

## Surgical Antibiotic Prophylaxis Practices in Tertiary Care Hospital before and After Implementation of Antimicrobial Stewardship

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### Abstract

**Objective:** To study surgical antibiotic prophylaxis practices in tertiary care hospital before and after implementation of antimicrobial stewardship.

**Material Method:** SAP practices data with respect to selection of antibiotic, timing of administration, dosing of antibiotic, repeat dosing intra operatively and discontinuation of antibiotic after 24 hrs of surgery was collected for 1 year and analyzed. Antibiotic policy was introduced as a part of antimicrobial stewardship program and training given. Same data was collected for consecutive year and analyzed. The difference in practices was observed.

**Results:** There was overall improvement in surgical antibiotic prophylaxis parameters. Selection of antibiotic was compliant in 75.4% cases. Compliance with antibiotic timing increased from 63.2% to 94.2%. Appropriate dosing of antibiotic improved from 86% to 92%. Intra operative antibiotic dose was repeated in all cases exceeding 4 hours of surgery. In only 15 % cases antibiotic was stopped after 24 hours of surgery.

**Conclusion:** Introduction of guidelines, implementation through Training, effective communication, reminders, feedback and continuous monitoring along with coordinated team work with surgeon can help us implement SAP guidelines effectively.

**Keywords:** Surgical antibiotic prophylaxis, Antimicrobial stewardship, Antibiotic policy.

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### Introduction

Antibiotic misuse and overuse is understood to be the leading cause of antimicrobial resistance. Among many misuses like prescribing antibiotics for non-bacterial infections, Surgical antibiotic prophylaxis (SAP) is one such domain where antibiotics are misused. They

contribute to 30 -50% total hospital antibiotic consumption [1]. Surgical antibiotic prophylaxis is one of the long known components of surgical safety checklist. It is the use of antibiotics in the preoperative period to prevent occurrence of surgical site infection in contaminated

and clean contaminated wound class. The antibiotics have to be given before incision in order to achieve maximum concentration in the tissue at the time of incision. Depending on the choice of antibiotic the timing varies from 30 minutes to 2 hours. While SHEA, IDSA, ASHP (USA) recommend providing 24 hours antibiotic cover postoperatively, NICE states use of single IV stat dose. Antimicrobial stewardship (AMS) program aims at reducing the irrational unindicated use of antibiotic and also curtailing the routine practice of continuing antibiotics for 5 to 10 days or till patient discharges in operated cases [2]. We aim to look at the changes in the SAP practices following AMSP interventions in our hospital. [3]

## Material Method

### Study setting

This study was conducted in General surgery, Obstetrics and Gynecology, Orthopedics and Urology departments of a tertiary care hospital. We started collecting data as a part of 1<sup>st</sup> audit from January to December 2021. The source of data collection was SAP prophylaxis register, Antibiotic data sheet, OT register and patient safety checklist. Average number of cases operated under clean and clean contaminated wound class surgery varies from 500 to 600 with Orthopedic, General surgery and Obstetrics and gynecology contributing maximally to the number.

### Study design

This was Cross sectional study conducted for period of 2 consecutive years with in between Antimicrobial stewardship interventions.

### Study populations

All Patients operated in tertiary care hospital as per inclusion criteria were the study population.

## Inclusion criteria

A total of 2281 cases in 1<sup>st</sup> year and 2327 cases in 2<sup>nd</sup> year were a part of this study. We collected sample by convenience sampling. They were based on following inclusion criteria.

- Patients of all age groups
- Elective surgeries
- Clean and clean contaminated wound class surgery
- Orthopedic, General surgery, Obstetrics and gynecology, Urology.

Cases excluded from the study population were those with contaminated and dirty wound class, emergency surgeries, Cardiovascular and thoracic surgery, Neurosurgery and Otorhinolaryngology surgeries.

The data for the 1 year of audit from Jan 2021 to December 2021 was collected and analyzed. Cases with incomplete records or missing documentation were removed before analysis. We introduced Antibiotic policy which was prepared using ICMR guidelines of 2019 and local antibiogram of hospital. This policy was made available as pocket booklet and distributed among all surgeons and post graduate residents for easy access and implementation. Repeated training sessions on antimicrobial stewardship protocols specifically focusing on surgical antimicrobial prophylaxis use was provided to all surgeons. Simultaneous collection of data for the next audit of year 2022 was started to monitor change in the surgical antibiotic prophylaxis practices. A feedback about the surgical prophylaxis practices was also given to the surgeons through monthly hospital infection control meeting and Bulletin. Nursing staff were also provided training for implementation.

Surgical prophylaxis recommendation based on ICMR 2019 guidelines and local antibiogram.(3)

Surgical Wound Classification	Antimicrobial prophylaxis
Class I /Clean:	None or single peri-operative dose of Cefuroxime/Cefazolin
Class II /Clean-Contaminated:	Cefazolin or Ampicillin-sulbactam or Ceftriaxone (doses not to be continued beyond 24 hours)

### Surgical antibiotic prophylaxis guidelines for Obstetrics and gynecology surgeries

- Antibiotic prophylaxis for Elective uncomplicated caesarean sections was single dose of IV Ceftriaxone 2gm, within 60 minutes before incision.
- For complicated cases or high risk cases, IV ceftriaxone 1 gm 12 hrly/Ampiclox 1 gm 12 hrly along with Metronidazole 100 ml IV 8 hrly plus Inj. Amikacin IV 8mg/kg/day 12 hrly for 48 hrs followed by Tablet Cefixime and Tab Metronidazole for 5 days.
- For Gynecological surgeries IV Ceftriaxone 1gm 12 hrly along with Inj. Metronidazole 500 mg IV 8 hrly and Inj. Amikacin 8mg/kg/day 12 hrly

followed by Tab. Cefixime and Tab Metronidazole for 5 days..

Categorization of surgeries (Clean or clean contaminated, uncomplicated or complicated) was done after consultation with operating surgeons. The Data collection was done by trained Infection control nurses under supervision of the principle investigator and data analyzed every month.

### Results

With no guidelines provided by the institute, all surgical departments were found using various types of antibiotic ranging from 3<sup>rd</sup> generation cephalosporins to beta lactam beta-lactamase inhibitors combinations. Commonest antibiotic preferred by all surgical departments were 3<sup>rd</sup> generation cephalosporins for clean cases with aminoglycosides.

**Table 1: Percentage of different antibiotic used for SAP before AMS intervention**

Department 2021	Total number of surgeries	Cefuroxime	Cefazolin	Cefotaxime	Ceftriaxone	Ampiclox	Amoxyclav	Cefoperzone + Sulbactam	Piperacillin taz	Ceftazidime	Gentamicin	Amikacin	Metronidazole
Surgery	652			87%	9%				4%			0.4%	
Orthopedic	740	15%		63%	0.6%						5%	63%	
Obgynac	427				25%	74%						73%	89%
Urology	462			76%	23%								

**Table 2: Percentage of different antibiotic used for SAP after AMS intervention**

Department 2022	Total number of surgeries	Cefuroxime	Cefazolin	Cefotaxime	Ceftriaxone	Ampiclox	Amoxyclav	Cefoperzone + Sulbactam	Piperacillin taz	Ceftazidime	Gentamicin	Amikacin	Metronidazole
Surgery	740	43%	0.6%	36%	17%		0.5%	0.1%	0.2%		0.1%		
Orthopedic	769	95%			0.5%		0.5%	1.5%	0.5%		3%	33%	
Obgynac	536	0.7%		0.8%	38%	51%	0.8%				22%	31%	49%
Urology	282	3.5%		90%	6%								

**Table 3: Different Antibiotic used for SAP before and after AMS Intervention**

Antibiotics	Surgery			Orthopedics			Obgynac			Urology		
	Before	After	P Value	Before	After	P Value	Before	After	P Value	Before	After	P Value
Cefuroxime	—	318	—	111	731	0.00	—	4	—	—	10	—
Cefazolin	—	4	—	—	—	—	—	—	—	—	—	—
Cefotaxime	567	266	0.0	466	—	—	—	4	—	351	254	0.0
Ceftriaxone	59	126	0.0	4	4	1.000	107	204	0.0	106	17	0.0
Ampiclox	—	—	—	—	—	—	316	273	0.076	—	—	—
Amoxyclav	—	4	—	—	4	—	—	4	—	—	—	—
Cefoperazone + Sulbactam	—	1	—	—	12	—	—	—	—	—	—	—
Piperacillin taz	26	1	0.0	—	4	—	—	—	—	—	—	—
Ceftazidime	—	—	—	—	—	—	—	—	—	—	—	—
Gentamicin	—	1	—	37	23	0.071	—	118	—	—	—	—
Amikacin	3	—	—	466	254	0.000	312	166	0.0	—	—	—
Metronidazole	—	—	—	—	—	—	380	263	0.0	—	—	—
Total	652	740	0.018	740	769	0.455	427	536	0.0	462	282	0.0

As shown in Table 1 and 2, General surgery preferred using Cefotaxime for both wound class in 87% of the cases. 63% cases of orthopedic received both Cefotaxime along with Amikacin. Prophylaxis with dual antibiotics was also a common protocol among Obstetrics and gynecology Department. Urology department was consistent with using 3<sup>rd</sup> generation Cephalosporin throughout the year. All urological surgeries belonged to clean contaminated wound class.

After continuous training, awareness programs, we found change in the antibiotic choices made by these departments. Significant improvement was seen with Department of orthopedic where Cefuroxime was predominantly used

(95%). Use of Amikacin along with Cephalosporin was reduced from 63% to 33%. As dual antibiotics were still used by Department of Orthopedics, which was not as per antibiotic policy, the overall compliance could not reach beyond 63%. The Compliance of surgery Department improved to 43% for Cefuroxime. Surgeries managed using 2<sup>nd</sup> generation cephalosporins or any other lower class antibiotic instead of 3<sup>rd</sup> generation cephalosporins were also considered as compliant.

AMS intervention helped in curtailing use of antibiotic in all caesarean section and gynecology surgeries. Use of Metronidazole was 89% which reduced to 49% and use of amino glycosides reduced

from 73% to 51% (Amikacin and Gentamicin). Classifying cases in uncomplicated and complicated cases prevented generalized use of all 3 antibiotics (Ceftriaxone or Ampiclox along with Amikacin and Metronidazole) in all cases. Urology department was consistent with use of 3<sup>rd</sup> generation Cephalosporin throughout the study period.

There was significant improvement in timing of antibiotic administration from 63.2% to 94.2%. Numbers of surgeries exceeding 4 hours were 123 in year 2021

and 102 in year 2022. The repetition of intra operative dose was 100% during both period. Compliance was good with dosing of antibiotic (86%) and improved more after intervention (92%).

A Compliance of Antibiotic selection as per policy increased from 33.6 % to 75.4 % by AMS intervention. We could not achieve much of success in antibiotic discontinuation beyond 24 hrs. Only in 15% cases the antibiotic was stopped after 24 hrs.

**Table 4: comparison between surgical antibiotic prophylaxis practices before and after antimicrobial stewardship intervention**

SAP Practices	Surgery			Orthopedics			Obgynac			Urology		
	Before	After	P Value	Before	After	P Value	Before	After	P Value	Before	After	P Value
Compliant with policy	137	503	0.0	111	477	0.0	107	509	0.0	416	268	0.0
Antibiotic given within specified timing	424	725	0.0	627	754	0.0	214	456	0.0	199	259	0.005
Appropriate dosing	509	644	0.0	614	692	0.031	406	525	0.0	439	282	0.0
Prophylaxis not given beyond 24 hours	0	237	0.0	0	0	—	0	118	0.0	0	0	—
Total	652	740	0.018	740	769	0.455	427	536	0.0	462	282	0.0

**Table 5: comparison between surgical antibiotic prophylaxis practices before and after antimicrobial stewardship intervention**

SAP practices	Before AMS intervention	After AMS intervention	P value
Antibiotic compliant with policy	33.6%	75.4%	0.000
Antibiotic given within specified timing	63.2%	94.2	0.000
Antibiotic repeated intraoperatively	100%	100%	—
Appropriate dosing	86%	92%	0.000
Antibiotic discontinued after 24 hours	0%	15%	0.000

## Discussion

Surgical antibiotic prophylaxis can be called as the low hanging fruit when it comes to antimicrobial stewardship

intervention. These practices can be corrected much easily with targeted training to operating surgeons. This along with team work of surgeons, nursing In

charges, Anesthetist, Infection control nurse and Clinical pharmacist can make implementation possible. Education through frequent lectures, reminders, feedback to surgeons regarding improvements in the practices is the important stepping stones that bring about change in the age old practices. Time and again such team work have been proven useful for implementation program related to SAP compliance [4].

We achieved a significant change in surgical antibiotic prophylaxis practices after antimicrobial stewardship intervention. With no guidelines provided to surgeons, the antibiotic selection was not fixed as per wound class. Dual antibiotics were also given irrespective of the guidelines. Antibiotic administration was not within specified timing and majority of the times exceeded 60 minutes. BMI adjusted doses compliance was better even before AMS intervention in comparison to other aspects of SAP. In order to fix issues with antibiotic selection and timing of administration, a team of OT nursing staff, Infection control Nurse, clinical pharmacist were trained along with the surgeons and provided with Hospital guidelines for implementation. The documentation of type of antibiotic given with dose, time of administration and repeat dosing of antibiotic was ensured by the OT nurse and Infection control nurse. Clinical pharmacist monitored anti biotic usage in the post operative period.

Major reason for preferring Ceftriaxone as drug of choice for prophylaxis was found to be its easy availability in our hospital and cheaper cost. We made Cefuroxime available at the pharmacy at a cheaper price as a part of AMS intervention. This helped us in improving the compliance towards use of 2<sup>nd</sup> generation Cephalosporin. Jordan study as also proved that availability of recommended antibiotic can directly impact the antibiotic selection [5].

63% cases of orthopedic surgeries before intervention and 33% cases after AMS

intervention still received dual antibiotics against the guidelines. Metanalysis study done by Soblogean etal could not prove additional advantage of using dual antibiotic over single antibiotic for surgical prophylaxis of closed fracture [6].

We found a better compliance with antibiotic administration timing (94.2%) and dosing (92%). These findings were in contrast to findings of Mushira et.al where overall low compliance to antibiotic dosing (32%) was seen [7].

Though by all these measures we achieved majority of good practices, there is still scope for improvement. We could not control antibiotic usage beyond 24hours. Except for Obstetrics and gynecology cases where antibiotics were to be continued for 5 to 7 days as per guidelines, the usage of antibiotic for all other surgeries after 24 hours was not justified. These type of hurdle with SAP implementation was also observed by Van Disseldorp et.al and ElburAl et.al [8,9]. Parulekar et.al found only 63% compliance with Antibiotic discontinuation beyond 24 hours [10].

One major reason for low compliance with antibiotic discontinuation is the false perception of surgeon that prolonged antibiotic therapy prevents infection. High quality studies have demonstrated no additional benefit of prolonged antibiotic usage in prevention of SSI. Reluctance in accepting the hospital guidelines, non accountability, lack of awareness about pros and cons of antibiotic usage makes 100 percent implementation rather difficult [11,12].

## Conclusion

Introduction of Hospital antibiotic policy helped the surgeons to narrow their choices of antibiotics usage for clean and clean contaminated surgeries. Timing of antibiotic administration also improved after coordinated team efforts. Dosage of antibiotics improved further with increase in the awareness. Discontinuation of

antibiotic after 24 hours was not satisfactory and needs more attention.

Effective communication with the nurses, Doctors anesthetist and OT nurse helped use achieve maximally in SAP practices. Monthly SAP data presentation in HIC meeting gave the surgeons a better perspective about the antibiotic usage. Continuation of this process of awareness can definitely help us achieve parameters that were deviated from standard guidelines. Further studies that show the impact of SAP on surgical site infections can help us convince surgeons to adhere to guidelines.

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