A prospective assessment of antimicrobial agents utilization pattern in a tertiary care hospital

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ABSTRACT

Background: The antimicrobial resistance is increasing globally and, concurrently, downward trend in development of newer antibiotics is leading to a serious public health problem and economic consequences.

Methods: Prescriptions with at least one antimicrobial were included in the study. A total of 242 prescriptions were included in the study. The antimicrobials were classified into different classes based on WHO-ATC classification.

Results: A total of 281 antimicrobials prescribed in 242 prescriptions with an average of 1.16 per prescription. In most of the prescriptions, 1 antimicrobial were prescribed (88.43%). The routes of the antimicrobial administration were mostly oral 268 (95.37%) followed by injectable 13 (4.63%). The most commonly prescribed classes of antimicrobial in this study were antibiotics for systemic use (J01) (74.02%) followed by antimycobacterials (J04) (13.88%), antiparasitic drugs (P) (8.19%), antimycotics for systemic use (J02) (2.49%) and antivirals for systemic use (J05) (1.42%). Among antibiotics, the most commonly prescribed classes of antibacterial was various antibacterial FDCs (19.22%), followed by quinolones (18.86%), macrolides (18.15%), β-lactams (11.03%) cephalosporins (6.76%), penicillins (4.27%), aminoglycosides (2.84%), metronidazole (1.78%), clindamycin (1.78%) and tetracycline (0.36%). The total percentage of antimicrobials prescribed as Fixed Dose Combinations (FDCs) were 32.38%.

Conclusions: The present study has reported that most commonly prescribed antimicrobials were quinolones followed by macrolides and β-lactams. Recommendations to change the ongoing prescribing practices should be based on the Standard Treatment Guidelines, EDL and Antibiotic policy or by following the information, education, and communication (IEC) interventions.

Keywords: Antimicrobial utilization pattern, Anatomical Therapeutic and Chemical - ATC, Essential Drug List- EDL, World Health Organization - WHO

INTRODUCTION

Drug utilization is defined by the World Health Organization (WHO) as “the marketing, distribution, prescription, and use of drugs in society, with special emphasis on the resulting medical, social, and economic consequences”. Overall, 80-90% of the antibiotics are consumed in outpatients and the rest in inpatients. About 20-50% of all antibiotic use is irrational and this irrational use leads to increased risk of adverse drug events, increase in antimicrobial resistance and higher health care cost. In the outpatients, the antibiotics are most commonly prescribed for fever, sore throat and diarrhea. These infections are usually viral in origin and antimicrobials have no role in their treatment.

The ‘microbial threat’ was first recognized as a widespread problem in the 1990s and is now highlighted as a major global risk by several agencies, including the World Health Organization (WHO) and World Economic Forum (WEF). The antimicrobial resistance is increasing globally and, concurrently, downward trend in development of newer antibiotics is leading to serious public health problem and economic consequences. There are many factors responsible for antimicrobial resistance, but the utmost important is the overall quantity of antimicrobial consumption.
the worldwide antibiotic consumption increased by 36% and 76% of which was in Brazil, Russia, India, China, and South Africa. In 2010, India was the single largest consumers of antibiotics in the world, followed by China and US.  

Antibiotic resistance is a major determinant of the outcome of infectious disease management. The clinician is not only important to development of this issue but also key to control it. The prescribing practice of clinician is affected by various elements and to modify this it is essential to understand reason behind it. It is utterly important to assess and audit the antimicrobials utilization pattern periodically for enabling suitable modifications in utilization patterns; to increase the therapeutic benefits and also to decrease the health care cost, antimicrobial resistance, adverse drug events for improving the medical services.  

The aim of this study was to assess the utilization pattern of different classes of antimicrobials in the Medicine OPD of a tertiary care teaching hospital along with the study of the dosage form of antimicrobials. We also assessed the utilization of antimicrobials from the essential drug list and as fixed dose combinations. 

METHODS 

Institutional Ethical Committee permission was taken before the start of the study. 

Study site 

This study was conducted in the Out Patient Department of General Medicine, King George’s Medical University, Lucknow, India. 

Study period 

This study was carried out prospectively over a period of 1 month, from 1st January 2016 to 31st January 2016. It was a prospectively designed cross-sectional observational study. 

Sample size 

Total 1000 patients of either sex, visiting for the first time to the OPD were selected randomly for the study. Prescriptions with at least one antimicrobial were included in the study. Those constituted 242 out of 1000 prescriptions screened. 

Patient selection 

Inclusion criteria 

Patient attends medicine OPD and were ready to give consent were included in the study. Prescription containing at least one antimicrobial agent. 

Exclusion criteria 

Patient who was followed up, referral patients, seriously ill patients and mentally disabled patients. 

Study material 

Proforma was designed for recording patient’s specific information such as patient's demographic profile, diagnosis, drug, name, dose, route, frequency and duration of prescription. The antimicrobials were classified into different classes based on WHO-ATC classification. The brand name of drugs was decoded by CIMS drug manual for the purpose of analysis. 

Prescribing indicators 

a. Percentage of encounters with an antimicrobial 

b. Percentage of antimicrobial prescribed in fixed dose combination (FDCs) 

c. Percentage of antimicrobial drug prescribed from the Essential Drug List. 

Statistical analysis 

Statistical Packages for Social Sciences (SPSS) version 20 was used for entry and analysis of the quantitative data. In the statistical analysis, frequencies, averages/means, and percentages were obtained. 

RESULTS 

Demographic data 

Out of 1000 prescriptions, only 242 prescriptions had at least one antimicrobial and were selected for analysis. The percentage of males was 54.96% and that of females was 45.04%. Age distribution shows, most of the patients were adults (20-60 years) constituting 81.82 %, followed by adolescents (15-19 years) 9.50 % and geriatric (≥60 years) 8.68 % (Table 1). 

| Age                  | No. (%) |
|----------------------|---------|
| Adolescents (15-19 year) | 23 (9.50%) |
| Adults (20-60 year)   | 198 (81.82%) |
| Geriatric (>60 year)  | 21 (8.68%) |
| Gender               | No. (%) |
| Male                 | 133 (54.96%) |
| Female               | 109 (45.04%) |

Prescription data 

A total of 281 antimicrobials prescribed in 242 prescriptions with an average of 1.16 per prescription. In most of the prescriptions, 1 antimicrobial were prescribed (88.43%), followed by 2 antimicrobial (8.26%), 3
antimicrobial (2.07%), and 4 antimicrobial in 1.24% of prescriptions (Table 2).

Table 2: Number of antimicrobials prescribed per prescription.

| No. of antimicrobials | No. of prescriptions (%) |
|-----------------------|--------------------------|
| 1                     | 214 (88.43%)             |
| 2                     | 20 (8.26%)               |
| 3                     | 5 (2.07%)                |
| 4                     | 3 (1.24%)                |
| Total                 | 242 (100%)               |

Routes of antimicrobial administration were mostly oral 268 (95.37%) followed by injectable 13 (4.63%). The most common antimicrobial prescribed in injectable was streptomycin (8), followed by benzathine benzylpenicillin (4) and Cefoperazone+ Sulbactam (1).

The most commonly prescribed classes of antimicrobial in this study were antibacterials for systemic use (J01) (74.02%) followed by antimycobacterials (J04) (13.88%), antiparasitic drugs (P) (8.19%), antimycotics for systemic use (J02) (2.49%) and antivirals for systemic use (J05) (1.42%) (Table 3).

Table 3: Percentage of different class of antimicrobials as per ATC classification.

| Class of antimicrobials | ATC code | Number (%) | No. of FDCs (%) |
|-------------------------|----------|------------|-----------------|
| Antibacterials          | J01      | 208 (74.02%) | 54 (19.22%)    |
| Antimycotics            | J02      | 7 (2.49%)   | 0 (0%)         |
| Antimycobacterials      | J04      | 39 (13.88%) | 26 (9.25%)     |
| Antivirals              | J05      | 4 (1.42%)   | 0 (0%)         |
| Antiprotozoals          | P01      | 10 (3.56%)  | 6 (2.13%)      |
| Anthelmintics           | P02      | 13 (4.63%)  | 5 (1.78%)      |
| Total                   |          | 281 (100%)  | 91 (32.38%)    |

Table 4: Percentage of different class of antimicrobials.

| Class of Antimicrobial | Name of the Antimicrobial | ATC Code | Number (%) |
|-----------------------|---------------------------|----------|------------|
| Tetracyclines (J01A)  | Tetracycline              | J01AA07  | 1 (0.36%)  |
| Penicillins (J01C)    | Amoxicillin               | J01CA04  | 7 (2.49%)  |
|                       | Ampicillin                | J01CA01  | 1 (0.36%)  |
|                       | Benzathine benzylpenicillin | J01CE08   | 4 (1.42%)  |
| Cephalosporins (J01D) | Cefuroxime                | J01DC02  | 10 (3.56%) |
|                       | Cefixime                  | J01DD08  | 6 (2.13%)  |
|                       | Cefpodoxime               | J01DD13  | 3 (1.07%)  |
| Macrolides (J01FA)    | Erythromycin              | J01FA01  | 7 (2.49%)  |
|                       | Azithromycin              | J01FA10  | 44 (15.66%)|
| Lincosamides (J01FF)  | Clindamycin               | J01FF01  | 5 (1.78%)  |
| Quinolones (J01M)     | Ofloxacin                 | J01MA01  | 28 (9.96%) |
|                       | Ciprofloxacin             | J01MA02  | 7 (2.49%)  |
|                       | Norfloxacin               | J01MA06  | 15 (5.34%) |
|                       | Levofloxacin              | J01MA12  | 3 (1.07%)  |
| Aminoglycosides (J01G)| Streptomycin              | J01GA01  | 8 (2.84%)  |
| Other antimicrobials   | Metronidazole             | J01XD01  | 5 (1.78%)  |
| Antimycotics for systemic use (J02) | Fluconazole | J02AC01  | 7 (2.49%)  |
| Antimycobacterials (J04) | Rifampicin                | J04AB02  | 3 (1.07%)  |
|                       | Isoniazid                 | J04AC01  | 3 (1.07%)  |
|                       | Pyrazinamide              | J04AK01  | 7 (2.49%)  |
| Antivirals for systemic use (J05) | Aciclovir        | J05AB01  | 4 (1.42%)  |
| Antiprotozoals (P01)  | Chloroquine               | P01BA01  | 4 (1.42%)  |
| Anthelmintics (P02)   | Albendazole               | P02CA03  | 6 (2.14%)  |
|                       | Ivermectin                | P02CF01  | 2 (0.71%)  |
| Various antimicrobial FDCs |                       |          | 91 (32.38%)|
| Total                 |                           |          | 281 (100%) |
Among antibacterials, the most commonly prescribed classes of antibacterial was various antibacterial FDCs (19.22%), followed by quinolones (18.86%), macrolides (18.15%), β-lactams (11.03%) cephalosporins (6.76%), penicillins (4.27%), aminoglycosides (2.84%), metronidazole (1.78%), clindamycin (1.78%) and tetracycline (0.36%) (Table 4).

Among the antibacterial FDCs, the most commonly prescribed FDCs were combination of macrolide and cephalosporin (6.05%) followed by fluroquinolone and nitroimidazole (4.63%), penicillin with β-lactamase inhibitor (3.91%), cephalosporin with β-lactamase inhibitor (3.20%), fluroquinolone and macrolide (0.71%), fluroquinolone and cephalosporin and sulfamethoxazole-trimethoprim (0.36%) (Table 5).

Table 5: FDCs of different class of antimicrobials.

| Name of FDCs                                      | Number (%) |
|--------------------------------------------------|------------|
| Amoxicilin+Clavulanate                            | 8 (2.85%)  |
| Amoxicilin+Dicloxacillin                          | 3 (1.07%)  |
| Cefixime+Clavulanate                              | 5 (1.78%)  |
| Cefpodoxime+Clavulanate                           | 3 (1.07%)  |
| Cefoperazone+Sulbactam                            | 1 (0.36%)  |
| Macrolide+Cephalosporins                          | 17 (6.05%) |
| Fluroquinolones+Macrolide                         | 2 (0.71%)  |
| Fluroquinolones+Cephaplosporins                   | 1 (0.36%)  |
| Fluroquinolones+Ornidazole/Tinidazole             | 13 (4.63%) |
| Sulfamethoxazole+Trimethoprim                     | 1 (0.36%)  |
| Isoniazid+Rifampicin                              | 8 (2.85%)  |
| Isoniazid+Rifampicin+Ethambutol                   | 11 (3.91%) |
| Isoniazid+Pyridoxine                              | 7 (2.49%)  |
| Artesunate+Sulfadoxine-Pyrimethamine              | 3 (1.07%)  |
| Artesunate+Lumefantrine                            | 3 (1.07%)  |
| Ivermectin+Albendazole                            | 5 (1.78%)  |
| Total                                             | 91 (32.38%)|

The antimicrobials prescribed from the National Essential Drugs List were 47.68%.

DISCUSSION

Assessment of the antimicrobial prescription is an important issue because of rapidly increasing antimicrobial resistance across the globe, lack of adherence to standard treatment guidelines and increase in health care expenditure.

The average number of drugs per prescription is an important index of prescription audit. Polypharmacy is usually associated with negative consequences such as increased chances of drug interactions, adverse drug events, medication non-adherence and ultimately increased health care cost. In this study, a total of 281 antimicrobials prescribed in 242 prescriptions with an average of 1.16. In a study conducted by Khan et al it was 1.61.14

The average number of antimicrobials per prescription was mostly one (88.43%) followed by two antimicrobials in 8.26% prescriptions. The FDCs constituted 32.38% of total antimicrobials. Two studies from India reported antimicrobial FDCs as 18.88% and 29.18%, respectively.15,16

In the present study, most commonly prescribed antimicrobial class was quinolones followed by macrolides, β-lactams, and aminoglycosides. In the study conducted by Admane et al, most commonly prescribed antimicrobials were β-lactam antibiotics (61.54%) followed by sulphonamides (26.05%) and fluoroquinolones (6.97%).16 Another study by Selvaraj et al, reported β-lactams (35.09%), followed by fluoroquinolones (18.88%) and combinations of antimicrobials from different classes (13.85%) as the most commonly prescribed classes of antimicrobials.13 Lalani et al, reported that the most commonly prescribed antimicrobials were Ciprofloxacin (3.80%), followed by Amoxicillin (3.73%) and Metronidazole (2.30%).17 According to Khan et al, most commonly prescribed antimicrobials were the β-lactams (penicillins and cephalosporins) followed by the quinolones, Nitroimidazoles , aminoglycosides and the macrolides.14

Among different classes of antimicrobial FDCs, the combination of macrolide and cephalosporin was the most frequently prescribed combination followed by combination of fluroquinolone and nitroimidazole and combination of penicillin with β-lactamase inhibitor.

The percentage of antimicrobials prescribed from the National Essential Drugs List was 47.68%, which is lower than the WHO standard value (100%).18 Only 16.48% of FDCs were from the National Essential Drugs List.

CONCLUSION

The present study has reported that most commonly prescribed antimicrobials were quinolones followed by macrolides and β-lactams. The FDCs of antimicrobials was 32.38%. The rational use of antimicrobial agents is one of the important factors to control the antimicrobial resistance, adverse drug events and health care cost. Recommendations to change the on going prescribing practices should be based on the Standard Treatment Guidelines, EDL and Antibiotic policy or by following the information, education, and communication (IEC) interventions.

Limitations of study

This study was conducted only in a single department with a limited period of time and sample size. The
 rationality of antimicrobial prescriptions was not checked in this study.

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REFERENCES

1. WHO. Introduction to drug utilization research/WHO International Working Group for Drug Statistics Methodology, WHO Collaborating Centre for Drug Statistics Methodology, WHO Collaborating Centre for Drug Utilization Research and Clinical Pharmacological Services 2003.
2. Cars O, Mosløad S, Melander. A. Variation in antibiotic use in the European Union. Lancet. 2001;357:1851-3.
3. Wise R, Hart T, Cars O. Antimicrobial resistance. Is a major threat to public health. BMJ. 1998;317:609-10.
4. Gold HS, Moellingar RC. Antimicrobial drug resistance. New England Journal of Medicine. 1996;335:1445-53.
5. Kakkilaya BS. Rational use of antibiotics. Available from: http://www.rationalmedicine.org/antibiotics.htm.
6. Rosdahl VT, Pedersen KB. The Copenhagen Recommendations. Report from the Invitational EU Conference on the Microbial Threat. Copenhagen, Denmark 9-10 September 1998. Available from: http://soaping.icecube.snowfall.se/strama/Kopenhagenmstromet_1998.pdf.
7. Howell L. Global Risks: An Initiative of the Risk Response Network. Geneva, World Economic Forum, 2013.
8. Kaplan W, Laing R. Priority Medicines for Europe and the World 2004. Available from: http://apps.who.int/iris/bitstream/10665/68769/1/WHO_EDM_PAR_2004.7.pdf.
9. Cizman M. The use and resistance to antibiotics in the community. Int J Microb Agents. 2003;21:297-307.
10. Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, et al. Global antibiotic consumption 2000 to 2010: an analysis of national pharmaceutical sales data. Lancet Infect Dis. 2014 Aug;14(8):742-50.
11. Finch RG. Antibiotic resistance: a view from the prescriber. Nat Rev Micro. 2004;2(12):989-94.
12. Soumerai SB. Factors influencing prescribing. Aust J Hosp Pharm. 1988;18:9-16.
13. Krishnaswamy K, Dinesh Kumar B, Radhaiah G. A drug survey precepts and practices. Eur J clinpharmacol. 1985;29:363-70.
14. Khan FA, Singh VK, Sharma S, Singh P. Prospective Study on the Antimicrobial Usage in the Medicine Department of a Tertiary Care Teaching Hospital. JCDR. 2013;7(7):1343-46.
15. Selvaraj R. Prospective assessment of antimicrobial prescribing pattern at a tertiary care hospital. Al Ameen J Med Sci. 2015;8(4):276-80.
16. Admane PD, Hiware SK, Mahatme MS, Dudhgaonkar SD, Deshmukh SN, Mahajan MM. Prescription pattern of antimicrobials in tertiary care hospital in central India. Int J of Pharmacol Research. 2015;5(2).
17. Lalan BK, Hiray RS, Ghongane BB. Drug prescription pattern of outpatients in a tertiary care teaching hospital in Maharashtra. Int J Pharm Bio Sci. 2012 July;3(3):225-9.
18. Isah AO, Ross-Degnan D, Quick J, Laing R, Mabadeje AFB. The development of standard values for the WHO drug use prescribing indicators. ICIUM/EDM/WHO. http://archives.who.int/prudc2004/rdudc/ICIUM_Posters/1a2_txt.htm.

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