A STUDY TO DETERMINE THE BASIS OF ANTIBACTERIAL USE AT THE DEFENCE FORCES MEMORIAL HOSPITAL

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Abstract: For many years pharmacists have debated about the rational use of drugs in scientific conferences and symposium. As a group, antibacterial contribute significantly to the cost of drugs and are claimed worldwide to account for 15% to 30% of the total health budget. Rational use of drugs require that patients receive medication appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time at the lowest cost to them and their community however it's been noted that there is a global problem of inappropriate antibacterial use. The general objective of this study was to determine the basis for antibacterial drugs use at the DFMH for the purpose of promoting rational drug use, improve safety, lower costs, and recommend areas that require further investigation. The study specifically sought to establish the factors that determine the basis of antibiotic use by prescribers; identify the patterns of antibacterial use and to determine the expenditure on antibacterial drugs as a percentage of total drug cost at the hospital between January and December 2013. This study was done at the Defence forces memorial hospital located in Nairobi County in Kenya. A retrospective cross-sectional study design was used to determine the basis of antibacterial use at the DFMH. The researcher collected data retrospectively for the period covering January and December 2013 from patient's prescription records and 48 healthcare professionals were also administered semi structured questionnaires. The target population was therefore 9377 patients prescription records and 48 healthcare professionals. Qualitative data was analysed by use of content analysis presented in a prose form. On the other hand, quantitative data was analysed by use of Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics such as percentages and frequencies were used to describe the characteristics of the target population. Data was then presented in graphs and tables. This study established that there is a Drug and Therapeutics Committee at DFMH and a formulary list or EML authorized for acquisition of medicines. Further, all medicines on the formulary list were identified by generic names (INN) and the formulary or EML medicines were based on those recommended in the STG. In addition, the study found that the hospital had STGs for infectious diseases for the most prevalent conditions. The study also revealed that the most commonly used antibiotics were Amoxycillin, Cefuroxime, Ofloxacin, Flucloxacillin, Metronidazole, Clarithromycin, Azithromycin, Cefadroxil, Levofloxacin and Tobramycin respectively. In relation to expenditure on antibacterial drugs, the study found that in 2013 the budgeted cost of antibiotics was 17.97% which agreed with some studies; however the actual expenditure was 7.75% of the total drug hospital budget, this was lower in relation to other studies that concluded expenditure was 50% of total budget. The study concluded that antibiotic prescribing at DFMH was mainly based on STGs and EML, and that Amoxicillin a broad spectrum antibiotic was the most prescribed drug in the hospital. Further it concluded that antibiotic expenditure was 7.75% of the total medicines budget in the hospital. The study recommends that the hospital should continue encouraging the use of the STGs and

hospital formularies in prescribing and to regularly revise the STGs according to WHO recommendations, it further recommends that the study should be carried out in other public hospital institutions in Kenya.

Introduction

The use of antibacterial has significantly brought down mortality and morbidity from communicable diseases. At the same time, inappropriate use of antibacterial is wide spread all over the world (Leung et al., 2011). Even for trivial infections of viral aetiology, an increasing trend is noticed for use of combinations, broad spectrum and newer generation antibacterial. This phenomenon is now posing serious negative impact in low economy countries where infectious diseases behold a major health challenge. High level of community antibacterial resistance necessitates the use of expensive drugs and may not be affordable for majority of patients with no third party payers. Today the situation is that many of the second and third line agents are turning to be ineffective in clinical settings. The slow pace with which new molecules of antibacterial are introduced into the market is inadequate to meet the needs of this global threat (Truter, 2008).

Antibacterial agents are the most prescribed drugs to hospital patients. The basis upon which they are prescribed remains a very important element in the quality of care, infection and cost control. Worldwide, more than half of all medicines are prescribed, dispensed, or sold improperly, and 50% of patient receive antibiotics without clear indications (Hogerzeil et al., 1993). Antibacterial agents have been found to be inappropriately used in various parts of the world, but few studies have been conducted in developing countries to determine their basis and patterns of use.

Irrational prescribing is a global problem. Bad prescribing habits lead to ineffective and unsafe treatment, exacerbation or prolongation of illness, higher costs, increased morbidity and mortality (Kanu et al., 2013). The situation is worse especially in developing and low income countries. Significant intervention has been difficult due to lack of adequate information and data on antibacterial use in most healthcare settings in the developing world.

Kenya, like other developing countries, has inadequate data on antibacterial use that can be useful in policy and decision making. However, there is one existing official report on national antibiotic use according to a report by GARP Kenya Working Group 2011 (Kshirsagar et al., 1998). Similarly at the DFMH there is inadequate information on the basis of antibacterial drug use. Knowledge on how antibacterial agents are being used and the basis for their use is fundamental in achieving rational drug use. The international conference for improving use of medicines that was held in turkey in 2011 (ICIUM 2011) renewed the call for closely monitoring antibacterial use and identifying antibacterial use problems.

In light of the above issues and challenges outlined, the researcher intends to undertake a retrospective cross-sectional study that will determine the basis of antibacterial use at the DFMH with the aim to promote rational antibacterial use and to recommend areas for further investigation in order to improve quality of care, containment of costs and identification and control of antibacterial abuse (Desta, Abula & Asfawosen, 2002).

Problem Statement

For many years pharmacists have debated about the rational use of drugs in scientific conferences and symposium (Erah, 2000). Rational use of drugs require that patients receive medication appropriate to their clinical needs, in doses that meet their own individual requirements for an adequate period of time at the lowest cost to them and their community however it's been noted that there is a global problem of inappropriate antibacterial use compounded by lack of important data and high costs of treatment resulting to high costs of treatment, antibiotic drug resistance and increased morbidity and mortality (Pechere et al., 2002). Unless the situation is remedied soon, the number of infections that could become resistant to antibiotics, will increase exponentially and put the whole of humanity at a risk. Antibacterial drugs comprise a large proportion of the total number of drugs prescribed at the DFMH and the knowledge of the basis of their use is very important for safeguarding and promoting rational drug use by ensuring continuous monitoring and evaluation of antibacterial use. The general objective of this study was to determine the basis for antibacterial drugs use at the DFMH for the purpose of promoting rational drug use, improve safety, lower costs, and use the findings to recommend areas that require further investigation.

The specific objectives of this study were;
1. To identify the factors that determines the basis of antibiotic use by prescribers.
2. To identify the patterns of antibacterial use.
3. To determine the expenditure on antibacterial drugs as a percentage of total drug cost at the hospital over a 12 month period.

Literature Review

Basis for antibacterial use

Proper selection of an antibacterial agent is based on a number of factors, including the identity of the pathogen, the site of infection, the pharmacokinetics (PK) and pharmacodynamics (PD) of the agent, potential toxicity to the patient, possible drug interactions, cost, and convenience of administration (Olayemi, Olayinka & Musa, 2010). The initial choice of an antibacterial agent may be modified during the course of treatment as the patient's clinical status evolves (eg, response to therapy, function of major organ systems, and so forth) and as more information about the nature of the infection comes to light. For example, when a patient presents severely ill, with signs and symptoms suggesting overwhelming bacterial infection, one must choose antibacterial agents empirically. In such emergent circumstances, an initial regimen is selected based on the best information about the nature of the infection that can be gleaned from the available history, physical examination, and preliminary laboratory studies. Possible pathogens are identified based on these findings, and drugs are targeted against the likely culprits, based on known patterns of antibacterial activity (Taylor et al., 1997). Estimates of antibacterial susceptibility of likely pathogens must take into account various factors that might predict resistance, such as the setting in which the infection was acquired (community, hospital, or nursing home); the previous use of antibiotics in the patient; and the potential of likely pathogens to produce extended-spectrum b-lactamases in the presence of b-lactam antibiotics (Yah, Yusuf & Eghafona, 2008).

Principles of PK and PD must also be considered in designing empiric regimens and in modifying those regimens in accordance with changes in the clinical condition of the patient. Patients who are severely ill almost always are treated with intravenous agents to bypass potentially slow and erratic oral absorption so that therapeutic levels are reached as soon as possible. Loading doses often are given under these circumstances to achieve a steady state more rapidly (Kadam, 2009).

According to Dusing, Lottermoser and Mengden (2001) combinations of antibacterial agents may be chosen not only for breadth of spectrum, but for favorable PD effects, such as synergistic killing, in which two agents demonstrate greater than additive activity. Toxicity is important to consider in formulating an empiric regimen. This is especially true in severely ill patients in whom organ function may be tenuous already.

Therapy may be modified as the clinical course evolves. When the identity of the etiologic organism has been confirmed by culture, antibacterial therapy can be refined based on precise measures of susceptibility of the strains to antibacterial agents. Depending on the patient's clinical progress, changes in dosage, route of administration, and even class of agent may be necessary or desirable (Eraker, Kirst & Becker, 2002). In general, an empiric regimen ultimately should be refined to the narrowest antibacterial spectrum, least toxicity, least invasive route of administration, and lowest cost that is effective.

Antibacterial susceptibility

Antibacterial susceptibility testing Susceptibility testing is indicated for clinically relevant isolates when antibacterial susceptibility cannot be predicted with confidence. Broadly speaking, susceptibility testing may be either qualitative as provided by such methods as the Kirby-Bauer technique, or quantitative, as provided by tube dilution methodologies, E-test, and so forth (Sintchenko et al., 2005). Quantitative testing of inhibitory and bactericidal activity by serial dilution is considered to be the gold standard, and results are reported as the lowest concentration of the agent, usually in micrograms per milliliter, at which inhibitory (minimal inhibitory concentration [MIC]) or bactericidal (minimal bactericidal concentration [MBC]) activity occurs.

Pharmacology

Once an antibacterial agent is selected based on known or suspected pathogens, the goal of therapy is to deliver the drug to the site of infection. Effective treatment of serious infections is believed to depend on concentrations of the anti-infective agent in excess of the MIC of the organisms, at the site of the infection (Chandy et al., 2014). The optimal dose and route of administration needed to achieve therapeutic concentrations, and appropriate monitoring for efficacy and toxicity, depend in large measure on the study of PK (ie, the absorption, distribution, and elimination of drugs). Related observations include the fact that with some agents, such as aminoglycosides and fluoroquinolones, antibiotic concentrations that are many multiples of the MIC for the pathogen are more effective than concentrations that exceed the MIC by smaller proportions. With other agents, such as b-lactams, higher multiples of the MIC makes no difference, but maintenance of steady levels just higher than the MIC results in the greatest efficacy (Chandy et al., 2013).

Pharmacokinetics

Absorption of drugs given by the intravenous route is rapid and complete as soon as the infusion is finished. Peak serum levels of the antibiotic are achieved almost immediately. For this reason, the intravenous route is most often chosen when antibacterial therapy is administered to a patient with a severe infection. Other routes, such as intramuscular and oral, are less rapid and less certain, because they are more likely to be affected by physiologic alterations (Haasum, Fastbom & Johnell, 2013). Peak serum levels are delayed and usually are not as high as those achieved by intravenous infusion. A few antibacterial agents, however, have excellent bioavailability; they are very well absorbed by the gastrointestinal tract, possibly by virtue of facilitated diffusion or active transport across gastrointestinal epithelium, so that a high percentage of active drugs reach the bloodstream. The fluoroquinolones, metronidazole, doxycycline, and trimethoprim-sulfamethoxazole are examples of very well absorbed drugs (Aldeyab et al., 2011). Intramuscular and oral absorption (of even highly bioavailable agents) may be impaired by poor circulation associated with hypotension. Gastrointestinal absorption also may be altered by ileus, colitis, bowel ischemia, and changes in gastric pH. Many of these conditions may be present in sepsis. Oral absorption may also be affected by food; some agents, such as erythromycin, are absorbed more slowly or less completely in the presence of food and some, such as cefditoren, are better absorbed in the presence of fatty food. Drug interactions can also alter absorption by the oral route. For example, fluoroquinolones and tetracyclines may be chelated by concurrently administered antacids and may be more poorly absorbed (Shapiro et al., 2014).

As the drug is absorbed, it is distributed to various body compartments. An important determinant of drug concentration is the volume through which it is distributed, or in simple terms, the extent to which it is diluted by body fluids (intravascular, interstitial, and intracellular). The volume of distribution is defined mathematically as $VD = A/Cp$, where VD is the volume of distribution, A is the total amount of drug present, and Cp is plasma concentration. Some drugs are avidly sequestered in certain tissues (eg, nafcillin in the liver), or are highly fat soluble and penetrate body compartments not accessible to drugs that are only water soluble (Kinh Van et al., 2013). In such cases, the volume of distribution, calculated for practical purposes based on measured serum levels, is very high, often exceeding total body volume. In those cases, the volume of distribution becomes a mathematical construct rather than a true measurable volume. Similarly, in patients who are very obese or who have a high fluid volume (cirrhosis, congestive heart failure, pregnancy), the volume of distribution for a given drug may be larger than expected, and the serum level correspondingly low. Sepsis and fever alone may increase the volume of distribution (Aldeyab, Kearney & McElna, 2011). It should be noted that this process is a dynamic one, and that as soon as drug absorption is underway, distribution, metabolism, and elimination begin, albeit often at different rates. All of these factors affect antibiotic concentrations in serum, and subsequently in tissue, at the site of infection. For example, even when a drug is infused intravenously, the concentration in serum can be influenced by the rate of infusion. Although the processes of distribution and elimination begin almost immediately, a rapid infusion can overwhelm the rates of distribution or elimination, and result in a higher peak serum level than a slower infusion (Shapiro et al., 2014).

Metabolism and elimination begin as soon as a drug is administered, and a balance between absorption and these processes ensues. The rate of elimination is expressed in terms of the half-life of the drug in serum. More than 90% of a single dose is eliminated by four half-lives. When

agents are administered intermittently, the dosing interval is usually calculated as three to four times the half-life of the drug. As redosing, elimination, and accumulation of residual drug continue, an equilibrium, or steady state, is reached after four to five dosing intervals. A higher initial dose, or loading dose, accelerates this process (Olayemi, Olayinka & Musa, 2010). Most antibacterial agents, including most b-lactams, aminoglycosides, tetracyclines, vancomycin, and sulfonamides, are excreted by the kidneys, either by glomerular filtration, tubular secretion, or both. Aminoglycosides, fluoroquinolones, most tetracyclines, and vancomycin are excreted primarily by glomerular filtration (Pechere et al., 2002). Only that fraction of antibiotic not bound to serum protein is excreted by this process, however, so a high degree of protein binding can prolong the half-life in serum. Tubular secretion, or active transport into the urine, contributes to the elimination of many b-lactam antibiotics. Probenecid, which blocks active transport, may prolong the half-life of these agents. Erythromycin, clindamycin, rifampin, nafcillin, and cefoperazone are excreted mainly by the liver, and doxycycline in the stool (Erah, 2000).

Toxicity

Impairment of renal or hepatic function may result in accumulation of drug if the dosage or the dosing interval is not altered. Toxic side effects may occur as serum and tissue drug concentrations increase. For example, high levels of imipenem, penicillins, or fluoroquinolones may cause seizures; high aminoglycoside levels may cause or exacerbate renal failure; high levels of vancomycin or aminoglycosides, particularly in combination, may cause hearing impairment or vestibular damage (Desta, Abula & Asfawosen, 2002). Reduction in the creatinine clearance to 30% of normal or less results in an exponential increase in the half-life of those drugs that are eliminated by the kidneys. For drugs with a narrow therapeutic index, even lesser reductions in renal function may necessitate changes in the dose or the dosing schedule. Certain antibacterial agents are contraindicated in the presence of renal insufficiency, whereas others require dosage modification (Kshirsagar et al., 1998).

The creatinine clearance can serve as a useful indicator of whether the dose should be adjusted, and if so, by how much. A quick estimate of the creatinine clearance can be made using this equation: clearance = (140- age)/measured serum creatinine. The initial dose should not be modified, but subsequent doses may be reduced as a percentage based on the estimated creatinine clearance (McManus, Hammond & Whicker, 1997). For example, if the estimated creatinine clearance is 50 mL/min, the calculated maintenance dose with some agents might be reduced by 50%, if given at the usual dosing interval. An alternative measure is to lengthen the dosing interval. Lengthening the dosing interval, results in a concentration versus time curve that approximates the situation in normal renal function, and is preferred by some authors. However using a longer dosing interval runs the risk of longer periods during which the serum level drops below the MIC of the organism, and for this reason some favor administration of smaller doses given at regular intervals. The use of hemodialysis, peritoneal dialysis, and continuous arteriovenous hemofiltration further confound calculations of dose modification (Bosu & Ofori-Adjei, 1997).

Guidelines for dosage modification in dialysis patients can usually be obtained from the manufacturer's product literature, and are based on the degree to which the drug is removed by dialysis. In general, the various methods of dialysis are at least partially effective in clearing b-

lactams and aminoglycosides, but have little effect on vancomycin. This topic is discussed elsewhere in this issue (Kanu et al., 2013).

Unfortunately, there is no clinical measure of hepatic dysfunction that is easily adaptable for use in modifying doses of antibiotics that are excreted or metabolized by the liver. In patients with severe liver disease, it may be prudent to reduce doses of erythromycin, metronidazole, chloramphenicol, and clindamycin, but there are no specific guidelines for most antibacterial agents. Under ideal circumstances, dosing is adjusted most accurately by a combination of calculated estimates followed by periodic monitoring of measured serum concentrations. Changes in the dosage or interval between doses can be made in response to the measured level, and follow-up serum levels can be obtained at the appropriate time (four to five dosing intervals), whereupon new adjustments can be made (McManus, Hammond & Whicker, 1997). This procedure is particularly helpful in patients whose renal (or hepatic) function is fluctuating. Levels of almost any antibacterial agent can be measured by bioassay, radioimmunoassay, or high-pressure liquid chromatography. For practical purposes, however, such laboratory studies are usually available only for aminoglycosides and vancomycin, at least within a time frame that is clinically useful. The likelihood of toxicity also may increase with duration of exposure to a potentially toxic drug, regardless of changes in dose or dosing schedule. Duration of potentially toxic drugs should be minimized if an equally effective alternative can be used, once a pathogen is identified (Bosu & Ofori-Adjei, 1997).

Pharmacodynamics

Although PK describes the absorption, distribution, and elimination of drugs by the body, PD, as it applies to antibacterial agents, describes the interaction of drugs and microbes. When certain PD relationships exist, dosages of antibacterial agents and dosing intervals can be manipulated in ways not readily apparent from the classic PK principles outlined previously (McManus, Hammond & Whicker, 1997). For example, synergistic activity between two antibiotics can result in bactericidal activity against an organism that cannot be killed by a single agent, or can result in more rapid killing than can be achieved by either agent alone. In the case of enterococci, for example, no single agent is bactericidal, but a combination of penicillin or vancomycin plus an aminoglycoside produces a bactericidal effect at serum aminoglycoside levels that is sub therapeutic in other settings (Kshirsagar et al., 1998). Another PD property, the post antibiotic effect, or persistent suppression of bacterial growth after drug levels have fallen below the MIC, is at least partly responsible for the clinical success of regimens that use a single large daily dose of aminoglycoside, in contrast to the traditional shorter dosing interval.

Patterns of antibacterial use

A description of the pattern of drug use covers the extent and profiles of drug use(as well as trends) and it may be described in terms of prevalence or incidence. Drug use studies can provide a basis for improving safety, efficacy and reducing risks (such as microbial resistance to antibiotics) associated with the use of drugs. The rational use of drugs or medicines is an essential aspect of achieving good and effective health care delivery and this is an essential goal of the WHO (Erah, 2000). Since drug therapy is a very important aspect of healthcare management, it follows that if drugs are misused or abused, this may have considerable effect on the overall outcome of the health of the individual members of a community and by extension,

the whole community with attendant socio-economic implications. Documentation of the pattern of drug use will therefore show whether the drugs are used rationally or otherwise (Pechere et al., 2002).

Medication adherence or compliance describes the degree to which a patient correctly follows instructions about medicine use. The World Health Organization (WHO) estimates that only 50% of people complete long-term therapy for chronic illnesses as they were prescribed, which puts patient and community health at risk. Once started, patients seldom follow treatment regimens as directed, and seldom complete the course of treatment. The failure to complete treatment regimens as prescribed has significant negative health impacts worldwide (Olayemi, Olayinka & Musa, 2010).

A Survey of antibiotic prescribing pattern in government health facilities of Wassa West district of Ghana was conducted by Bosu and Adjei (1997). Antibiotic prescribing pattern was studied from 700 retrospective outpatients clinical records from seven government health facilities in the Wassa West of Ghana. Prescribing patterns were compared between the district hospital six-health centers. The percentage of patients receiving one or more antibiotic was significantly more at the health centers (60.7%) than at the hospital 41.2% (chi2=13.6;p<0.001) the average number of antibiotics was 1.4 and 1.1, respectively. The commonest antibiotics prescribed were penicillin, cotrimoxazole, benzyl penicillin, metronidazole and amoxicillin. Malaria, upper respiratory tract infection, soft tissue infection and diarrhoea were the commonest indications for antibiotic use, factors such as the diagnostic facilities, type of prescriber, lack of refresher training and patient demand were considered to significantly influence antibiotic prescribing.

McManus, Hammond and Whicker (1997) did a study on antibiotic use in the Australian community in 1990-1995. The objective of the study was to determine the pattern of antibiotic use in the Australian community and compare it with the pattern in the other developed countries. A survey of data from the national database on drugs dispensed in Australia (1990-1995), an international database on retail drug sales (1985-1994), and Australian prescribers surveys (1994, 1995). The main outcome measures: National and international retail sales of oral antibiotic (defined daily doses [DDDs]/1000 population/day) and antibiotic prescriptions dispensed through community pharmacies by drug type; antibiotic prescribing profiles for common conditions. Antibiotic use in Australia remained steady between 1990 and 1995, with an estimated 24.7 DDDs/1000 population/day dispensed through community pharmacies in 1990 and 24.8 DDDs/1000 population/day in 1995. Amoxycillin, although declining in use, remained the most dispensed antibiotic. Compared with the other countries surveyed, Australia had the highest percentage use of tetracyclines, such as doxycycline, and the lowest percentage use of fluoroquinolones. Use of trimethoprim-sulfamethoxazole and flucloxacillin declined in Australia. In new cases of upper respiratory tract infection or pharyngitis, an antibiotic prescription was recorded for 57% of urban patient encounters and 73% of rural patient encounters.

In 1975, the world health assembly requested the director-general to advise member states on the selection and procurement of essential drugs corresponding to their national health needs. A study of the prescribing patterns and rational drug utilization of medical practitioners in the west of India (Kshirsagar et al., 1998) was undertaken by analyzing their prescriptions the results indicated lack of rational prescribing practices by a significant number of practitioners. Fixed-dose formulations dominated the prescribing pattern and generic prescriptions were negligible, with prescriptions for essential drugs accounting for less than 60% of total number of drugs

prescribed. More than 30% of prescriptions were irrational, with probability of such prescriptions increasing significantly with the number of drugs per prescription. A study of sources of drug formulations available for prescription revealed significantly more fixed-dose combinations, many of which were irrational. The drug prescribing pattern for outpatients in three hospitals in northwest Ethiopia was studied by Desta et al. (2002). Objective: To evaluate and compare patterns of drug prescribing practiced in the outpatient departments of three hospitals. Methods: Case notes of outpatients attending the Gondar teaching hospital (n=2023), Bahir Dar regional hospital (n=2597) and Debre Tabor rural hospital (n=1808) were reviewed retrospectively over one year period. Results: The leading diagnoses in the three hospitals were similar and include disease of the respiratory system, gastrointestinal tract, sexually transmitted and skin. The average number of drugs per patient was 0.98 in Gondar, 1.8 in Bahir Dar and 2.2 in Debre Tabor hospitals. Antibacterial including anti-TB drugs (40-51%) and analgesics (11-49%) were the most frequently prescribed drugs in the three hospitals. Conclusion: The average number of drugs prescribed per patient was within the acceptable range. Deviation of prescribing pattern among the outpatients possibly reflects the availability of drugs, attitude (habit) of the prescriber and diagnostic profiles and facilities. Much remains to be done to promote rational selection and use of drugs in hospitals.

Materials and Methods

The study was done at the Defence forces memorial hospital which is located in Nairobi County in Kenya. It is a teaching and referral hospital that largely caters for the defence forces personnel and their dependants it also caters for the civilian population in cases of emergencies and national disasters. A retrospective cross-sectional study was carried out to determine the basis of antibacterial use at the DFMH.

The study design was a hospital based retrospective cross sectional study. Retrospective drug use study is an approved, systematic process that captures, reviews, analyses, and interprets aggregate medication use data within specific healthcare setups. In retrospective studies data is collected and analysed after the events of interest have occurred. These studies identify the patterns in prescribing practices and drug use that can lead to interventions aimed at enhancing the quality of healthcare and containment of costs in a healthcare environment. Retrospective studies have the advantage of being inexpensive, rapid and have easily accessible data. Cross-sectional studies can be used as a measure of drug use in relation to guidelines (STG) or restrictions (hospital formulary). Such studies can be used to compare similar data collected over the same period in a health facility, ward or country and can be drug problem, indication, prescriber or patient based.

The researcher collected data retrospectively for the last 12 calendar months from patient prescription records. According to DFMH pharmacy prescription records, 9377 patients were dispensed antibiotics in the year 2013 in DFMH. A group of healthcare professionals (doctors, nurses and pharmacists) were interviewed using an interview schedule. In DFMH there are 48 doctors, nurses and pharmacists. The target population was therefore 9377 patients' prescription records with antibiotics dispensed and 48 healthcare professionals. The study included all the patients prescription records (9377) that had an antibacterial agent prescribed and dispensed at

the pharmacy in the year 2013. In addition, the study included 48 healthcare professionals (doctors, nurses and pharmacists), who were purposively sampled.

This study used both primary and secondary data. The researcher collected secondary data retrospectively for the period between January and December 2013 months from patient prescription records. In addition, primary data was obtained from the respondents by use of a semi structured questionnaire. A semi structured questionnaire allows for both qualitative and quantitative data collection as both open ended and closed ended questions are used.

Data analysis involves reduction of accumulated data to a manageable size, developing summaries, looking for patterns and applying statistical techniques. The data that was collected in this study was both qualitative and quantitative in nature. Qualitative data was analysed by use of content analysis presented in a prose form. On the other hand, Quantitative data was analysed by use of Statistical Package for Social Sciences (SPSS) version 20. Descriptive statistics such as percentages and frequencies were used to describe the characteristics of the target population. Data was then presented in graphs and tables.

Approval was obtained from the university research development and ethics committee. In addition, approval was obtained from the DFMH medical advisory committee. Consent was also obtained from each respondent before data collection and to ensure confidentiality names of subjects were coded and the data collected was used for the purpose of this study only and discarded after finishing the study.

Results and Discussions

The study had a purposive sample of 48 respondents, 20 nurses, 20 doctors and 8 pharmacists. However, a total of 47 responses were obtained representing a response rate of 97.91%. This, according to Babbie (2002), is an excellent response rate given that any response of 50% and above is adequate for analysis.

Basis of Antibacterial Use

The study established that there was a Drug and Therapeutics Committee at the DFMH, a formulary list or EML authorized for acquisition of medicines and also found that all medicines on the formulary list were identified by generic name (INN). The study further established that the formulary or EML medicines were based on those recommended in the STG. In addition, it revealed that the hospital had STGs for infectious diseases for the most prevalent conditions. In connection to antibacterial drug sensitivity tests, the study established that the hospital laboratory routinely performed antibacterial drug sensitivity tests. Antibacterial susceptibility testing is indicated for clinically relevant isolates when antibacterial susceptibility cannot be predicted with confidence (Sintchenko et al., 2005). In addition the hospital had protocols or norms for surgical prophylaxis with antibacterial for preoperative patients. Hence the key findings of the study were as follows, antibacterial use at the hospital was based on disease diagnosis, types of infection, empirical treatment, affordability, laboratory test, STGs, severity of illness, patient factors, drug factors and formulae. This findings correspond to the principals .of rational antibacterial drug use that states that proper selection of an antibacterial agent should be based on a number of factors, including the identity of the pathogen, the site of infection, the

pharmacokinetics (PK) and pharmacodynamics (PD) of the agent, potential toxicity to the patient, possible drug interactions, cost, and convenience of administration (Olayemi, Olayinka & Musa, 2010).

Patterns of Antibiotic Drugs

In this regard, the study revealed that the most commonly used antibiotics were Amoxycillin, Cefuroxime, Ofloxacin, Flucloxacillin, Metronidazole, Clarithromycin, Azithromycin, Cefadroxil, Levofloxacin and Tobramycin respectively. This shows that Amoxycillin was the most commonly used antibiotic at DFMH. These findings agree with McManus, Hammond and Whicker (1997) argument that in Australia, Amoxycillin, although declining in use, remained the most dispensed antibiotic. However unlike in Australia where flucloxacillin use had declined, its use in DFMH was still high. Further, the findings agree with a study conducted in Wassa West district of Ghana by Bosu and Adjei (1997) that established that the commonest antibiotics prescribed were penicillin, cotrimoxazole, benzyl penicillin, metronidazole and amoxicillin. However, cotrimoxazole and benzyl penicillin use at the DFMH had declined.

Table 1: Frequency of Antibiotic Use

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	% of the total
Metronidazole	30	43	73	80	36	34	40	39	69	49	56	34	583	6.22
Amoxycillin	143	323	484	481	282	365	416	279	381	368	398	161	4081	43.52
Flucloxacillin	47	51	64	63	54	100	100	83	43	44	114	20	783	8.35
Cefuroxime	35	104	121	105	141	145	64	180	120	118	40	34	1207	12.87
Cefadroxil	15	21	29	63	55	62	3	21	67	39	52	9	436	4.65
Ofloxacin	17	33	127	108	114	111	122	112	123	88	72	41	1068	11.39
Tobramycin	3	0	15	14	3	6	14	10	5	2	6	13	91	0.97
Clarithromycin	9	28	73	42	62	100	94	24	24	18	41	32	547	5.83
Azithromycin	40	30	28	53	83	89	29	18	37	32	35	14	488	5.20
Levofloxacin	3	9	8	4	17	15	2	6	7	15	6	1	93	0.99
Total	342	642	1022	1013	847	1027	884	772	876	773	820	359	9377	100.00

Expenditure on Antibacterial Drugs

In relation to expenditure on antibacterial drugs, the study established that in 2013 budgeted cost of antibiotics was Ksh21, 505, 920 (based on the actual expenditure for the previous year 2012) and the total budget was Ksh119, 680, 000, which represents a 17.97% of the total budget.

Table 2: Budgeted Cost of Antibiotics in Ksh

Budgeted cost of antibiotics	Total budget	Percentage
21, 505, 920	119, 680, 000	17.97%

On the other hand, the actual expenditure of antibiotics in DFMH in 2013 was Ksh10,747,100 and the total budget was Ksh138,680,000, which represents 7.75% of the total drug expenditure. This shows that the expenditure on antibiotics in the hospital had decreased significantly by 49.9% when compared to the estimated budget and the actual expenditure for the previous year. These findings however contrast with Kanu et al., (2013) argument that antibiotic expenditures account for nearly 50% of a hospital's total drug budget. However, they agree with an argument that in India antibiotics constitutes 15.7 % of the drug market and is the largest therapeutic group, while in the UK antibiotics account for 19 % of the total expenditure on medicines.

Table 3: Actual Expenditure of Antibiotics in Ksh

Actual expenditure of antibiotics	Total budget	Percentage
10,747,100	138, 680, 000	7.75%

Conclusion

The existence and access to STGs, EML and approved hospital formulary containing current information on antibacterial drugs to prescribers and other healthcare prescribers at the DFMH is an indication of the hospitals commitment to standards of patient care and rational antibacterial use. The formulary ensures that authorized antibacterial drugs will be procured on a priority basis.

The study also concludes that the most commonly used antibiotics were Amoxicillin, Cefuroxime, Ofloxacin, Flucloxacillin, Metronidazole, Clarithromycin, Azithromycin, Cefadroxil, Levofloxacin and Tobramycin respectively.

In relation to expenditure on antibacterial drugs, the study concludes that in the year 2013 the budgeted cost of antibiotics was Ksh 21,505,920 representing 17.97% of the total budget, however, the actual expenditure on antibiotics at DFMH in the year 2013 was Ksh 10,747,100 reperesenting 7.75% of the total budget. This shows that the hospital spent less money on the actual expenditure than was projected for antibiotics. Further comparison between the actual expenditure for the previous year 2012(Ksh 21,505,920) and actual expenditure for the year 2013(Ksh 107, 747,100) reveals a marked reduction of 49.9% on expenditure on antibacterial agents at the DFMH.

Recommendations

The study recommends that the hospital should continue encouraging the use of the STGs and hospital formularies in prescribing and to regularly revise the STGs according to the needs of the

hospital and WHO recommendations. The study recommends increased awareness and sensitisation exercises to the clinical staff on hospital policies, protocols and guidelines. It further recommends continuous systematic monitoring of antibiotic use at the facility by the drugs and therapeutic committee.

Areas for Further Research

This study sought to determine the basis of antibiotic use at DFMH. It therefore recommends studies on the basis of antibacterial use to be carried out in Kenyan public hospitals.

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