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Assessment of Antibiotic Utilization Pattern In Hospital Settings

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Abstract

Drug utilization evaluation is an effective tool for detecting the possible drug related problems and in enhance the clinical use of drugs in public and its impact on the health care system. This tool is adapted by pharmacists to assess appropriate use of medication. DUE usually focus on drugs with more side-effects, high cost or complex dosing regimens. It is important for almost all drugs especially for antibiotics because of its increased utilizationin hospitals and community settings. In prior to starting antimicrobial therapy, the prescriber should consider the type of infection, characteristics of the antibiotic, its category of use, spectrum of activity, cost- effectiveness and duration of therapy. The evolution of multidrug resistance and the emergence of multidrug- resistant microbes are on the rise which can be reduced by increasing the habits of appropriate antibiotic prescribing for the successful outcome of the therapy. Prescribing an antibiotic by understanding the significance of antimicrobial stewardship and following an appropriate guideline may lead to appropriate selection of an antibiotic. Hence, antibiotic utilization studies can help in improving the practice of rational use of antibiotics thereby improving patient safety, which in turn helps in reducing antimicrobial resistance, drug related problems and risk of mortality and morbidity.

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INTRODUCTION

Prescriptions are one of the most important therapeutic transactions in the form of written orders of the medications used in diagnosis, treatment, and prevention of a disease in a specific patient by a medical practitioner. Medicines play a vital role in enhancing and facilitating public health and safety. However, to generate the required outcome, these have to be safe, effective and must be used judiciously. (Singh and Batta, 2018) Nowadays, Drug Utilization Studies (DUS) are used as a prospective support in the assessment of healthcare systems. In 1977,The World Health Organization (WHO) has defined Drug Utilization Evaluation (DUE) as the marketing, distribution, prescription and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences (Shalini *et al.*, 2010). DUE is a system of ongoing, systematic, criteria-based evaluation of drug use that will help in ensuring that drugs are used aptly. It is drug-specific or disease-specific and can be assembled so that it will aid in assessing the process of prescribing, dispensing or administering a drug (Al, 2017).

Scope of Drug Utilization Evaluation

DUE is indented to justify medication use as well as to ameliorate the health care outcome.

Table 1: Frequently prescribed class antibiotics

Class of antibiotic	Frequency of use(%)
Cephalosporins,	28.23-86
Pencillins,	4.95-53
Quinolones	2.64-15
Nitroimidazoles	19.95-94
Macrolides	1.69-7.26
Aminoglycosides	8.70-64

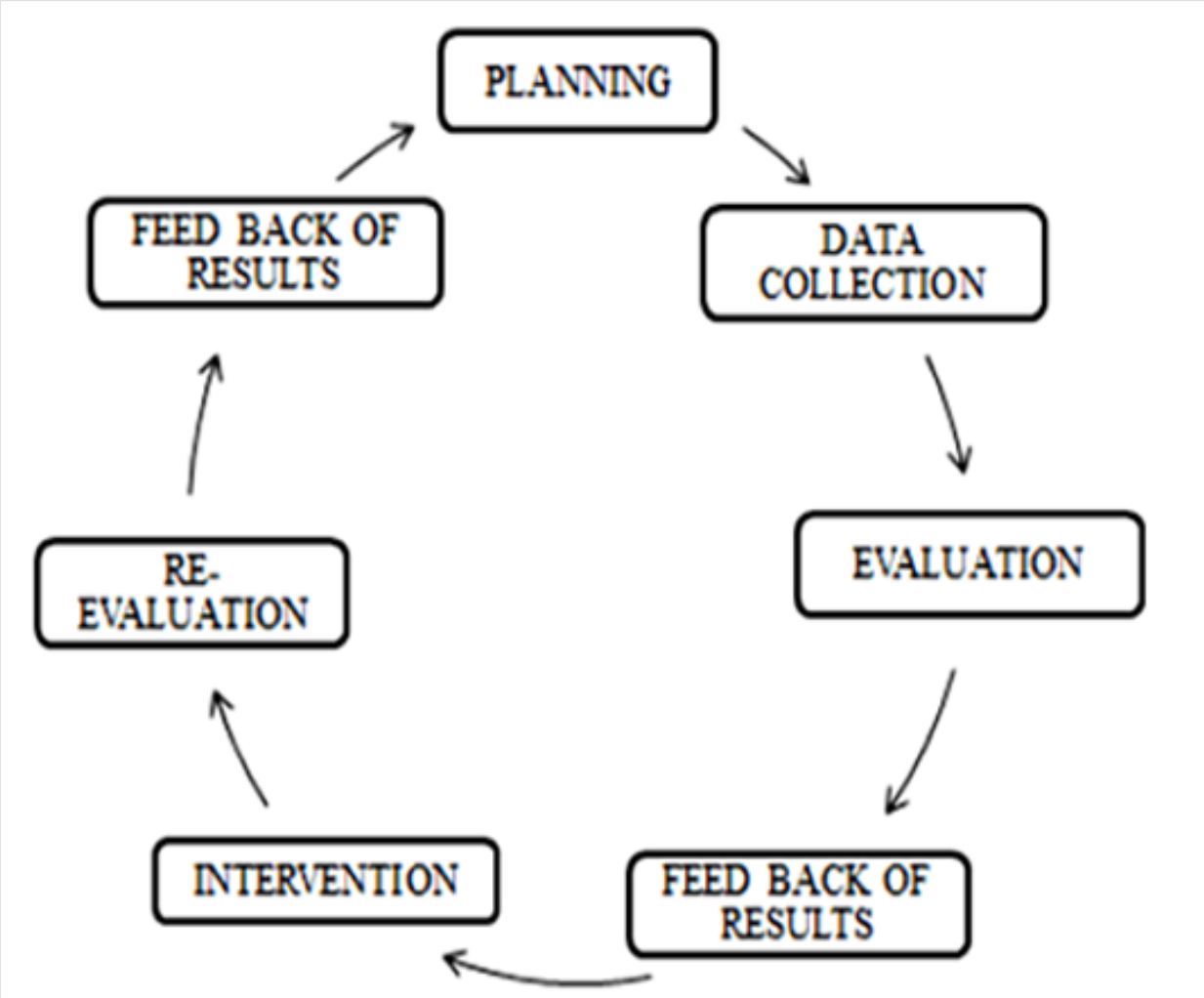

Figure 1: The DUE Cycle

$$\text{DDD/100 bed-days} = \frac{\text{No. of units administered in a given period} \times 10}{\text{DDD} \times \text{number of days} \times \text{numb}}$$

Figure 2: Formulafor calculating DDD

It is also aimed to evaluate the current and developing modes of drug utilization at the different hierarchy of the health management system. These studies are used to oversee the utilization pattern of diverse drug categories and to assess the number of Drug-Related Problems (DRP's). DUE aids the health care management to comprehend, elucidate, enhance the prescription pattern and administration besides the use of different categories of drugs. DUS is mainly concentrated on the most common and exploited category of drugs such as antibiotics, analgesics, and chemotherapeutic agents (Krivoy *et al.*, 2007).

DUE Is Designed To

1. To optimize drug use by developing criteria and standards

2. To educate clinicians and other health care professionals (HCP), to promote appropriate use

3. To provide feedback of results obtained during evaluation to clinicians and other HCPs

4. To review drug use

5. To analyse prescription patterns (Mahmood *et al.*, 2017)

The DUE cycle is as shown in Figure 1.

Categories of DUE

Prospective

It is the assessment of the medications prescribed to the patients before it is dispensed. In this, pharmacist can identify the drug related problems and resolve it before it reaches the patient. The pharmacist reviews the patient's medications, its dose and its duration of action for identifying the drug - disease contraindications, therapeutic alternatives, generic substitution, improper dosing and duration of treatment, drug-allergy interactions and clinical misuse.

Concurrent

It requires the monitoring of ongoing treatment to warrant better patient outcome. It gives an opportunity for the pharmacist to bring to the notice of the prescriber about the drug-drug interactions, over dose or sub therapeutic dose, duplication in treatment, drug-disease interactions, over and under utilization, drug-age, drug-gender and drug-pregnancy precautions.

Retrospective

It involves the treatment review after the patient has received the medication. It helps to identify the prescribing pattern, dispensing or administering of drugs to avoid inappropriate use of drugs over or under utilization, drug-disease contraindications, drug-drug interactions, appropriate generic use, therapeutic duplication, incorrect drug dosage, inappropriate length of treatment and clinical misuse (Shalini *et al.*, 2010; Rekha, 2017)

The Anatomical Therapeutic Chemical (ATC) Classification and Defined Daily Dose (DDD)

The ATC and DDD systems are tools for representing drug utilization research to enhance the quality of drug use and are endorsed by the World Health Organization (WHO) as an international standard for drug utilization studies.

The predominantly utilized drugs are classified using the ATC Classification system, and drug use is measured as DDD/100 bed-days. In ATC Classification, the drugs are classified into different groups based on the system that they exhibit their action on, their chemical, pharmacological, and therapeutic properties.

The formula for calculating DDD per 100 bed-days is as per Figure 2. (Patel *et al.*, 2016).

Prescribing Pattern of Antibiotic(s)

Antibiotics are one of the most important weapons existing in today's medical practice to treat and prevent infections. Antibiotic utilization studies can assist in fostering the practice of rational use of antibiotics, that is to use them at the right dose and time, for the right duration, and at the right cost. As antibiotic resistance is on the rise, there is a need to advocate rational prescribing of antibiotics to reduce the misuse and thus enhance its rational use (Meher and Br, 2014; Dryden *et al.*, 2011). In most of the cases, it is observed that antibiotics are used without obtaining bacteriological evidence stating the presence of infection. When antibiotics are prescribed for needless situations, there are more chances for adverse effects to occur which may be irreversible, leading to prolonged hospital stay and unnecessary health care costs. Therefore; antibiotics should be used when it is necessary to control the spread of infection and save the patients with serious bacterial infection (Stevens *et al.*, 2005). The prescription pattern can indicate the medical practitioner's comprehension of the disease conditions and patient medical history. Prescribing can be improved by tailoring the hospital antimicrobial formulary and by adhering to available regional guidelines considering the antibiogram of the hospital setting and thereby promoting the well judged use of antimicrobials which will aid in controlling the rise of antimicrobial resistance (Kamath *et al.*, 2014; Ather *et al.*, 2017). Most of the antibiotic(s) are prescribed by brand name rather than generic name. Majority antibiotic(s) are prescribed as parenteral formulations as it is

known for its faster onset of action than oral formulations either as a combination therapy or as a single antibiotic (Al, 2017; Kamath *et al.*, 2014; Azimifard, 2019). Nowadays, prescribing of broad-spectrum antibiotics has become immense. Cephalosporin class of antibiotics is seen to be the most frequently prescribed antibiotic due to its relatively broader spectrum of activity and lower toxicity for several infections. Among cephalosporin class of antibiotics, ceftriaxone is the most frequently prescribed followed by other classes of antibiotics like penicillins, nitroimidazoles and fluoroquinolones (Raut *et al.*, 2017). In most of the scenarios, the category of use of antibiotic is seen as prophylaxis. The main intention of prescribing an antibiotic as a prophylactic is to prevent the occurrence of an infection provided there exists a risk, but unnecessarily if prescribed without a proper justification will result in the progress of antimicrobial resistance (Raut *et al.*, 2017). Majority of the antibiotics are commonly prescribed for disease conditions associated with soft tissue and skin followed by gastrointestinal system (Raut *et al.*, 2017). The frequently prescribed classes of antibiotics arementioned in Table 1. (Al, 2017; Oh *et al.*, 2014; Gowthami and Spurthi, 2016).

Appropriateness Of Antibiotic Use

The WHO has defined appropriate use of antimicrobials as "the cost–effective use of antimicrobials which maximizes clinical therapeutic effect while minimizing both drug-related toxicity and the development of antimicrobial resistance". The successful outcome of the therapy will depend greatly on the appropriate selection of antibacterial agents (Amábile-Cuevas, 2011). Rational use of an antibiotic requires the use of a safe, appropriate, efficacious, and cost-effective antibiotic given to the right patient, for the right indication in the right dose and in the right formulation, at right intervals and for the right duration of time (Amer *et al.*, 2013). Prescribing an antibiotic without following an appropriate guideline, may lead to inappropriate selection of an antibiotic, which in turn results in ineffective antibiotic use, unsafe drug therapy, worsening of illness, drug toxicity, increased cost of therapy, and prolonged hospitalization. The prolonged duration of antimicrobial therapy with or without evidence of infection, failure to select the suitable antimicrobial agent when the respective specimen culture and antimicrobial susceptibility data are available, selection of an antibiotic which is too broad or too narrow and prescribing sub therapeutic or an over dose leads to inappropriate use of antibiotics. So before choosing an antibiotic, the prescriber should send the specimen for identifying the microorganism before initiating an antimicrobial therapy whenever necessary (Adorka *et al.*, 2014; Saleem *et al.*, 2019). It is also vital to see to the appropriate selection of the antibiotics with respect to its spectrum of activity, physicochemical, pharmacokinetic, pharmacodynamic properties, antibiotic susceptibility pattern, clinical symptoms, and severity of the condition, co morbidities and other types of infection or disease conditions for prescribing an antibiotic. Adding to this, the route, duration, and time of administration should be considered (Saleem *et al.*, 2019). In many inpatients, even though an oral route of administration of antibiotics is possible, most of them receive intravenous formulations for a longer period of time. Roughly one third of all inpatients who commence on IV antibiotics are suitable for conversion to an oral equivalent which is having same or relatively same bioavailability. An intravenous course of treatment for 48–72 hours followed by oral medication to achieve the course of treatment is favourable to severeal patients except in serious/life-threatening conditions. It is also found to have an added advantage of reducing economical burden of the patient (Shrayteh *et al.*, 2014). Therefore it is necessary to create a panel of experts for determining appropriateness of antibiotic prescriptions, such as initiatives like Antimicrobial Stewardship Programmes (Amer *et al.*, 2013; Luepke *et al.*, 2017). This can facilitate development of a proper guideline for choosing an appropriate antibiotic for various disease conditions (Azimifard, 2019).

Antibiotics And Antimicrobial Resistance

Infections are one of the most dominant origins of morbidity and mortality seen in medical practice and the use of antimicrobials has greatly revolutionized the outcome of patients suffering from the infection. Antibiotics are indispensable medications that are used for the main purpose of disputing infections, eitheras prophylaxis, empirical or definite. (Shamna *et al.*, 2014; Kadam *et al.*, 2009). Inappropriate use of antibiotics can lead to drug-related problems, Surgical Site Infections (SSIs) and antibiotic resistance, which in turn can increase the risk of morbidity and mortality; thereby resulting in the increased cost of the treatment and hospital stay. Similar to how a coin has two sides; antibiotics can bring out two effects. The first one is to control infections when used appropriately and the other is that it can pave way to emergence of antibiotic resistance, when used inappropriately (Oh *et al.*, 2014; Gowthami and Spurthi, 2016; Sinha *et al.*, 2016).

Multi-Drug Resistance (MDRs) is progressing day by day and has turn into a challenge in providing patient care. Antibiotic resistance is defined as the

genetic potential of bacteria to encode the resistance genes that forges the inhibitory effect of potential antibiotics for survival. It is necessary to perform antimicrobial susceptibility testing to endorse susceptibility to selected empirical antimicrobial agents or to identify resistance in individual bacterial isolate. Antimicrobial susceptibility tests can aid the general practitioners in choosing an antibiotic and dosage to treat infections which are difficult. Results are regularly reported by including the minimal inhibitory concentration (MIC), which is the minimum drug concentration required to inhibit microbial growth. Typically, reports contain a μg / mL quantitative result and a qualitative interpretation (Amer *et al.*, 2013; Leekha *et al.*, 2011; Lim *et al.*, 2015).

Prevention of Emergence of Antimicrobial Resistance

The emerging antimicrobial resistance mostly results from inappropriate antimicrobial therapy. In the United States, according to the Centre for Disease Control and Prevention (CDC) in a year 2 million patients are estimated to be affected by infections due to drug-resistant bacteria, resulting in approximately 23,000 deaths per annum (Luepke *et al.*, 2017). Focusing on the influence of antimicrobial resistance, a constant increase in resistance by 2050 would lead to 10 million deaths every year (de Kraker *et al.*, 2016). Reducing the excessive utilization of broad-spectrum antibiotics, avoiding sub therapeutic and over dose of antibiotics, tailoring the duration of antibiotic therapy and cautiously using antibiotics as a prophylactic canassist in reducing the rise of antimicrobial resistance (Amer *et al.*, 2013). Provided that the mechanism of resistance to two antimicrobials are different; the probability that a mutant strain is resistant to both antimicrobials is much less than the probability that it is resistant to either one. In other words, an antimicrobial combination therapy gives a better chance of at least one drug being beneficial, therefore the resistant mutant population could be prevented from emerging as a dominant strain and causing failure of therapy (Leekha *et al.*, 2011; Jorgensen and Ferraro, 2009).

CONCLUSIONS

The rational use of antibiotics could decrease the trouble of multidrug resistance and emergence of multi drug resistant microbes, thereby enhancing patient care which in turn would reduce the resultant mortality and morbidity as well as the drug-related problems. Judgmental use of antimicrobial agents require proper diagnosis, determining the need, time and duration of antimicrobial therapy, a proper understanding of the microbial agent and how it acts on different microbes. The health care professional should be encouraged to inculcate the habit of ordering for the culture and antimicrobial sensitivity of respective specimens of infected patients to provide appropriate antimicrobial therapy to prevent the rising antimicrobial resistance.

Conflict of Interest

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