

ORIGINAL RESEARCH

THE EFFECTIVENESS OF ANTIMICROBIAL STEWARDSHIP PROGRAMS IN REDUCING SURGICAL SITE INFECTIONS: A HOSPITAL BASED PROSPECTIVE STUDY IN ASSAM MEDICAL COLLEGE

**Dr Basobjyoti Hazarika¹, Dr Prapti Bora², Dr Partha Pratim Das³, Dr Arunjyoti Sarmah^{4*},
Dr Reema Nath⁵, Dr Sarbeswar Bhuyan⁶**

¹Assistant Professor of Surgery, Nalbari Medical College, Nalbari Assam, India.

²Assistant Professor of Microbiology, Assam Medical College, Dibrugarh Assam, India.

³Assistant Professor of Microbiology, Lakhimpur Medical College, Lakhimpur Assam, India.

^{4*}Assistant Professor of Microbiology, Nalbari Medical College, Nalbari Assam, India

⁵Professor of Microbiology, Assam Medical College, Dibrugarh Assam, India.

⁶Professor of Surgery, Assam Medical college, Dibrugarh Assam, India.

Corresponding Author: Dr. Arunjyoti Sarmah, Assistant professor of Microbiology, Nalbari Medical College, Nalbari Assam, India.
Email ID: drarun198630@gmail.com

ABSTRACT

Background: To assess the effectiveness of antimicrobial stewardship programs (ASP) in reducing surgical site infections.

Methods: ASP programme was started on pilot mode in 293 bedded General Surgery ward of Assam Medical College & Hospital. Five key performance indicators were monitored: (1) intravenous (IV)-to-oral switch rate, (2) consumption of restricted IV antimicrobials (raw consumption and defined daily doses (DDD) index), (3) cost of restricted IV antimicrobials, (4) antimicrobial sensitivity profiles, and (5) MDR rate among hospital-acquired infections (MDR-HAI).

Results: Intravenous (IV)-to-oral switch rate in year 2018, 2019 and 2020 for amoxicillin-clavulanate decreased from 100% to 94% and 75% respectively. For trimethoprim-sulfamethoxazole decreased from 100% to 85% and 80%, for levofloxacin increased from 85% to 90% and 95% and for ciprofloxacin increased slightly from 12% to 15% and 24% respectively. The difference was significant ($P < 0.05$). The consumption of restricted IV antimicrobials in year 2018 was 905.2 per 1000 patient day, in year 2019 was 850.4 per 1000 patient day which further decreased to 580.6 per 1000 patient day in year 2020. The difference was significant ($P < 0.05$). The cost of restricted IV antimicrobials was decreased with the advent of the corresponding generic drugs. There was significant difference in standardized costs and theoretical cost savings in year 2018, 2019 and 2020 respectively ($P < 0.05$). There were non-significant overall sensitivity indices for the majority of the assessed microorganisms such as E. coli, MRSA/MSSA, K. pneumonia, Acinetobacter, Pseudomonas aeruginosa, Enterococcus spp. ($P > 0.05$). The raw number of MDR isolates ICU and LTC in 2018 was 6.4 and 5.3, in year 2019 was 5.2 and 3.2 and in year 2020 was 3.6 and 2.8 respectively. The difference was significant ($P < 0.05$).

Conclusion: Antimicrobial prescribing practices were significantly enhanced by the installation of a multidisciplinary ASP, both in terms of numbers and quality. To increase the strategy's

effectiveness, the authors highly advise ASP implementation with a special emphasis on physicians' involvement and education.

Keywords: Antimicrobial, stewardship programs, sensitivity

INTRODUCTION

One of the main problems facing contemporary healthcare systems is antimicrobial resistance (AMR), which increases the financial burden on society and causes significant morbidity and mortality. Scientists and public health officials pay close attention to it because of its link to antibiotic misuse and overuse as a primary causal factor. There is substantial evidence that the emergence and spread of antimicrobial resistance (AMR) and multidrug-resistant (MDR) organisms are strongly correlated with the amount and pattern of antibiotic use and prescribing.¹

Because hospital-acquired illnesses (HAIs) are so common, long-term care (LTC) facilities use a lot of antibiotics. This raises the possibility of developing AMR, further jeopardizing the fragile LTC population's health and prognosis.² Furthermore, in other healthcare settings, LTC has been shown to act as a reservoir for resistant infections. Apart from the frequent absence of prescribing guidelines, another factor contributing to AMR that is frequently documented in long-term care facilities is insufficient antibiotic prescribing practice, which arises from a number of misconceptions among practitioners and healthcare providers. This highlights how important it is to address AMR in long-term care by enhancing the practice of giving antibiotics.³

Given that antimicrobials are becoming less effective and that multidrug-resistant organisms (MDROs) are becoming more prevalent, it is critical to emphasize the need for regulation and promotion of the responsible use of antimicrobials.⁴ In each institution, an infectious disease physician led the Antimicrobial Stewardship Program, while a pharmacist served as the second leader. The group is in charge of making sure that antimicrobials are managed to stop the emergence of multidrug resistance without impairing patients' ability to recover.⁵ We performed this study to assess the effectiveness of antimicrobial stewardship programs (ASP) in reducing surgical site infections.

MATERIALS & METHOD

After considering the utility of the study and obtaining approval from the ethical review committee, ASP programme was started on pilot mode in 293 bedded General Surgery ward of Assam Medical College & Hospital (AMCH). The ASP team comprised of a clinical pharmacist, two clinical microbiologists and an infection control nurse. Five key performance indicators were monitored: (1) intravenous (IV)-to-oral switch rate, (2) consumption of restricted IV antimicrobials (raw consumption and defined daily doses (DDD) index), (3) cost of restricted IV antimicrobials, (4) antimicrobial sensitivity profiles, and (5) MDR rate among hospital-acquired infections (MDR-HAI). The results were compiled and subjected to statistical analysis using the Mann-Whitney U test. P value less than 0.05 was regarded as significant.

RESULTS

Table I Intravenous (IV)-to-oral switch rate

Antibiotics	2018	2019	2020	P value
amoxicillin-clavulanate	100%	94%	75%	0.05
trimethoprim-sulfamethoxazole	100%	85%	80%	
levofloxacin	85%	90%	95%	

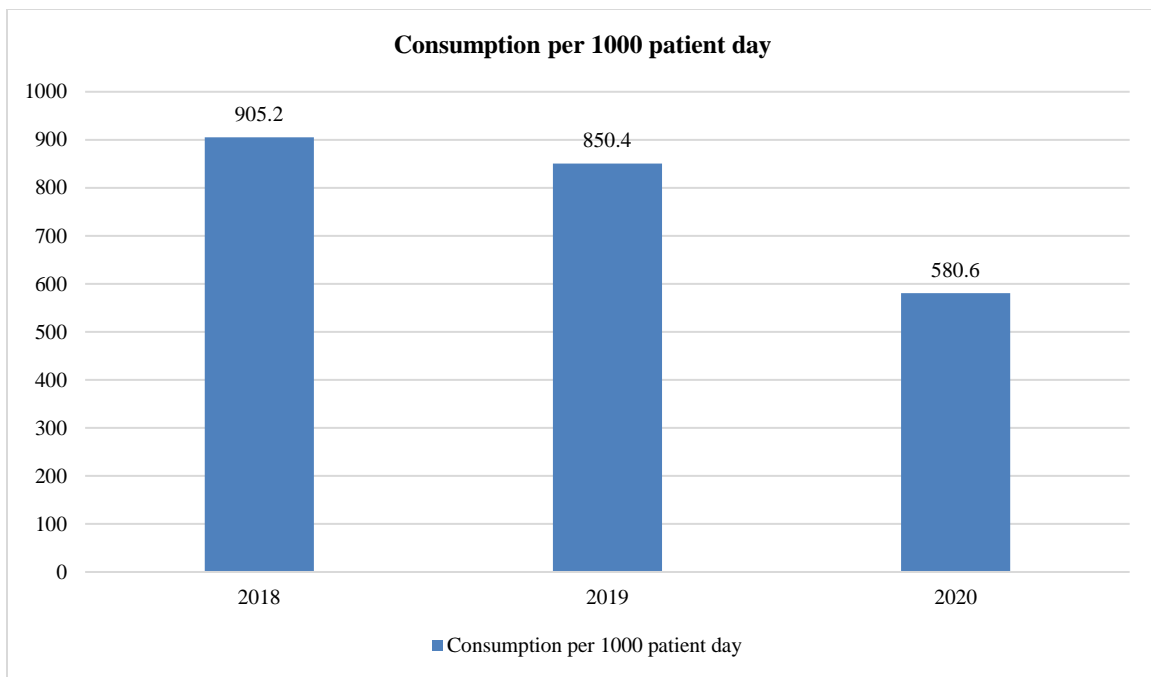
ciprofloxacin	12%	15%	24%	
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Intravenous (IV)-to-oral switch rate in year 2018, 2019 and 2020 for amoxicillin-clavulanate decreased from 100% to 94% and 75% respectively. For trimethoprim-sulfamethoxazole decreased from 100% to 85% and 80%, for levofloxacin increased from 85% to 90% and 95% and for ciprofloxacin increased slightly from 12% to 15% and 24% respectively. The difference was significant ($P < 0.05$) (Table I)

Table II Consumption of restricted IV antimicrobials (per 1000 patient day)

Year	Consumption per 1000 patient day	P value
2018	905.2	0.01
2019	850.4	
2020	580.6	

The consumption of restricted IV antimicrobials namely Colistin, Polymixin B, Tigecycline and Carbapenems in year 2018 was 905.2 per 1000 patient day, in year 2019 was 850.4 per 1000 patient day which further decreased to 580.6 per 1000 patient day in year 2020. The difference was significant ($P < 0.05$) (Table II, Graph I).



Graph I Consumption of restricted IV antimicrobials (per 1000 patient day)

Table III Cost of restricted IV antimicrobials

Antibiotics	2018	2019	2020	P value
standardized costs	1.46	1.42	1.40	0.05
theoretical cost savings	1.32	1.28	1.24	0.01

The cost of restricted IV antimicrobials was decreased with the advent of the corresponding generic drugs. There was significant difference in standardized costs and theoretical cost savings in year 2018, 2019 and 2020 respectively ($P < 0.05$) (Table III).

Table IV Effect on antimicrobial sensitivity

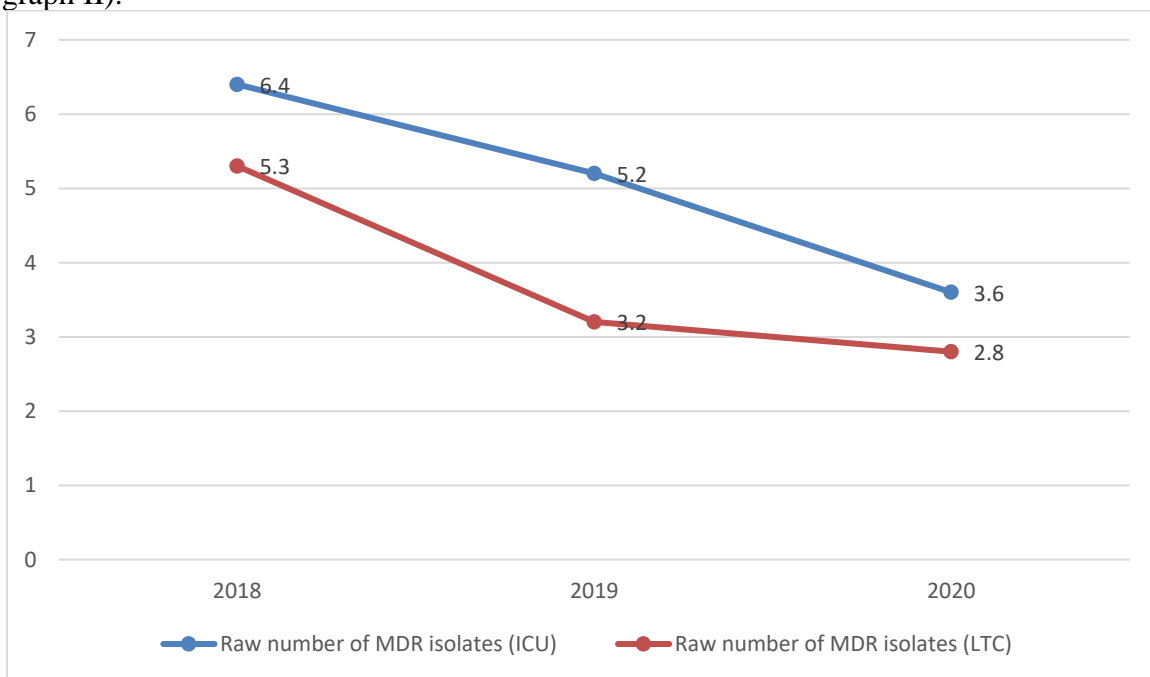
Antibiotics	2018	2019	2020	P value
E. coli	45.2	43.8	44.6	0.54
MRSA/MSSA	68.4	69.4	68.7	0.71
K. pneumonia	35.7	36.2	36.4	0.92
Acinetobacter spp.	18.4	19.2	18.6	0.84
Pseudomonas aeruginosa	68.2	65.4	64.8	0.96
Enterococcus spp.	70.2	69.4	68.2	0.25

There were non- significant overall sensitivity indices for the majority of the assessed microorganisms such as E. coli, MRSA/MSSA, K. pneumonia, Acinetobacter, Pseudomonas aeruginosa, Enterococcus spp. ($P > 0.05$) (Table IV).

Table V Effect on multidrug resistance: hospital- acquired infections (MDR-HAI)

Year	Raw number of MDR isolates (ICU)	Raw number of MDR isolates (LTC)	P value
2018	6.4	5.3	0.05
2019	5.2	3.2	
2020	3.6	2.8	

The raw number of MDR isolates ICU and LTC in 2018 was 6.4 and 5.3, in year 2019 was 5.2 and 3.2 and in year 2020 was 3.6 and 2.8 respectively. The difference was significant ($P < 0.05$) (Table V, graph II).



Graph II Effect on multidrug resistance: hospital- acquired infections (MDR-HAI)

DISCUSSION

Antimicrobial stewardship programs (ASPs) aim to optimize the use of antimicrobial agents to improve patient outcomes, minimize the development of antimicrobial resistance, and reduce healthcare costs.⁶ Inappropriate antibiotic use contributes to the development and spread of antimicrobial resistance among bacteria. By promoting appropriate antibiotic prescribing practices, ASPs in LTC facilities can help mitigate the emergence and spread of antibiotic-resistant pathogens.⁷ Several studies have demonstrated a correlation between ASP implementation and reductions in rates of antibiotic-resistant infections in LTC settings.^{8,9} Optimizing antibiotic use through ASPs can lead to improved clinical outcomes for residents in LTC facilities, including reduced rates of antibiotic-associated adverse events, fewer *Clostridium difficile* infections, and lower mortality rates.¹⁰ By ensuring that residents receive the right antibiotic for the right indication and duration, ASPs can help enhance the quality of care and minimize the risks associated with antibiotic overuse or misuse.¹¹ We performed this study to assess the effectiveness of antimicrobial stewardship programs (ASP) in reducing surgical site infections.

In our study intravenous IV-to-oral switch rate in year 2018, 2019 and 2020 for amoxicillin-clavulanate decreased from 100% to 94% and 75% respectively. For trimethoprim-sulfamethoxazole decreased from 100% to 85% and 80%, for levofloxacin increased from 85% to 90% and 95% and for ciprofloxacin increased slightly from 12% to 15% and 24% respectively. Alawi et al¹² by examining changes in antimicrobial usage and costs as well as multidrug resistance (MDR) rates over a five-year period, the efficacy of the antimicrobial stewardship program (ASP) in a long-term care (LTC) facility was determined. There was an approximate 5.5-fold increase in the IV-to-oral switch and a 40% decrease in the total amount of restricted IV antimicrobials consumed. In terms of price, it was calculated that there would be a cumulative cost savings of 5.64 million SAR (US\$1.50 million). Antimicrobial sensitivity profiles did not significantly change microbiologically, but there was a notable drop in the MDR-HAI rate, which decreased significantly in the ICU from 3.22 per 1000 patient days in 2015 to 1.14 per 1000 patient days in 2020. It's interesting to note that there was a high correlation between the amount of antibiotics consumed and the annual overall MDR rate.

In our study the consumption of restricted IV antimicrobials in year 2018 was 905.2 per 1000 patient day, in year 2019 was 850.4 per 1000 patient day which further decreased to 580.6 per 1000 patient day in year 2020. The classic Finnish study on macrolide-resistant *Streptococcus pyogenes* demonstrated how reducing macrolide use could minimize antimicrobial resistance. Resistance to antibiotics fell from 9.2% in 1997 to 7.4% in 2000.¹³

It was observed that the cost of restricted IV antimicrobials was decreased with the advent of the corresponding generic drugs. There was significant difference in standardized costs and theoretical cost savings in year 2018, 2019 and 2020 respectively ($P < 0.05$). We found that there were non-significant overall sensitivity indices for the majority of the assessed microorganisms such as *E. coli*, MRSA/MSSA, *K. pneumoniae*, *Acinetobacter* spp, *Pseudomonas aeruginosa*, *Enterococcus* spp. ($P > 0.05$). The raw number of MDR isolates ICU and LTC in 2018 was 6.4 and 5.3, in year 2019 was 5.2 and 3.2 and in year 2020 was 3.6 and 2.8 respectively. A different nationwide study conducted in the United Kingdom examined the prescribing practices for antibiotics prior to and during the introduction of the Quality Premium, a lucrative initiative that was introduced in 2015 with the goal of lowering the use of antibiotics in primary care. The program's first year saw a 5.4% decrease in the number of antimicrobial prescriptions, or around 2 million fewer items distributed, and an 18.5% decrease in the dispensing of broad-spectrum antibiotics.¹⁴

CONCLUSION

Antimicrobial prescribing practices were significantly enhanced by the installation of a multidisciplinary ASP, both in terms of numbers and quality. To increase the strategy's effectiveness, the authors highly advise ASP implementation with a special emphasis on physicians' involvement and education.

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