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# Drug Utilization Pattern of Antimicrobials in Post-Operative Patients in General Surgery Wards of Tertiary Care Hospital, Rajasthan

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**Abstract:** The purpose of the present study that we had planned was to evaluate the drug utilization pattern of antimicrobials in post-operative wards of surgery Department of tertiary care hospital. The study was carried out retrospectively by analyzing the record of prescription attached with the discharge tickets of the patients who were admitted in post-operative wards of the surgery department of tertiary care hospital, Rajasthan, Ajmer, from July 2014 to December 2014. A total of 630 prescriptions were analyzed. The percentage of male patients (58.57%) was higher than female patients (41.43%). Antimicrobials constituted 28.85% of the total drugs. Cephalosporin group of antimicrobials was the leading antimicrobials prescribed (33.21%). Ceftrixome was the leading antimicrobial prescribed within the group as well as a whole among the antimicrobials prescribed. Aminoglycosides were the next commonest antimicrobials prescribed (27.66%) among which Amikacin was commonly prescribed. Penicillins were the next commonest antimicrobials prescribed (07.89%), among which FDC of amoxicillin + clavulanic Acid and piperacillin + tazobactum was the most frequently prescribed of all. These groups were followed by macrolides, fluoroquinolones, carbapenems and other groups of antimicrobials. Among the all prescribed antimicrobials 07.83% were prescribed as fixed dose combinations. The proportion of prescription containing antimicrobials was quite high in the present study. An awareness and continuous medical education regarding the use of antimicrobials, especially the newer and broad spectrum agents may also be helpful. Thus, the study of drug utilization and prescribing pattern is an essential part of medical audit which seeks to monitor, evaluate and, if necessary suggest modification in prescribing practices of medical practitioners so as to make medical care rational and cost effective.

**Keywords:** Antimicrobials, post-operative, drug utilization, prescription, retrospectively.

## INTRODUCTION

In India prevalence of antimicrobials drugs use varies from 24% to 67% and estimated to account for 50% of total value of drugs sold in our country[1]. Not all uses can be justified. Some of the prescriptions of these drugs are irrational and above all excessive utilization of antimicrobials drugs lead to their misuse and engenders problems like,

- Difficulty in selection of proper drug.
- Increases cost and side effects of drug therapy.
- Development of bacterial resistance.

It has been observed that 64% of total antimicrobials prescribed are either not indicated or inappropriate in terms of drug selection or dosage [2]. In many cases antimicrobials are used without an appropriate bacteriological basis [3,4].

It is well known fact that, if the injudicious use of antimicrobials in hospitals can be improved, the misuse of antimicrobials can be avoided. Several remedial measures can be applied to this situation, but before that, it is necessary to evaluate the existing baseline practice. A drug utilization study may therefore help us to identify the problems, suggest the remedial measures and promote rational use[5]. Drug utilization studies are the actual powerful exploratory tools to ascertain the role of drugs in the society.

Drug Utilization has been defined as the "marketing, distribution, prescription and use of drugs in the society with special emphasis on the resulting medical, social and economic consequences" (WHO 1977).

Major proportions (30-50%) of antimicrobials prescribed in hospital practice are for surgical prophylaxis to prevent postoperative wound infections [6-7]. The principles governing such prophylactic use of antimicrobials stress on the choice of the antimicrobials, the route of administration, the timing of prophylaxis, the duration of antimicrobials cover and cost effectiveness.

In the surgical department, a number of drugs (viz. antimicrobial agents [AMAs], non-steroidal anti-inflammatory drugs [NSAIDs], gastrointestinal tract [GIT] related drugs, etc.) are prescribed, but the AMAs are most frequently prescribed to prevent infections at the surgical sites [8, 9]. As the micro-organism developed resistance to these AMA with the passage of time, therefore, a drug (or AMA) must be used in a rational way for the treatment of disease or to prevent infections because it is of utmost importance for the success of treatment and well-being of patients [10, 11].

The choice of the antimicrobials depends on the pathogenic organisms likely to be present in the operative field at the time of surgery. The route, the timing and the duration of administration should all be so designed as to achieve high tissue levels of the antimicrobials agent(s) at the time of surgery without inducing toxicity or facilitating the emergence of resistant organisms [12].

## AIMS & OBJECTIVES

The purpose of the study that we have planned is to evaluate the prescribing and drug utilization pattern of antimicrobials in the post-operative patients in wards of the Surgery Department of a tertiary care hospital, Rajasthan with an objective of studying the:-

- Total number of prescriptions and their percentage wise distribution in different age groups.
- Frequency of prescribing Agents
- Prescribing prevalence of antimicrobials given in whole study.
- Prescribing prevalence of individual antimicrobials
- Essential Status of Fixed Dose Combinations (FDCs.)

## MATERIALS AND METHODS

The study was retrospective, non-interventional and was conducted at Surgery department tertiary care hospital, Rajasthan, India. The study was carried out for 6 months duration. Prior permission of the Institutional Ethics Committee was obtained for conducting the study.

Before starting the study a written approval for the protocol from Principal, Head of Department of Surgery, Superintendent of Hospital, was obtained, then the data from discharge tickets containing the prescription of the patient during his/her stay in post-operative wards of the surgery department were collected from the record room of the tertiary care hospital, Ajmer from July 2014 to December 2014.

### Selection criteria of patients

### Inclusion Criteria

- All post-operative patients till discharged, in Surgery Department of hospital, only adults of either sex including pregnant/lactating mothers were taken.
- Drugs used post-operatively were only considered and not the drugs that are already going on.

### Exclusion Criteria

- Any patient who dies post-operatively before being discharged
- Patient who absconded/discharged against medical advice
- Patient referred to higher centre
- All paediatric patients

### Sample Size

WHO recommendation on sample size is that there should be at least 600 prescriptions included in cross-sectional survey describing current treatment practices.

### Collection of Data

Data of patients matching inclusion criteria were only recorded. Data like name, age, sex, diagnosis, treatment was recorded from patient's case file attached along with discharge tickets.

Data was then analysed using following criteria as under

- Total number of prescriptions and their percentage wise distribution in different age groups.
- Frequency of prescribing Agents.
- Prescribing prevalence of antimicrobials given in whole study.
- Prescribing prevalence of individual antimicrobials
- Essential Status of Fixed Dose Combinations (FDCs.)

## RESULTS

The purpose of the study was to evaluate the prescribing and drug utilization pattern in post-operative wards of surgery Department of J L N hospital Ajmer. The study was carried out retrospectively by analyzing the record of prescription attached with the discharge tickets of the patients who were admitted in post-operative wards of the surgery department of J.L.N. Hospital Ajmer and a total of 630 prescriptions were analyzed.

The prescriptions were collected from record room monthly from July 2014 to December 2014. From the collected data, a total of 630 were randomly selected for study, according to the inclusion criteria.

Information on demographic profile, diagnosis and treatment were spread over the age groups. Each prescription was then analyzed using WHO recommended prescribing indicators.

Table No. 1 shows age group wise distribution of the prescriptions. The patients, mainly belongs to age ranging from 15 years to 30 years, 30-45 years as well as 45-60 years, whereas the number of patients belonging to age group 60-75 years and >75 years is comparatively less.

Table No. 2 shows the prescribing frequency of various drugs. As it is evident from the table that, Antimicrobials and the GIT drugs are the most frequent classes of drugs prescribed.630(100%) prescription contains antimicrobials, 615(97.62%) contained GIT drugs, whereas NSAID'S and CNS drugs constituted 497(78.98%) &470(74.60%) of prescriptions respectively. Respiratory drugs 104(16.51%) and CVS drugs 50(07.94%) were least prescribed. Prescribing Frequency of vitamins & minerals accounted for 45.08% of total prescriptions.

Table No.3 & 4 shows the prescribing frequency of antimicrobials overall as well as among themselves during the study. As we can see from the table that Cephalosporins are the most commonly prescribed antibiotic (33.21%) among the antibiotics used overall. Among the drugs used overall it accounts for 9.58%. Aminoglycosides were also prescribed frequently and accounted for second most frequently prescribed group, 27.66% of total antimicrobials prescribed, followed by metronidazole (18.54%), pencillins (7.89%) , fluoroquninolones (3.70%), macrolides (3.64%), carbapenems (1.91%) and linezolid (1.48%).Others constituted 1.97% of the total prescribed antimicrobials.

Table no. 5 shows the number of FDC's used among the AMA's. Out of 1632 AMA's prescribed 142 were FDC's. Among which 40.14% were from National as well as World essential medical list.

**Table-1: Number of Prescriptions- Age Group Wise**

| Age group | Total No. of Prescriptions | Percentage (%) |
|---|---|---|
| 15-30 years | 213 | 33.81 |
| 30-45 years | 154 | 24.44 |
| 45-60 years | 157 | 24.92 |
| 60-75 years | 90 | 14.29 |
| >75 years | 16 | 02.54 |
| Total | 630 | 100 |

**Table-2: Frequency of prescribing Agents (Total No. of prescription-630)**

| Agents | Number of Prescriptions | Percentage (%) |
|---|---|---|
| Antimicrobials | 630 | 100 |
| GIT Drugs | 615 | 97.62 |
| Analgesic & Antipyretics | 497 | 78.89 |
| CNS drug | 470 | 74.60 |
| Vitamins, Minerals &Haematinics | 284 | 45.08 |
| Respiratory Drugs | 104 | 16.51 |
| CVS Drugs | 50 | 07.94 |

**Table-3: Prescribing Prevalence of Antimicrobials**

| Antimicrobials | Total No. | Prescribing Frequency (%) | |
|---|---|---|---|
| | | Among AMA's | As a Whole |
| Beta Lactam | | | |
| a. Pencillins | 128 | 07.89 | 02.27 |
| b. Cephalosporins | 539 | 33.21 | 09.58 |
| c. Carbapenems | 31 | 01.91 | 00.55 |
| Fluoroquninolones | 60 | 03.70 | 01.07 |
| Aminoglycosides | 449 | 27.66 | 07.98 |
| Linezolid | 24 | 01.48 | 00.43 |
| Metronidazole | 301 | 18.54 | 05.35 |
| Macrolides | 59 | 03.64 | 01.05 |
| Others | 32 | 01.97 | 00.57 |

| | | | |
|---|---|---|---|
| Total | 1623 | 100 | 28.85 |

**Table-4: Prescribing prevalence of individual antimicrobials**

| DRUG | Total No. |
|---|---|
| 1.Beta-Lactum | 698 |
| a.Pencillins | 138 |
| • Amoxyclav | 57 |
| • Crystalline pencillin | 01 |
| • Piperacillin+Tazo | 70 |
| b.Cephalosporins | 539 |
| • Cefotaxime | 146 |
| • Ceftazidine | 24 |
| • Cefixime | 21 |
| • Cephalexin | 15 |
| • Ceftriaxome | 333 |
| c.Carbapenems | 31 |
| • Meropenam | 31 |
| 2.Macrolides | 59 |
| • Azithromycin | 49 |
| • Clindamycin | 10 |
| 3.Fluoroquinonolones | 60 |
| • Levofloxacin | 21 |
| • Ofloxacin | 14 |
| • Ciprofloxacin | 25 |
| 4.Aminiglycosides | 449 |
| • Amikacin | 439 |
| • Gentamycin | 10 |
| 5.Nitroimidazole- Metronidazole | 301 |
| 6.Oxazolidinone-Linezolid | 24 |
| 7.Others | 32 |
| • Ofloxacin+Ornidazole | 15 |
| • Sulfamethazole | 04 |
| • Tetracyclins | 10 |
| • Antihelmintics | 02 |
| • Fluconazol | 01 |
| Total | 1623 |

**Table-5: Essential Status of Fixed Dose Combinations (FDCs.) (National Essential Medicines List -2011 [NEML] & WHO List of Essential Medicines-2015 [WHO EML])**

| System / Drugs | Total No. of Medicine Formulations | FDCs | % | Essential n(%) | | Non Essential n (%) | |
|---|---|---|---|---|---|---|---|
| | | | | NEML | WHO EML | NEML | WHO EML |
| AMAs | 1623 | 142 | 07.83 | 57 (40.14) | 57 (40.14) | 85 (59.86) | 85 (59.86) |

## DISCUSSION

The study was carried out retrospectively by analyzing the record of prescription attached with the discharge tickets of the patients who were admitted in post-operative wards of the surgery department of J.L.N. Hospital Ajmer, from July 2014 to December 2014. A total of 630 prescriptions were analyzed.

We observed that majority of cases in this sample were between the age group of 15 and 45 years. This is the usual trend as 15-45 is the productive age group that is actively involved in socioeconomic activities, and later it may be the age factor making them vulnerable to diseases, which may needs surgical interventions.

As it is evident from the table that, antimicrobials 1623(28.85%) are most commonly used drug prescribed in 100% of prescriptions which is same as found in the study of Bhansali NB *et al*. [8].

Similarly the same result was found in the study, “An in-depth study of drugs prescribing pattern

in the surgery department", conducted by Kumar R *et al*. [13].

Table 3 and 4 shows overall as well as of individual prescribing frequency of antimicrobials during study. Excessive and inappropriate use of antibiotics is the major cause of the emerging problem of antibiotic resistance which has become a major threat to the medical field. As we can see from the table that Cephalosporins are the most commonly prescribed antibiotics (33.21%). Among the drugs used overall it accounts for 9.58%. Aminoglycosides accounted for second most frequently prescribed group (27.66%), followed by Metronidazole (18.54%), Pencillins (7.89%), Fluoroquninolones (3.70%), Macrolides (3.64%), Carbapenems (1.91%) and Linezolid (1.48%).Others constituted 1.97% of the total prescribed antimicrobials.

Majority of drugs were used without culture and sensitivity tests. Use of two antimicrobials agents was also common. Ideally, an antimicrobial agent for surgical prophylaxis should (1)prevent SSI, (2) prevent SSI-related morbidity and mortality, (3) reduce the duration and cost of health care (when the costs associated with the management of SSI are considered, the cost-effectiveness of prophylaxis becomes evident)[14,15] (4) produce no adverse effects, and (5) have no adverse consequences for the microbial flora of the patient or the hospital[16], To achieve these goals, an antimicrobial agent should be (1) active against the pathogens most likely to contaminate the surgical site, (2) given in an appropriate dosage and at a time that ensures adequate serum and tissue concentrations during the period of potential contamination, (3) safe, and (4) administered for the shortest effective period to minimize adverse effects, the development of resistance, and costs.[17,18,19] The selection of an appropriate antimicrobial agent for a specific patient should take into account the characteristics of the ideal agent, the comparative efficacy of the antimicrobial agent for the procedure, the safety profile, and the patient's medication allergies.

The higher number of antibiotics per patient indicates that more and more antibiotics were used for prophylaxis purpose rather than definitive treatment purpose. It is used more as a blanket therapy to prevent any or all types of infection. This leads to increased incidence of adverse drug reactions and to the selection of drug resistant bacterial strains.

The average number of antibiotics used in our study came out to be 2.78, which is comparable with 2.18 found in a study conducted by Abula T [20], Kedir M [21]. This was relatively higher than those in other reports [22].

Total AMAs prescribed (28.85%) (Table 3) was more than as revealed by Bhansali NB et al. (16.16%) [8] and Shankar R *et al*. (21.1%)[23] in their studies, but less as compared to 37.89% as revealed in the study by Kumar R *et al.* [13].

Average number of antibiotics was higher than 1.55 as found in the study by Kumar R *et al*.[13], but comparable with the 2.95 as calculated by Bhansali NB *et al*.[8] in there study. In the drug utilization study in post-operative patients in surgery wards of M P Shah medical college, Jamnagar, conducted by Parveen *et al*.[9] found that the Average number of antibiotics were 3.92 which is comparable to our study.

Commonest group of AMAs prescribed was cephalosporin (33.21%) (Table 3) that was less as revealed in the study by Bhansali NB *et al*. (74.73%) [8] And Parveen *et al*. (44.5%) [9] But comparable to results obtained by Sharma et al. (34%) [24] Respectively in their study. Among cephalosporin, ceftriaxione (61.78%) (Table 4) was commonly prescribed in our study, other studies [8,9] also disclosed use of ceftriaxone (64.66% and 23.77% respectively) in surgical patients.

In the study done by Sapna P *et al*. [25] found that ceftriaxone was prescribed to 23.77% of patients. Similar results were reported by Prashanth P *et al.* 2011 in a study done in postoperative patients in Karnataka [26]. In an Iranian study, the use of ceftriaxone as surgical infection prophylaxis was the commonest and 266 out of 300 patients were prescribed ceftriaxone [27]. A different scenario was seen in one Canadian study among TURP patients in which antibiotic regimens prescribed were ciprofloxacin (32%), cefazolin (25%) and gentamicin (3%) [28]. Cephalosporin has been proved as a very important class of a drug but its use against the suggested protocol can lead to emergence of resistance [26,28].

But in the study conducted by Kumar R *et al.*[13] they found cefuroxime as the commonly prescribed cephalosporin.

Al Shimememri *et al*.[29] in their study observed, ceftriaxone as the most commonly used drug without use of culture and sensitivity tests. Thomas *et al*.[30] also observed use of antimicrobials without culture and sensitivity as common practice in primary and tertiary healthcare system in India.

Other antibiotics prescribed of this group are cefotaxime, cefixime, cephalexin and ceftazidine. Aminoglycosides (27.66%) were the second most commonly prescribed antimicrobial, which is consistent with the finding of the study conducted by Bhansali NB *et al.* (25.26%) [8], Kumar R *et al*. (14.70%) [13] and Sharma N *et al*. (26%) [24] But

more than the observation of Parveen A *et al*. (15%) [9] In their study. Among aminoglycosides amikacin (94.33%) was the commonest prescribed which is more than that observed by Bhansali NB *et al*. (25.16%) [8] and Sharma N et al. (26%) [24] In their studies respectively.

Gentamycin (2.23%) is another commonly prescribed aminoglycosides. Penicillin's (7.89%) were prescribed most commonly in a fixed dose combination as either Amoxicillin+Clavulanic Acid or Piperacillin+ Tazobactum.

In the Nitroimidazole group Metronidazole (18.54%) was used most commonly as a single drug, however, in our study, their prescribing frequency was higher than that reported by Sharma N *et al.* (12%) [24] and kumar R *et al.* (5.36%) [13] But less than that by Parveen A *et al*.(30.7%) [9] In their studies.

Among the macrolides, azithromycin was prescribed mainly, clindamycin is also prescribed. These drugs were prescribed mainly for abscess, lump and varicose vein. In the Carbapenems group which were least (1.91%) meropenam used as a single drug. In some cases Linezolid (1.48%) were also found.

In our study the Fluoroquinolones prescribed accounts only for 3.70% including Levofloxacin, ciprofloxacin and ofloxacin, while it was 12%, 2%, and 5.58% as reported in the studies done by Sharma N *et al*.[24], Parveen A *et al*.[9] and Kumar R *et al*.[13] respectively.

Others antimicrobial drugs contributing about 1.97% in our study includes sulfamethoxazole, doxycycline, albendazole and fluconazole.

8.75% of the antimicrobials were prescribed as Fixed Dose Combination, including amoxicillin with clavulanic acid, tazobactam with piperacillin and ofloxacin with ornidazole. This prescribing frequency is lower than 18.84% that was reported by Parveen A *et al*. [9]. Prescribing frequency of amoxicillin + clavulanic acid, piperacillin+ tazobactam was 40.14% & 49.30% respectively in our study which was quite different from Parveen A *et al*.[9] (23.4% and 11.11% respectively), and kumar R *et al*.[13] (37.81% and 16.80% respectively). FDC's combination of ofloxacin with the ornidazole accounts for 10.56% which is less than 21% as observed by Kumar R *et al.* [13] during his study.

Surgical procedures needs antimicrobial coverage to avoid postoperative infective complications, but it is observed that unnecessary use of antimicrobials is also common. For surgical prophylaxis, international guidelines indicates that use of 1 or at the most 2 generation cephalosporins is suitable, rather 3 and 4 generation and other higher antimicrobials are also commonly used for the purpose[31]. There are many reasons for such a type of trend such as the desire to avoid postoperative complications, to get early relief, claim of lack of time for of investigations or lack of sufficient microbiological laboratory infrastructure, and belief and experience of surgeon over a number of antimicrobials.

Beta-lactam and aminoglycosides were the most commonly used antibiotics. This is consistent with the findings of the study conducted by Abula T[20], Kedir M[21], Bhansali NB *et al.*[8], Sharma N *et al*.[24].

Among the AMAs drug combinations 40.14% were rational and in essential medicine list. FDCs used were Amoxicillin with Clavulanic Acid which is included in essential drug list. Other combinations used were FDCs of Quinolones and Nitroimidazoles e.g. Ofloxacin + Ornidazole etc. These combinations have not been recommended in any standard books [32, 33] and not included in EDL, but continue to be heavily prescribed drugs in gastrointestinal infections to cover up for diagnostic imprecision and the lack of access to laboratory facilities. Such injudicious use of antimicrobials FDCs can rapidly give rise to resistant strains of organisms, which is a matter of serious concern to the health care situation in our resource poor country. A glaring example is the emergence of Ciprofloxacin-resistant *Salmonella typhi* strains which have made treatment of typhoid fever a difficult and expensive proposition in India today [34].

## CONCLUSION

Misuse of antibiotic therapy, including failure to complete therapy, skipping of doses, reuse of leftover antibiotics, and inappropriate choice of antibiotics, inappropriate combination, inappropriate dose regimen and too long duration of drug usage can potentially expose patients to suboptimal doses of antibiotic therapy. Such antibiotic-taking behaviour can result in insufficient antibiotic exposure for eradicating infectious bacteria and potentially create an environment that promotes antibiotic resistance [35, 36]. Antibiotic misuse or over-use may increase the emergence of resistant bacteria and as a result increase the selection pressure on physicians who tend to prescribe newer broad spectrum agents for excessive periods of time [37]. Antibiotic resistance has become a serious problem in both developed and developing nations. In certain settings, such as hospitals and some child-care locations, the rate of antibiotic resistance is so high that the normal, low cost antibiotics are virtually useless. This leads to a never-ending ever-spiraling race to discover new and different antibiotics just to keep us from losing ground in the battle against infection. The fear is that we will eventually fail to keep up in this race, and the time when people did not

fear life-threatening bacterial infections will be just a memory of a golden era [38].

It is of utmost clinical importance to crub development of drug resistance. Measures that can be taken are: No indiscriminate and inadequate or unduly prolonged use of AMAs, Prefer rapid acting and selective (narrow spectrum) AMAs whenever possible, Use combination of AMAs whenever prolonged therapy is undertaken, e.g. tuberculosis [39].

**REFERENCES**


1. Chambers HF. Antimicrobial: General considerations. In Hardmam JG and Limbird LE (eds), Goodman and Gillman's. The pharmacological basis of therapeutics. 10th ed. M. C. Graw Hill; 2001.p. 1152 – 1153.
2. Chambers HF and Sandle MA. Antimicrobials: General considerations. In Hardman, JG and Limbird LE, (eds) Goodman and Gilman's. The pharmacological basis of therapeutics 8th ed. MC Graw Hill, 1996 p 1050 – 1053.
3. Vadajiya Shailesh, Naik Viren and Mevada A. A Study of Anti-Microbial Drug Utilization Pattern and Appropriateness inthe Surgical Units of Civil Hospital, Ahmedabad. Int. J. Pure App. Biosci. 2(3): 77-82 (2014).
4. Jhaveri BN, Patel TK, Barvaliya MJ, Tripathi CB. Drug utilization pattern and pharmacoeconomic analysis in geriatric medical in-patients of a tertiary care hospital of India. Journal of pharmacology & pharmacotherapeutics. 2014 Jan;5(1):15.
5. Mahajan B, Kaushal S, Chopra SC. Drug Utilization Study of Antimicrobial agents (AMAs) in the Intensive Care Units (ICUs) at Medical College Hospital of North India.
6. Barriere SL. Cost-containment of antimicrobial therapy. Drug intelligence & clinical pharmacy. 1985 Apr;19(4):278-81.
7. Post-operative wound infection: the case for effective prophylaxis. WHO Drug Information 1992; 6(2): 53-54.
8. Gosai TR, Dholaria NK, Suthar SD, Chacko J, Chavda DA, Trivedi HR. Drug utilization study in post-operative patients in surgical ward of a tertiary hospital attached with medical college.
9. Parveen A, Shaheen K, Qamer Shaik M, Ali SW, Hussain M, Ali SA. Prescribing patterns of antibiotics in post-operative patients in a teaching hospital. Indo Am J Pharm Res. 2014;4(1):527-32.
10. Laing RO, Hogerzeil HV, Ross-Degnan D. Ten recommendations to improve use of medicines in developing countries. Health policy and planning. 2001 Mar 1;16(1):13-20.
11. World Health Organization. Introduction to Drug Utilization Research. Geneva: World Health Organization; 2003.
12. Sande MA, Kapusnik-uner JE, Mandell LG. Anti-microbial agents: General consideration. In Gilman AG, Rall TW, Nies AS, Taylor P, eds. The Pharmacological Basis of Therapeuiics. New York, Pergmon Press 1990; 1018-1046.
13. Kumar R, Kohli K, Sidhu DS, Kaur N, Chandra M, Garg M. An in-depth study of drugs prescribing pattern in the Surgery Department of a Tertiary Care Teaching Institute in Northern India. International Journal of Basic & Clinical Pharmacology. 2017 Jan 25;3(4):681-6.
14. Alerany C, Monterde J, Semeraro C. Impact of local guidelines and an integrated dispensing system on antibiotic prophylaxis quality in a surgical centre. Journal of Hospital Infection. 2005 Jun 1;60(2):111-7.
15. Allerberger F, Gareis R, Jindrák V, Struelens MJ. Antibiotic stewardship implementation in the EU: the way forward. Expert review of anti-infective therapy. 2009 Dec 1;7(10):1175-83.
16. Voit SB, Todd JK, Nelson B, Nyquist AC. Electronic surveillance system for monitoring surgical antimicrobial prophylaxis. Pediatrics. 2005 Dec 1;116(6):1317-22.
17. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. American journal of infection control. 1999 Apr 1;27(2):97-134.
18. Gorbach SL, Condon RE, Conte Jr JE, Kaiser AB, Ledger WJ, Nichols RL. Evaluation of new anti-infective drugs for surgical prophylaxis. Clinical infectious diseases. 1992 Nov 1;15(Supplement_1):S313-38.
19. Källman J, Friberg Ö. Antibiotic prophylaxis in cardiac surgery general principles. APMIS. 2007; 115:1012-5.
20. Abula T, Desta Z. Drug prescribing in surgical and gynaecological wards of a teaching hospital.
21. Abula T, Kadir M. Ethiop J Health Dev. 2004, 18, 1, 35-38.
22. Durbin WA, Lapidas B, Goldmann DA. Improved antibiotic usage following introduction of a novel prescription system. Jama. 1981 Oct 16;246(16):1796-800.
23. Shankar RP, Pranab KS, Upadhyay DK, Dubey AK, Subash P. Drug utilization among surgical outpatients. TMJ. 2006;56(2-3):230-4:.
24. Sharma N, Bhargava M, Mahawar D, Parakh R, Sharma D. Usage of antibiotics in postoperative patients in a tertiary care teaching hospital in India. Int J Pharm Res Bio Sci. 2014;3(2):99-105.
25. Sapna P, Padma L, Veena DR, Shanmukananda P. Drug utilization study of antimicrobials in post-operative wards in a teaching hospital. Int Res J Pharm App Sci. 2012;2(5):56-9.
26. Prashanth P, Narendranath S, Geetha M, Kumar MN, Patil N, Reshma SR. Trends in prescribing antimicrobials in post-operative wards in a tertiary care hospital. Drug Invention Today. 2011 Dec 1;3(12).
27. Shohrati M, Hosseini SM, Rahimian S. Assessment of reasonable use of ceftriaxone in

internal and surgical wards. Trauma Monthly. 2010 Jan;2010(3, Autumn):171-6.
28. Lawson KA, Rudzinski JK, Vicas I, Carlson KV. Assessment of antibiotic prophylaxis prescribing patterns for TURP: A need for Canadian guidelines?. Canadian Urological Association Journal. 2013 Jul;7(7-8):E530.
29. Al Shimemeri A, Al Ghadeer H, Memish Z. Antibiotic utilization pattern in a general medical ward of a tertiary medical center in Saudi Arabia. Avicenna journal of medicine. 2011 Jul;1(1):8.
30. Thomas M, Govil S, Moses BV, Joseph A. Monitoring of antibiotic use in a primary and a tertiary care hospital. Journal of clinical epidemiology. 1996 Feb 1;49(2):251-4.
31. Bratzler DW, Houck PM. Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project. The American Journal of Surgery. 2005 Apr 1;189(4):395-404.
32. Margeet AP, Samuel LS, Jr. Chemotherapy of protozoal infections. In: Brunton LL, Lazo JS, Parker KL, editors. Goodman and Gilman's the Pharmacologcal Basis of Therapeutcs. 11. New York: Mc Graw- Hill; 2006p.1049-50.
33. Katzung BG, Masters SB, Trevor AJ, editors. Basic & clinical pharmacology.
34. Amitava S. Indian market's fixation with fixed dose combinations (Editorial) Rational Drug bulletin. 2002;12:1.
35. Dajani AS. Adherence to physicians' instructions as a factor in managing streptococcal pharyngitis. Pediatrics. 1996 Jun; 97(6 Pt 2):976-80.
36. Sclar DA, Tartaglione TA, Fine MJ. Overview of issues related to medical compliance with implications for the outpatient management of infectious diseases. Infect Agents Dis. 1994 Oct; 3(5):266-73.
37. Hulscher ME, Grol RP, van der Meer JW. Antibiotic prescribing in hospitals: a social and behavioural scientific approach. Lancet Infect Dis. 2010 Mar; 10(3):167-75.
38. Kardas P, Devine S, Golembesky A, Roberts C. A systematic review and meta-analysis of misuse of antibiotic therapies in the community. Int. J. Antimicrob. Agents. 2005 Aug; 26(2):106-13.
39. Antimicrobial drugs: General consideration. Tripathi KD. Essentials of Medical Pharmacology.7th Edition. New Delhi: Jaypee Brothers Medical Publisher (P) Ltd.; 2013: 689-703.