Short Communication

Access this article online

Quick Response Code:

Website: www.jacmjournal.org

DOI: 10.4103/jacm.jacm_26_17

Assessment of the cautionary antimicrobial consumption pattern using defined daily dose as a part of the antimicrobial Stewardship programme

Sharmin Sarosh Bala, Vinay G Pawar, Shashikala Shivaprakash

Abstract:

INTRODUCTION: Antimicrobial resistance is rapidly invading the hospital settings worldwide, threatening the ability to treat common infectious diseases. Antimicrobial Stewardship has been adopted by many institutions to enhance clinical outcomes, while diminishing the unintended consequences of antibiotics including antimicrobial resistance.

METHODOLOGY: In the first phase of the Antimicrobial Stewardship Programme (ASP) conducted at a tertiary 345-bedded hospital in South Mumbai, a list of "Reserve" (cautionary) antimicrobials was prepared and circulated, followed by assessment of the utilisation pattern of the antimicrobials, awareness and training of the hospital staff, and drug utilisation review.

RESULTS: Most of the cautionary antibiotics were prescribed in the geriatric population. There was a statistically significant reduction in the consumption of glycopeptides post-intervention (mean reduced by 12.58, confidence interval – 24.6, –0.47, $P < 0.05$).

CONCLUSION: This study is the first step toward the global action plan on antimicrobial resistance adopted by the World Health Assembly.

Keywords:

Antimicrobial Stewardship, cautionary antimicrobials, defined daily dose

Introduction

The rapid spread of antimicrobial resistance (AMR) globally is of great concern, which threatens our ability to treat common infectious diseases. AMR increases the cost of health care, accompanied with prolonged hospitals stays and may terminate with the requirement for intensive patient care. This occurs, especially due to the lack of antimicrobial policies and appropriate infection control programmes in most part of the world. Irrational use of reserve/cautionary antimicrobials (CAs) has led to the horizontal spread of antimicrobial resistant genes within a broad range of microorganisms, and the vertical spread in subsequent generations.[1] The universal burden of antimicrobial resistance is placing the gains of the millennium development goals at risk and endangers the achievement of the sustainable development goals.

India was the world's largest consumer of antimicrobials for human health in 2010. In developing countries, inexpensive antimicrobials, poor public health systems, hospital infections and higher rates of

Antimicrobial Stewardship, Sir H. N. Reliance Foundation Hospital, Mumbai, Maharashtra, India

Address for correspondence:
Dr. Sharmin Sarosh Bala, Sir H. N. Reliance Foundation Hospital, Mumbai, Maharashtra, India.
E-mail: sharminbala@gmail.com

How to cite this article: Bala SS, Pawar VG, Shivaprakash S. Assessment of the cautionary antimicrobial consumption pattern using defined daily dose as a part of the antimicrobial Stewardship programme. J Acad Clin Microbiol 2018;20:52-6.

infectious diseases have led to the tremendously higher use of inappropriate antimicrobials and greater levels of resistance compared to developed countries.[2]

The World Health Organisation (WHO) recommends the anatomical therapeutic chemical classification system and the defined daily dose (DDD) as a unit of measurement for use in drug consumption studies.[3] The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults. Prescription records presented in DDDs per 1000 inhabitants per day provide a rough estimate of the fraction of the study population treated daily with a particular drug or class of drugs.[4]

Antimicrobial Stewardship ensures that the patient only receives an antimicrobial when needed; and the right drug, dose and duration is prescribed. It consists of systematic measurements and coordinated interventions designed to promote the optimal use of antimicrobial agents, including their choice, dosing, route and duration of administration. The primary aim of antimicrobial Stewardship is to enhance clinical outcomes while diminishing the unintended consequences of the antimicrobial agents. Additional benefits include improving susceptibility rates to targeted antimicrobials and optimising resource utilisation.[5,6]

Aim

The aim of this study is to assess the utilisation rate of the CAs in a tertiary care hospital following the implementation of the antimicrobial Stewardship programme (ASP).

Methodology

The study was conducted by the ethical standards of the responsible committee on human experimentation of the institution.

Study design

A prospective interventional study was conducted at a 345-bedded tertiary care hospital in South Mumbai. The experiment was conducted in two phases as follows: pre-interventional and post-interventional phase. The ASP is an ongoing programme in the hospital, started in 2015. As a part of the ASP, this study was conducted from January to December 2016 to evaluate the prescription of CAs, while educating the health staff on prescribing during the course. As a protocol of the ASP, certain interventional measures such as education, audits and feedbacks on the rational antimicrobial use were conducted to reduce the consumption of CA (prolonged duration and multiple antimicrobials). In the beginning of the study, a list of CA was prepared and circulated to all the health-care providers in the hospital, which included Carbapenems (Meropenem, Doripenem, Imipenem and Ertapenem), Glycopeptides (Vancomycin and Teicoplanin), Echinocandins (Anidulafungin and Fosfomycin) and Other Class (Linezolid, Colistin, Tigecycline and Polymyxin-B).

A caution alert pop-up message was generated in the SAP system (Systems, Applications and Products), which cautioned every prescriber each time the CA was prescribed. The utilisation pattern of these CA was then studied by retrieving the "prescription trend reports" through the hospital database– SAP. The retrieved data were comprehensively collated, analysed and calculated utilising the DDD system of the WHO; expressed as a number of DDDs per 1000 patient-days. The DDD/1000 patient-days were calculated for each CA. Analysis of the utilisation pattern of the CAs was an ongoing process throughout the study period. The steps involved in the implementation of the ASP are illustrated below.

Implementation steps followed in the hospital antimicrobial stewardship programme

- Step 1
  Preparation of the list of cautionary antimicrobials: this list consists of 14 CAs which were intended to be prescribed and administered cautiously
- Step 2
  Circulation of the list of cautionary antimicrobials: the list was made readily accessible through local-area network to all the health-care providers. A caution alert pop-up was enabled through the hospital IT system for all doctors
- Step 3
  Assessment of utilisation pattern: utilisation pattern of the CAs was assessed by retrieving the data on monthly basis through the hospital database– SAP system through the "prescription trend report"
- Step 4
  Awareness and trainings: education, audits and feedbacks on the rational antimicrobial use
- Step 5
  Drug utilisation review: on-going utilisation audits of the CAs were assessed.

Statistical analysis

The "*t*" parametric test was performed on the pre-intervention and post-intervention data of average DDD/1000 patient days using R Studio Version 1.0.143 (Boston, M.A, U.S.A).

Results

The utilisation pattern of the CA was studied from January 2016 to December 2016. A total of 477 patients were identified to have received 1790 CA. The

age group that received maximum number of CA was > 60 years (n = 243 [50.94%]) followed by 40–60 years (n = 133 [27.88%]), <20 years (n = 53 [11.11%]) and 20–40 years (n = 48 [10.06%]) [Figure 1]. The most commonly prescribed CAs were Meropenem (n = 759 [42.40%]), Colistin (n = 239 [13.35%]) and Teicoplanin (n = 235 [13.13%]), whereas the least commonly prescribed CAs were Doripenem (n = 2 [0.11%]), Micafungin (n = 11 [0.61%]) and Imipenem-Cilastatin (n = 15 [0.84%]). Fosfomycin and Polymyxin-B were not prescribed throughout the study period.

Tables 1 and 2 illustrate the utilisation pattern of the individual CA in the study period.

The statistically significant reduction in the consumption pattern was observed for glycopeptides (mean reduced by 12.58 post-intervention, confidence interval − 24.6 to − 0.47 and P < 0.05). There was no statistically significant change (P > 0.05) in the consumption of Carbapenems, Echinocandins or other class of drugs post-intervention [Figures 2 and 3].

Discussion

Evaluation of ASPs is based on their performance on antimicrobial consumption, as well as on clinical and microbiological outcomes and cost-effectiveness. In 2017, the Joint Commission has declared that all hospitals and nursing care centres should conduct ASPs.[7] The "National Programme on the Containment

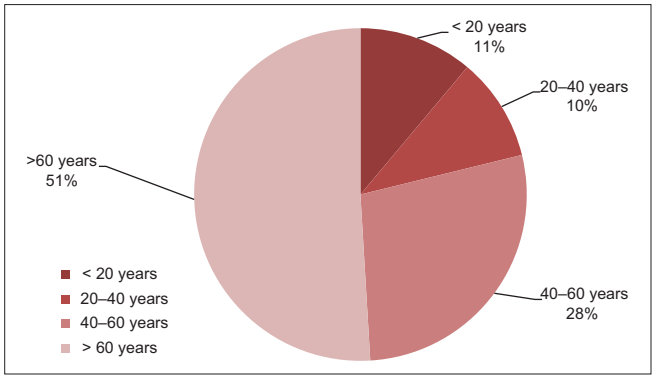

Figure 1: Graphical representation of patients who received cautionary antimicrobials (age groups)

Table 1: Pre- and post-intervention usage of the cautionary antimicrobials

CAs	Difference in mean pre- and post-intervention	*P*	CI
Carbapenems	−0.12	>0.05	−8.77-8.57
Glycopeptides	−12.58	<0.05	−24.6-−0.47
Echinocandins	0.77	>0.05	−13.1-14.7
Other class of CA	−6.38	>0.05	−17.9-5.1

CI: Confidence interval; CAs: Cautionary antimicrobials

Table 2: Detailed month wise pre- and post-intervention usage of the cautionary antimicrobials

CAs	Average DDD/1000 patient-days												
	Preintervention (January 2016 to June 2016)							Postintervention (July 2016 to December 2016)						
	January	February	March	April	May	June	Total	July	August	September	October	November	December	Total
Echinocandins														
Anidulafungin	0	0	52.7	0	0	49.66	102.36	0	26.78	18.35	35.89	30.54	24.36	135.92
Caspofungin	40.82	60.72	0	34.82	27.66	0	164.03	5.79	40.26	0	0	0	0	46.04
Micafungin	0	0	0	0	0	0	0	0	0	73.42	17.13	7.63	0	98.18
Carbapenems														
Meropenem	29.3	60.3	48.39	32.38	27.02	34.19	231.58	10.70	30.24	37.67	24.5	26.54	33.84	163.5
Doripenem	0	0	0	0	0	0	0	0	0	0	9.79	0	0	9.79
Imipenem	0	0	0	0	0	0	0	0	4.57	0	1.22	0	0	5.79
Ertapenem	0	0	0	0	4.82	15.05	19.87	2.75	8.66	13	13.05	20.36	12.18	70
Glycopeptides														
Teicoplanin	53.82	59.04	68.59	35.29	36.78	37.25	290.77	11.36	40.9	31.46	46.9	36.27	46.1	213
Vancomycin	33.49	37.42	21.96	26.47	16.35	26.6	162.29	6.2	13.04	25.62	11.62	12.54	20.09	89.12
Other class														
Linezolid	28.02	10.07	11.29	14.12	8.04	16.93	88.47	4.3	7.3	11.18	15.85	10.46	6.09	55.19
Colistin	53.66	50.6	56.21	33.29	41.01	53.17	287.94	15.65	38.6	58.5	28.01	42.88	56.38	240.02
Tigecycline	47.84	30.36	0	49.41	28.94	35.55	192.11	6.71	19.48	41.81	29.37	24.43	36.53	158.33

DDD: Defined daily dose; CAs: Cautionary antimicrobials

of Antimicrobial Resistance" was inaugurated under the guidance of the National Centre for Disease Control (NCDC) under the 12th five years plan (2012–2017). The overarching aim of the National Action Plan on Antimicrobial Resistance (NAPAMR) is to efficiently combat antimicrobial resistance in India, and contribute to the global attempts to reduce this public health threat. The scope of the NAPAMR emphases primarily on resistance in bacteria.[8] Regulatory authorities and accreditation agencies in India (National Accreditation Board of Hospitals and the International Organisation for Standardisation) mandate on a functioning Infection Control Team, and ensure stringent implementation of hospital antibiotic and infection control policies during the licensing and accreditation process of each health institution.[9]

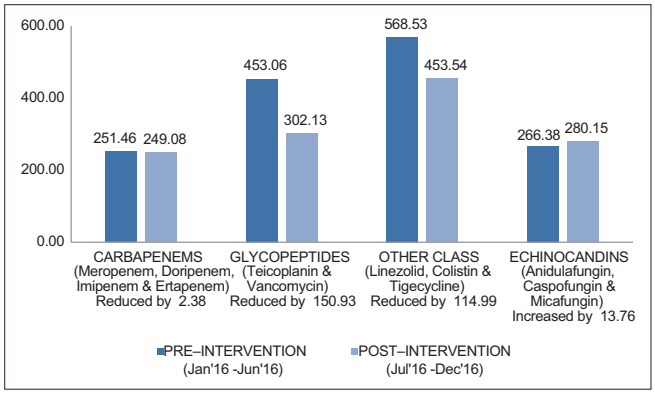

Figure 2: Graphical representation of the pre- and post-intervention usage of the cautionary antimicrobials (expressed in average defined daily dose/1000 patient-days)

In the current study, elderly patients constituted nearly half of the population that received CAs. Almost half of the patients under the study were prescribed Meropenem, followed by Colistin and Teicoplanin. It was observed that post-implementation of the ASP programme, there was a significant reduction in the use of Glycopeptides (similar to the findings of a recent meta-analysis[10]). Although the implementation of the ASP resulted in a small reduction in the CA usage, inappropriate use may persist for many drugs, despite the cautionary status. This emphasises the need for combined interventions utilising education and expert counselling, targeted to Echinocandins, Carbapenems and other class of CAs. The challenge ahead is to streamline their utilisation through continued education and effective communication among all health-care professionals. Given the decrease in new antimicrobial agents and the imminent emergence of resistance shortly after the introduction of new agents, the CDC and the WHO have advocated the universal implementation of ASPs in hospitals as a promising strategy to preserve antimicrobial benefit.[10] The Indian Council of Medical Research (ICMR) has initiated the Antimicrobial Stewardship and Prevention of the Infection and Control Programme in 2013. Treatment guiding principles for the prescription of antimicrobials have been made available by the NCDC and the ICMR.[9] These guidelines can help individual health-care facilities develop antibiotic policies based on local resistance profiles. The objective is to build capacity and enable collaborative action to improve

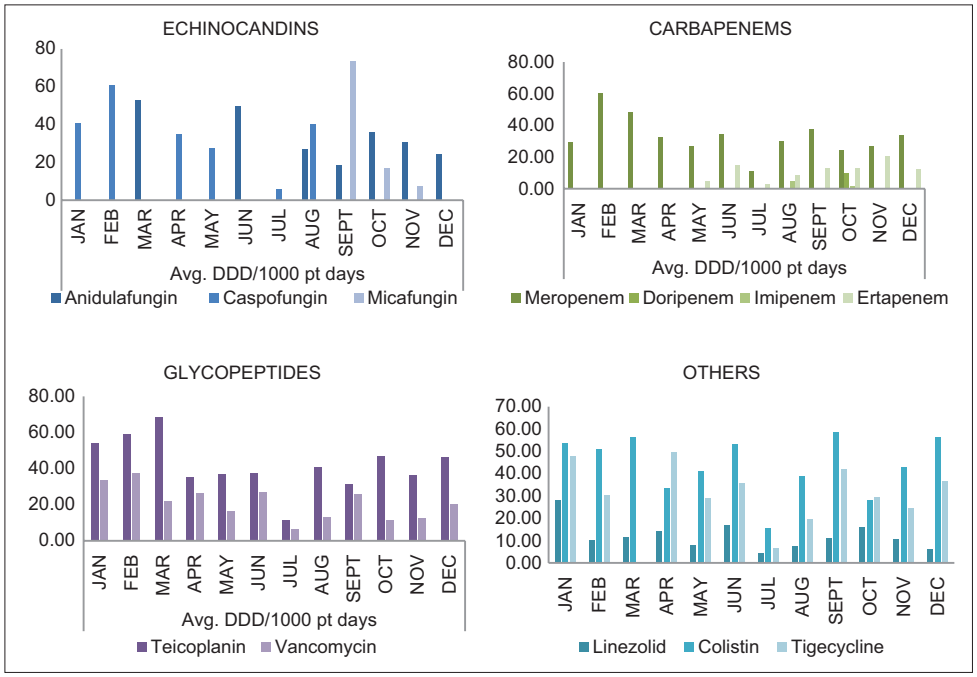

Figure 3: Graphical representation of category-wise cautionary antimicrobials usage (expressed in average defined daily dose/1000 patient-days)

antibiotic stewardship and reduce healthcare-associated infections through feasible infection control practices.

Limitation of the study

The cost-effectiveness, length of hospital stay, individual microbial infections treated have not been included, which is likely to be covered in the next phase of the study.

Conclusion

This study is the first step towards antimicrobial resistance containment within our hospital as suggested by the World Health Assembly. An evident reduction in the utilisation pattern of one of the classes of CAs was observed following the ASP implementation. The irrational use of CAs has to be considered meticulously.

Acknowledgements
We are grateful to the IT department of Sir H. N. Reliance Foundation Hospital to assist with the SAP system.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

References

1. Alanis AJ. Resistance to antibiotics: Are we in the post-antibiotic era? Arch Med Res 2005;36:697-705.
2. Laxminarayan R, Chaudhury RR. Antibiotic resistance in India: Drivers and opportunities for action. PLoS Med 2016;13:e1001974.
3. WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC Classification and DDD Assignment 2013. Oslo: WHO Collaborating Centre for Drug Statistics Methodology; 2012.
4. Sjoqvist F, Birkett D. Drug utilization. Introduction to Drug Utilization Research. (WHO Booklet). New York: WHO Office of Publications; 2003. p. 76-84.
5. Dellit TH, Owens RC, McGowan JE Jr., Gerding DN, Weinstein RA, Burke JP, *et al*. Infectious diseases society of America and the society for healthcare epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. Clin Infect Dis 2007;44:159-77.
6. Barlam TF, Cosgrove SE, Abbo LM, MacDougall C, Schuetz AN, Septimus EJ, *et al*. Implementing an antibiotic stewardship program: Guidelines by the infectious diseases society of America and the society for healthcare epidemiology of America. Clin Infect Dis 2016;62:e51-77.
7. Spellberg B, Bartlett JG, Gilbert DN. How to pitch an antibiotic stewardship program to the hospital C-suite. Open Forum Infect Dis 2016;3:210.
8. National Action Plan on Antimicrobial Resistance. Government of India 2017. Available from: http://www.cseindia.org/userfiles/inap_amr_20170420.pdf. [Last accessed on 2018 Feb 09].
9. Treatment Guidelines for Antimicrobial Use in Common Syndromes. Indian Council of Medical Research. New Delhi, India: Department of Health Research; 2017. Available from: http://www.icmr.nic.in/guidelines/treatment%20guidelines%20for%20antimicrobial.pdf. [Last accessed on 2018 Feb 09].
10. Karanika S, Paudel S, Grigoras C, Kalbasi A, Mylonakis E. Systematic review and meta-analysis of clinical and economic outcomes from the imp lementation of hospital-based antimicrobial stewardship programs. Antimicrob Agents Chemother 2016;60:4840-52.