ORIGINAL ARTICLE

Prevalence of Antimicrobial Utilization in a Tertiary Care Teaching Hospital

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ABSTRACT

Background: Antibiotic resistance is said to be direct consequence of antibiotic use. Inappropriate prescribing and use practices are putting patients at unnecessary risk for acquisition and spread of resistant and difficult-to-treat pathogens. **Methods:** A total of 600 prescriptions from various O.P.Ds and 400 case record sheets of the in-patients, 100 each from the department of Medicine, Pediatrics, Obstetrics and Gynecology and Surgery were collected. The data was analyzed as per WHO outpatient prescribing indicators and appropriate prescribing indicators for inpatient antibiotic use. **Results:** OPD based prescriptions contained 1574 medicines with an average of 2.63 medicines per prescription. Total of 218 antibiotics were prescribed, 3 (1.4%) antibiotics were prescribed as injections. On the whole β-lactams (38.5%) were the most commonly prescribed group. Inpatients case records contained 2958 medicines. Total 606 antibiotics were prescribed for 297 (74%) inpatients that received an average of 2.04 antibiotics. β-lactam was the most commonly prescribed group of antibiotics in the inpatient department. **Conclusion:** Preparation and implementation of Standard treatment guidelines, antibiotic prescribing policy, prescribing from essential medicine list can make prescribing more rational, safe and help reducing cost of therapy.

Key words: Antibiotics, antibiotic resistance, antibiotic policy, prescribing, WHO indicators

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INTRODUCTION

The global impact of infectious diseases in this century is on the rise.[1] Opportune administration of suitable antimicrobial therapy to infected patients is indispensable to avoid infection-related morbidity and mortality.[2,3] Since their introduction in 1940s the role of antibiotics has expanded from treating serious infections to preventing infections in surgical patients, protecting patients with compromised immune systems, promoting growth and preventing disease in animals.[4] The 'antibiotics' revolution has changed the entire landscape of infectious disease making them curable. In India burden of Infectious disease is amongst the highest in the world leading to high consumption of antibiotics. In India between 2005 and 2009, the units of antibiotics sold increased by about 40 per cent.[5]

Antibiotics can be marvel drugs but they also have risks. Centers for disease control and prevention (CDC) finds that between a third and a half of all antibiotics used in the U.S. are either unnecessary or the antibiotic does not match the germ. Antibiotic resistance is said to be direct consequence of antibiotic use, the greater the volume of antibiotics used, the greater the chances that antibiotic-resistant populations of bacteria will exist. It is evident from the available literature that a significant portion of antibiotics prescribed in the outpatient setting is given for viral illnesses where the use of antibiotic therapy is irrational.[6] Antibiotics used in such situations where these cannot be expected to improve the patient's condition, will increase the chance of resistance. Nevertheless, inappropriate use of antibiotics has been described worldwide in both community and hospital settings particularly in developing countries.[5] This inappropriate prescribing and use practices are putting patients at unnecessary risk for preventable allergic reactions, acquisition and spread of resistant, difficult-to-treat pathogens such as carbapenem-resistant Enterobacteriaceae and *Clostridium difficile*.[7,8]

As an upshot of antibiotic resistance once treatable infections are becoming difficult to cure, raising costs to both patients and society. The U.S. Centers for Disease Control and Prevention estimates that antibiotic resistance is responsible for more than 2 million infections and 23,000 deaths each year in the United States.[4] Clinical audit, in accord with education, and prescribing guidelines can favorably change antibiotic prescribing patterns among practitioners.

Aim of the study

Thus the present study was conducted to assess the prescribing pattern of the antibiotic in different specialties of a tertiary care teaching hospital.

Ethical approval

The study protocol was approved by the Institutional Ethical Committee.

METHODS

Study design and healthcare setting

Prospective cross-sectional prevalence survey carried out in In-patient departments (IPDs) and Out-patient departments (OPDs) of Lady Hardinge Medical College and associated hospital (tertiary care teaching hospital).

Data collection

Out-patient: Patients were randomly selected on five days (Monday to Friday) per week with a maximum of two patients per day per department from the pharmacy of the hospital. This was done till a total of 600 prescriptions, were selected 100 each from Medicine, Pediatrics, Obstetrics and Gynecology (OBG), Surgery and 50 prescriptions each from ENT, Ophthalmology, Skin and Psychiatry.

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Once the predetermined numbers of prescriptions were collected from outpatients department the data was collected from the in-patients.

In-patient: Patients were randomly selected on five days (Monday to Friday) per week with a maximum of two patients per day per department. The patients who were discharged on the particular day and who were admitted for more than five days were randomly included. Only the general wards were selected. Inclusion was discontinued when the preset number of patients per department was reached that is, 100 each from the department of Medicine, Pediatrics, OBG and Surgery. Data was obtained from the case record form of the patients. All the antifungals, antivirals, antimalarial, antimycobacterial drugs were excluded.

The relevant data was recorded in customized data collection form. Information recorded included patient particulars, diagnosis, investigations, drug details and the indication for prescribing antimicrobial agent, suspecting organism underlying infection, whether the treatment was for prophylaxis or was empirical, and duration of therapy and details of any concomitant medications.

Data analysis

Outpatient: Data was analyzed as per WHO outpatient prescribing indicators.[9]

Indicator 1: Average number of drugs prescribed per encounter

Indicator 2: Percentage of encounters when injection was prescribed

Indicator 3: Percentage of encounters when antibiotic was prescribed

Indicator 4: Percentage of antibiotics prescribed from essential list

Inpatient: Appropriate prescribing indicators for inpatient antibiotic use.[10]

Indicator 1: Percentage of hospitalizations with one or more antibiotics prescribed

Indicator 2: Average number of antibiotics drugs prescribed per hospitalization with antibiotics prescribed

Indicator 3: Percentage of surgical in-patients who received antibiotics prophylaxis

Indicator 4: Percentage of antibiotics prescribed by generic name

Statistical analysis

Drug data and patient characteristic data were computed and analyzed using MS Excel and presented as percentages.

RESULTS

A total of 600 OPD based prescriptions were collected (out of which 350 prescriptions were written for female patients) which contained 1574 medicines with an average of 2.63 medicines per prescription. Description of WHO prescribing indicators for various OPDs is given in Table 1. A total of 218 antibiotics were prescribed. Overall antimicrobial agents (AMAs) were indicated therapeutically in 35.3% of patients and 64.7% patients for prophylaxis the most frequent diagnosis for which antibiotics were prescribed was upper respiratory tract infection in medicine and pediatrics departments, hernia from surgery, and pelvic inflammatory disease from OBG department. Of these 218 antibiotics, 3(1.37%) antibiotics were prescribed as injections. Psychiatry department was the only department in which no antibiotics were prescribed. On the whole β-lactams (38.5%) was the most commonly prescribed group followed by fluoroquinolones (21.6%), nitroimidazoles (19.7%). Various antibiotics used in various OPD is presented in Table 2.

A total of 400 inpatient case sheets were collected, out of which 230 were written for female patients. Case records contained 2958 medicines. Total 606 antibiotics were prescribed for 297 (74%) inpatients that received an average of 2.04 antibiotics. The AMAs were indicated therapeutically in 21.9% of patients and 78.1% patients for prophylaxis the most frequent diagnosis for which antibiotics were prescribed was lower respiratory tract infection in medicine department, cholecystectomy from surgery, lower segment caesarean section from OBG department and septicemia from pediatrics department. Description of WHO prescribing indicators for various IPDs is given in Table 3. In general similar to the trend in IPDs, β-lactams was the most commonly prescribed group of antibiotics in the inpatient department followed by nitroimidazoles (20.3%). Various antibiotics used in various IPD are presented in Table 4.

DISCUSSION

Current research was conducted to explore the prescribing patterns of the antimicrobial agents in different specialties of a tertiary care teaching hospital. Drug utilization research provides insights into the pattern, quality and determinants of use drugs. The International Network for the Rational Use of Drugs (INRUD) was established in 1989 to promote the rational use of medicines in developing countries. Various indicators were developed by INRUD in collaboration with WHO that provided objective indices to allow for assessment of medicine use practices.[9] All the indicators have been extensively field-tested in many countries and found to be easily generated, reliable, valid and consistent.[11]

The average number of medicines per prescription is an important criterion of the prescription audit which reflects the extent of the use of medicines.[12] In the present study average medicines per patient across all departments of the institution was 2.63%. Highest average number of medicine was observed in specialty of Medicine (3.23) where in department of Otorhinolaryngology it was 1.88 medicines per prescription.

Poly-pharmacy is challenging problem in healthcare still persist despite of continuing efforts.[13] It has been linked to medicine related problems and negative health outcome.[14] Poly pharmacy has been defined as the concurrent use of multiple medicines, and some researchers though have categorized it as minor (two medicines) and major (more than

Table 1: Description of WHO prescribing indicators for various OPDs (N=600, including pediatric prescriptions)

Indicators	Overall	Medicine	Surgery	OBG	ENT	Ophtha	Derma	Psychiatry
Total number of medicines prescribed	1574	323	218	313	94	108	147	147
Average number of medicines per patient	2.63	3.23	2.18	3.13	1.88	2.16	2.94	2.94
Encounters when injection was prescribed, n (%)	11(11)	2(2)	9(9)	0	0	0	0	0
Encounters when antibiotics were prescribed, n (%)	177(29.5)	35(35)	27(27)	32(32)	25(50)	15(30)	9(18)	0
Total number of antibiotics prescribed, n (%)	218(14.8)	42(13)	38(16)	59(19)	25(26.6)	19(17.6)	9(6)	0
Antibiotics prescribed from essential medicine list n (%)	160(73.4)	36(86)	21(55.3)	54(91.5)	17(68)	8 (42)	6(66.7)	0
Antibiotics prescribed by generic name, n (%)	19(8.7)	6(14)	8(21.1)	1(1.7)	1(4)	0	0	0

Table 2: Description of the antibiotics used in various O.P.D (N=218)

Class of Antibiotics	Overall N (%)	Medicine	Surgery	Obstetrics & Gynaecology	ENT	Ophthalmology	Dermatology	Pediatrics
β lactams	84(38.5)	17(40.5)	19(50)	5(8.5)	15(60)	3(15.8)	6(66.7)	19(73.1)
Fluoroquinoloneses	47(21.6)	8(19)	8(21.1)	6(10.2)	8(32)	14(73.7)	-	3(11.5)
Nitroimidazoles	43(19.7)	9(21.4)	9(23.7)	25(42.3)	-	-	-	-
Tetracyclines	22(10.1)	-	2(5.3)	20(33.9)	-	-	-	-
Macrolides	13(6.0)	8(19)	-	3(5.1)	-	-	1(11.1)	1(3.8)
Aminoglycoside	6(2.8)	-	-	-	-	2(10.5)	-	3(11.5)
Others	3(1.4)	-	-	-	2(8)	-	2(22.2)	-

Table 3: Description of antibiotic prescribing indicators for ipds (n=400, including 100 pediatrics prescriptions)

Indicators	Value	Medicine	Surgery	OBG	Pediatrics
Total number of medicines prescribed	2958	864	795	766	533
Total number of antibiotics (N=2958), n(%)	606(20.4)	113(13.1)	178(22.4)	187(24.4)	128(24)
Hospitalizations with one or more Antibiotics Prescribed, n(%)	297(74.3)	66(66)	85(85)	76(76)	70(70)
Average number of antibiotics drugs prescribed per hospitalization with antibiotics prescribed	2.04	1.71	2.1	2.46	1.82
Antibiotics prescribed by generic name (N=606), n (%)	130(21.5)	29 (25.7)	28(15.7)	3(1.6)	70(54.7)
Surgical In-Patients who received Antibiotics Prophylaxis	120(100)	NA	100	40(100)	NA

Table 4: Description of antibiotics on the basis of their groups in ipds (n=606)

Class of Antibiotics	N (%)	Medicine	Surgery	OBG	Pediatrics
β lactams	340(56.1)	63(55.8)	76(42.7)	119(63.6)	82(64.1)
Nitroimidazoles	123(20.3)	19(16.8)	45(25.3)	59(31.6)	-
Aminoglycosides	59(9.7)	5(4.4)	10(5.6)	7(3.7)	37(28.9)
Fluoroquinolones	54(8.9)	9(8)	43(24.2)	2(1.1)	-
Macrolides	20(3.3)	16(14.1)	3(1.7)	-	1(0.8)
Glycopeptide	8(1.3)	-	1(0.6)	-	7(5.5)
Oxazolidinones	1(0.2)	1(0.9)	-	-	-
Others	1(0.2)	-	-	-	1(0.8)

four medicines) still definite definition is lacking.[15]

In our study overall 11% encounters were observed with injections in OPDs. In Surgery OPD 9% of the prescription and 2% in medicine OPD had injections prescribed. Quick *et al.* observed 30.1% of the injections in Sudan.[16] Injection increases exposure to the infection, causes pain at the injection site and also they are consider costly affair.[9] Lambert *et al.* described factors associated with physicians' decisions to prescribe antibiotics. The two most frequent reasons physicians chose to describe their decisions to prescribe any antibiotics were "cure of the underlying infectious disease" and "lessens uncomfortable or painful symptoms".[17] In current study 28.2% of prescription contained at least one antibiotic.

Al-Shami *et al.* evaluated the quality of prescriptions with the aim to investigate the prescribing of antibiotics and generate a baseline picture of prescribing habits in government hospitals, the total number of generic antibiotics was 22.2%[18] these are higher than the present study. Though antibiotics prescribed within the EML was comparable with the present study. Prescriptions written with antibiotics were 51% in this study while in the present study only 28.2% prescriptions contained antibiotics. Takhar *et al.* investigated antibiotic usage pattern in the outpatient department of a government hospital in India, The average number of drugs per prescription was 5.01 and number of antibiotics per prescription encountered were 2.53. They also reported that 78.5% of the prescribed antibiotics were present in the EML.[19] Lalan *et al.* did a cross sectional descriptive study in Out Patient Department of Sassoon Hospital and found the average number of drugs per encounter was 3.62 and the encounter with an antibiotic prescribed was 46.17%.[20]

The distribution of preferred antibiotics group by the prescribers in outpatient department of our institution showed that β-lactams was the most commonly used. Although, overall preference of different groups in specialty-wise break-up was variable, in the specialty of obstretrics and gynaecology nitroimidazole (42.3%) was maximally prescribed whereas in specialty of ophthalmology fluoroquinolones (73.7%) were commonly written antibiotics predominately used as topical solution. Among the beta-lactams amoxicillin was maximally written antibiotic agent but less often it was combined with clavulanic acid. Similarly in another study in outpatient setting amoxicillin was the most common antibiotic agent used.[19] Same study also observed that amongst the dosage form for antibiotics oral route was preferred though 25.4%

antibiotics were given as injectable.[19] On the contrary in our study only 1.37% injectable preparations of antibiotics were prescribed in outpatient department of Surgery. In present study overall analysis of the inpatient showed that 20.4% of antibiotics were written for 74.3% of the hospitalized patients. Inpatients received an average of 2.04 antibiotics in our study, rate of 2.3 antibiotics per hospitalization is acceptable.[10] β-lactam antibiotics (56.1%) were also maximally used group in admitted patients. Almost similar trend was observed in another study.[21] Whereas glycopeptides and oxazolidinones that are considered reserve antibiotics were prescribed only in few inpatient.

Palikhe *et al.* studied the antibiotic utilization in pediatrics inpatients. The average number of drugs per patient was 5.01 that are comparable with our study but average antibiotics per patients were 2.41 which were more than in the current study (1.82). In their study antibiotics were prescribed at least once for 93% of hospitalized children though in our institution only 70% of pediatrics inpatients received antibiotics. [22] Cephalosporin group was the most frequently prescribed antibiotics followed by penicillin. Though in the present study penicillin were prescribed more than the cephalosporin, which is cost effective in comparison to cephalosporin. This may be due to availability of essential medical list and free medicines for the patients.

Shah *et al.* studied antibiotic use in department of OBG inpatients. They observed that 95.14% of the patients received antibiotics with the mean antibiotic of 1.91.[23] Though in our study, an average of 2.46% antibiotics per patient was reported, this is above the acceptable range. Ciprofloxacin was the preferred antibiotic followed by ampicillin and metronidazole in their study whereas in the present study beta-lactams (63.6%) and nitroimidazoles (31.6%) were commonly used. Pattern of antibiotics used were different in both of these institutions probably due to different morbidity profile of the patients and another reason could be the prescriber's preference for particular antibiotics on basis of their clinical experience with the particular medicine.

Although drug resistance is primarily a medical problem, the factors that influence the spread of resistance are ecological, epidemiological, cultural, social and economic. Nevertheless healthcare professionals, patients, healthcare facilities, drug sellers have little incentive to admit the consequences of their use of antibiotics on others, especially on future generations. Every time an antibiotic is used the probability of the development and spread of antibiotic-resistant bacteria is augmented. Range of reasons have been identified for overuse/misuse of antibiotics in India as in other countries including lack of availability of diagnostic facilities, patient demand, to make profit from drug sales, influence of medical representatives, lack of knowledge about the inappropriate use of antibiotics, overstock and near-expiry.[5,24,25]

Knowing that antibiotic resistance is a reality in India and that the prevalence of resistant bacteria will rise over time various intervention strategies have been suggested by The Global Antibiotic Resistance Partnership (GARP) - India Working Group. The recommendations includes vaccinations to prevent various illnesses and hospital infection control introducing the *H. influenzae* type b vaccine into the Universal Immunization Programme (UIP), introducing a pneumococcal vaccine, introducing a rotavirus vaccine into the UIP to prevent a large number of cases of dehydrating diarrhea. Improving antibiotic supply chain and quality. Checklists for prophylaxis against surgery-related infection. Continuing education of health care professionals. Forming an infection control plan, committee, and team in all hospitals. Time to time hospital audits by clinical microbiologists. Stewardship programs to reduce antibiotic resistance and healthcare costs, and increase good patient outcomes. Last, but not the least restricting the use of antibiotics in livestock and poultry (particularly for growth promotion) and keeping washout periods between the use of antibiotics and animal slaughter.[24] Thus the point which needs to be emphasized is that antibiotic effectiveness is a worldwide mutual resource and a collective responsibility, so to keep them effective we have to change how we use the antibiotics.

CONCLUSION

Minimal use of injections in OPD and relatively lower proportion of hospitalized patients who received antibiotics were overwhelming finding of the study but needs to be improved further. Preparation of hospital drug formulary on the basis of current EML, preparation and implementation of Standard treatment guidelines, antibiotic prescribing policy will make prescribing more rational and meaning full. Nevertheless in order to achieve the maximum benefits for human health, measures to reduce inappropriate use of antibiotics must be combined with efforts to improve access when they are needed.

Limitation

Limitation of the present study was that the sample size was small and the prescription data on antibiotics use was obtained from a government hospital and we cannot rule out the possibility that antibiotic use in private hospitals differs substantially from that in governmental hospitals. Further the prescriptions for out-patient department were collected at the hospital pharmacy.

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Conflict of interest

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