma maelezo haya kwa utaratibu kabla ya kufanya uamuzi iwapo utashiriki kwa utafiti huu au la. Tafadhali jiskie huru kuuliza wasaidizi wa utafiti maswali iwapo kuna jambo usilolielewa ama unahitaji maelezo zaidi. Iwapo umeelewa na umekubali kushiriki utafiti huu, utahitajika kutia sahihi fomu ya idhini. Kwa maslahi ya utafiti huu, rekodi zako za afya kutoka kwa faili yako zitatumika kupata maelezo kuhusu hali yako kwa wakati huu. Kujishirikisha na utafiti huu ni kwa hiari yako. Una ruhusa kukataa au kujiondoa wakati wowote. Unapojiondoa, kumbuka kwamba maelezo yako bado yatatumiwa kwa manufaa ya utafiti huu. Kwa kujiondoa kwa utafiti utazidi kupata matibabu kama unavyostahili katika Hospitali kuu ya Kenyatta.

Utaratibu

Unapo soma maelezo haya na kuyaelewa, utaombwa kupeana idhini ya kutukubali kutumia rekodi zako za kiafya (faili yako) kwa njia ya kutia sahihi. Faili yako itatumiwa kupata maelezo Zaidi kuhusu umri wako, iwapo unavuta sigara au la, magonjwa yoyote sugu unayotibiwa, na matibabu uliyopokea kwa ugonjwa wa pneumonia kwa wakati huu ambao umelezwa katika hospitali kuu ya Kenyatta.

Faida

Maarifa yatakayotokana na utafititi huu yanaweza kuboresha matibabu ambayo wagonjwa walio na ugonjwa wa Pneumonia wanapata. Matokeo ya utafiti huu yatawasilishwa kwa daktari wako na rufaa mwafaka itafanyika iwapo kuna haja.Washiriki hawatapata fidia yoyote ya kifedha kwa kushiriki katika utafiti huu.

Hatari

Ushiriki wako katika utafiti huu hauna hatari yoyote kwako. Utahitajika tu kupeana idhini ya kutukubalisha kupata maelezo zaidi kuhusu afya yako. Hakuna malipo yoyote kwa mshiriki.

Usiri

Habari zote tutakazopata kwenye faili yako zitabaki kuwa ni siri. Habari hizi zitawekwa kwenye eneo salama ambapo ni wale tu wanahusika na utafiti huu moja kwa moja ndio watakaozipata.

Kushiriki

Kushiriki kwa utafiti huu ni kwa hiari na uko na uhuru wa kujitoa katika hatua yoyote ama kukataa kushiriki bila ya maonevu.

Kazi ya kamati maadili ya ya utafiti

Lengo kuu la kamati hii ni kuhakikisha kwamba haki za wagonjwa zinazingatiwa na kuwa hakuna madhara wanayopata kwa kuhakikisha kwamba utafiti unafanywa kwa njia inayostahili.

Maswali kuhusu utafiti

Kama una maswali yoyote tafadhali wasiliana nami Dr. Pauline Nkirote Rintari kwa nambari hii ya simu: 0720501406.

Ama,

Mwenyekiti, Kamati ya Maadili ya Utafiti KNH/UON

Sanduku la Posta 20723-00202, Nairobi au nambari ya simu 020 2726300 ext 44355

Unaweza pia ukawasiliana na wasimamizi wa utafiti huu:

1) Prof. Omondi Oyoo,

Profesa, Idara ya Clinical Medicine na Therapeutics, Chuo kikuu cha of Nairobi.

Sanduku la Posta 19676 – 00200 Nairobi, Kenya

2) Prof Erastus Amayo,

Professa, Idara ya Clinical Medicine na Therapeutics, Chuo kikuu cha of Nairobi

Sanduku la Posta 19676 – 00200 Nairobi, Kenya.

3) Dr Loice Achieng,

Mhadhiri mkuu, Idara ya Clinical Medicine na Therapeutics, Chuo kikuu cha Nairobi

P.O BOX 19676 – 00200 Nairobi, Kenya.

4) Dr Wanjiku Kagima,

Hospitali kuu ya Kenyatta

Sanduku la posta 20723- 00202, Nairobi, Kenya

7.2 (A) FOMU YA IDHINI

Nimeelezwa asili ya utafiti huu na kuakikishiwa kwamba kushiriki kwangu ni kwa hiari na kwamba hakutakua na athari mbaya kwa afya yangu.

Sahihi/alama ya kidole: ……

Tarehe: ……

Kauli ya Mtafiti

Nimeeleza madhumuni na maana ya utafiti kwa mshiriki.

Sahihi: ……

Tarehe: ……...

7.3 (A) PARTICIPANT INFORMATION SHEET (Doctors)

Study title –An assessment of guideline concordant antibiotic prescribing for pneumonia in KNH medical wards.

Name of investigator and institution: Dr. Pauline Nkirote Rintari (University of Nairobi).

Name of sponsor: self

Introduction

You are invited to participate in the study because you prescribe antibiotics for the management of pneumonia in the Kenyatta National Hospital medical wards. It is important that you understand why the research is being done and what it will involve. Please take time to read through and through and consider the information carefully before you decide whether to participate. Ask the study staff if anything is unclear and if you need additional information. Once you are satisfied that you have understood the information given and you wish to take part in the study, you must sign the consent form. To take part in the study you may be required to provide information on your health history and you may harm yourself if the information given is not truthful. Your participation in this study is voluntary. You

may refuse to answer the questions that you do not want to answer. If you volunteer for the study, you may withdraw at any time but the information you have given will still be used for the study. Your refusal to participate or withdrawal from the study will not affect any benefits to which you are otherwise entitled.

Purpose of the study

The purpose of the study is to find out whether the antibiotics administered for treatment of pneumonia are in line with the KNH guide to empiric antimicrobial therapy. This information will be used to improve the quality of care given to pneumonia patients. A total of 74 other doctors in Kenyatta national hospital will also participate like you. The study is expected to take 2 months but your participation in the study is one day.

Benefits for the participant

You will not be charged for any test. The information gathered will be shared with your doctor to aid in better treatment of your illness.

Risks: You will be required to answer a few questions which may be personal but this will help in strengthening the study. The information obtained from your file regarding your illness will be kept confidential.

Procedure

If you agree to participate in the study you will be asked to fill a validated self-administered questionnaire.

Confidentiality

The information we obtain from you will be treated with utmost confidentiality. You will be assigned unique numbers linked to your name. Thus your name and file number will not appear on any data form.

If you have any questions you can contact: -

The Chairman, KNH/UON – Ethics and Research Committee

P.O BOX 20723-00202, Nairobi or Tel. 020 2726300 ext 44355

or

Dr. Pauline Nkirote Rintari

P.O BOX 45299-00100, Nairobi or Tel 0720501406

You can also contact my research supervisors:

1) Prof. Omondi Oyoo,

Professor, department of clinical medicine and therapeutics, University of Nairobi.

P.O BOX 19676 – 00200 Nairobi, Kenya

2) Prof Erastus Amayo,

Professor, Department of Clinical medicine and Therapeutics,

University of Nairobi.

P.O BOX 19676 – 00200 Nairobi, Kenya.

3) Dr Loice Achieng,

Senior lecturer, Department of clinical medicine and therapeutics,

University of Nairobi

P.O BOX 19676 – 00200 Nairobi, Kenya.

4) Dr Wanjiku Kagima,

Kenyatta National Hospital

P.O BOX 20723 Code 00202, Nairobi, Kenya

7.3 (B) CONSENT TO PARTICIPATE IN THE STUDY

I have read and understood the information in the consent form and it has been explained to me. My questions have been answered. I am also aware that participation is voluntary and I can withdraw from the study at any time without consequences. I have agreed to participate in the study.

Name of the participant / guardian_____

Date_____

Signature of Participant/Guardian_____

I confirm that I have explained the details of the research to the participant.

Researcher's Name _____

Date _____

Signature of Researcher_____

7.4 Study Pro-forma

BIODATA

Study number…… Name (initials)……

Physical address…… Date of Enrollment……...

SOCIAL DEMOGRAPHIC DATA

1. Age (in years) …….

2. Gender *(tick one)* ☐ Male ☐ Female

HEALTH INFORMATION

3. Past or current smoking history ☐Yes ☐No

4. Comorbid conditions

☐ Diabetes ☐ HIV ☐Heart failure ☐Asthma ☐COPD ☐Others (specify)

5. Hospital admission in the last 90 days ☐Yes ☐No

6. Length of hospital stay in the current admission in day(s)

7.5 Checklist to audit guideline concordant antibiotic prescribing.

1) Documented evidence of pneumonia?

a) Clinical features

One of : ☐cough ☐sputum production ☐fever > 37.8 ºC

Two of: ☐ pleuritic chest pain ☐dyspnea ☐ pulmonary consolidation by examination

☐altered mental status ☐ white blood cell count >12,000

b) Chest x ray with features of pneumonia ☐ Yes ☐ No

2)Samples for blood cultures collected

☐ Yes ☐ No ☐ Not documented

3) If yes to 2 above, blood cultures collected before initiating antibiotics

☐ Yes ☐ No

4) Empiric antibiotic concordant with the KNH empiric guide to antimicrobial therapy

☐ Yes ☐ No

5) If no to 4 above state the deviation under these headings

Appropriate antibiotic ☐ Yes ☐ No

Appropriate dose and frequency ☐ Yes ☐ No

Appropriate route ☐ Yes ☐ No

6) Empiric antibiotics re-evaluated after 48 hours? ☐ yes ☐No

7) Empiric antibiotics re-evaluated after review of culture results? ☐ yes ☐No

8) Time to oral antibiotics (days)

9) Total duration of antibiotic use (days)

7.6 Questionnaire

Questionnaire to assess attitude and barriers towards the implementation of the Kenyatta National Hospital guide to empiric antimicrobial therapy 2018 in the management of pneumonia.

Section 1 General questions

	Question	**Answer**
1.	After you left the medical school, how many years have you been working in a hospital? (if you have worked in two or more hospitals, please add the number of years in each hospital)	□ 1 year or less □ 2 years □ 3 years □ 4 years □ 5 years □ 6 years or more
2	Currently what position do you hold in KNH?	□ Resident □ Medical officer □ Medical officer Intern
3.	If you are a resident which year?	□ part 1 □ part 2A □ part 2B
4.	Do you think that knowledge of antibiotics will be important to you in your medical career (currently and in the future)?	□ Yes □ No
5.	What do you think about adherence to guidelines?	□ It is important □ It is not important □ I do not know
6.	How frequently do you prescribe antibiotics in the emergency room, outpatient clinic or in the wards?	□ More than once a day □ Once a day □ 3-5 times per week □ 1-2 times per week

		□ Less than once a week

Section 2 general questions on attitude towards guidelines

7.	Treatment guidelines are evidence-based.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
8.	Treatment guidelines are useful in daily clinical work and improve the quality of treatment.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
9.	Treatment guidelines are a good tool for starting initial treatment.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
10.	Treatment guidelines are convenient and the information is easy to find.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree

Section 3 perceived barriers to KNH empiric antimicrobial guideline of 2018 use

11.	Treatment guidelines are hard to implement in daily practice due to lack of medical resources (investigational abilities, etc.)	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
12.	Treatment guidelines are hard to implement in daily practice due to a lack of resources for patients (expensive medicines, etc.).	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
13.	There is no time to search for information.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
14.	Treatment guidelines are not accessible.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
15.	Treatment guidelines are too complicated and it is difficult to find the information.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
16.	Treatment guidelines reduce doctors' autonomy .	□ Strongly agree □ Agree □ Neutral □ Disagree

		□ Strongly disagree
17.	Treatment guidelines limit treatment options.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
18.	Treatment guidelines limit flexibility and individual approach.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
19.	There is no need for treatment guidelines as treatment routines exist.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
20.	Patients do not want doctors to conform to treatment guidelines.	□ Strongly agree □ Agree □ Neutral □ Disagree □ Strongly disagree
21	What are your top 3 barriers towards utilizing the KNH guide to empiric antimicrobial therapy 2018 in the management of pneumonia in the KNH medical wards?	Please list your responses 1. 2. 3.