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Review
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Review

Physician-reported barriers and challenges to antibiotic prescribing in surgical prophylaxis: a structured systematic review

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Abstract

Objectives The purpose of the study is to identify and analyse the barriers in surgical procedures where antibiotic dissipation is habitual.

Methods Extensive literature search is carried out using different electronic databases (PubMed, Europe PMC, PLoS and Google Scholar) between January 2000 and December 2020. The articles were selected purely based on the inclusion criteria. Only qualitative and cross-sectional studies were selected to reduce the risk of bias. The JBI and AXIS checklists were used to assessed the quality of the enrolled articles. Data extractions were done by using a predesigned standardized data collection form.

Key findings A total of 2067 articles were electronically retrieved but only 14 articles met the eligibility criteria. About 15 902 healthcare professionals (HCPs) with an average response rate of 64.7% were pooled for evidence synthesis. The majority of respondents (50%) discussed different barriers in their practice site for surgical antibiotic prophylaxis (SAP) administration. Barriers were categorized into four themes: lack of guideline availability and knowledge, lack of adherence to guidelines, lack of guideline knowledge and adherence and physician perceptions or off-label practices. A total of 723 (56.3%) out of 1282 HCPs from nine different studies reported a lack of adherence to guidelines during the perioperative process. The majority of respondents in three studies, 318 (82%) out of 386 HCPs, reported that physicians' perceptions play a crucial role in prescribing SAP during surgeries.

Conclusion This study concluded that the barriers within the practice site play a decisive role in SAP optimization and therefore all HCPs are recommended to maintain local/standard guidelines and adhere to them while prescribing SAP.

Keywords: barriers; surgical antibiotic prophylaxis; qualitative research; survey; antimicrobial stewardship; surgery; surgeons

Introduction

Surgical site infections (SSIs) are the most common and costly nosocomial infections which can be avoided by administration of antibiotics prior to surgery. Centre for Disease Control (CDC) defined SSI as superficial incisional SSI, the infection that involves only skin and subcutaneous tissue of incision and deep incisional SSI, the infection that involves deep tissues, such as fascial and muscle layers. It includes infection involving both superficial,

deep incision sites and organ/space SSI draining through the incision.[1] Misra *et al*.[2] reported an overall estimation of 20% SSIs and about 60% were preventable with the use of evidence-based literature. Appropriate antibiotic selection, dosage and administration timing can decrease SSIs, as well as antibiotic-associated *Clostridium difficile* infections, diarrhoea and pseudomembranous colitis which in turn improves the overall quality of life.[3] Ensuring utmost compliance and risk reduction strategies reduces financial burden, length of stay, readmissions and overall quality of life.[3]

Surgical antibiotic prophylaxis (SAP) is essential in preventing SSIs. Guidelines developed collaboratively by the American Society of Healthcare Pharmacist, Infectious Diseases Society of America, Surgical Infection Society and Society of Healthcare Epidemiology of America based on clinical evidence and emerging issues with an intention to provide all healthcare practitioners a standardized protocol for safe, effective and rational use of antibiotics in surgery.[4, 5] One study in Brazil reported that out of 56.3% antibiotic prescriptions, 11.7% were for SAP and cefazolin corresponds to 52% of SAP prescriptions.[6] Another study in Australia reported that internationally 12–19% of inpatient antimicrobial prescriptions were for SAP, 40.3% were inappropriate and 45.2% were non-compliance with Australian guidelines.[7]

Many Australian and international studies observed high rates of inappropriate prescription of antibiotics which lead to suboptimal patient care outcomes and the emergence of antibiotic resistance. Antimicrobial stewardship (AMS) was introduced as a clinical strategy for the confinement of antimicrobial resistance (AMR), thus reducing antimicrobial overuse and improving patient outcomes.[8] Stipulated AMS is a key strategy that involves many healthcare professionals (HCPs) in the reduction of inappropriate antimicrobial use by 22–36%. AMS program consists of multidisciplinary activities focussing on proper antibiotic use, including implementing interventions for antibiotic prescription, monitoring of antibiotic usage and resistance patterns, regularly reporting information on antibiotic use and resistance and educating clinicians and medical staff.[9] According to the World Health Organization (WHO), healthcare-associated infections and AMR are escalating at alarming rates in low- and middle-income countries, being 2- to 20 times higher than in high-income countries and need urgent attention where high level of resistance to commonly prescribed antibiotics together with lack of local AMR surveillance systems prevails.[10]

The study aims to assess the cumulative prevalence of reported barriers in prescribing SAP. The secondary objectives are to determine which antibiotics are still currently being prescribed as part of therapy and analyse different regimens of antibiotics used in perioperative procedures and analyse the incidence of SSIs.

Methods

Search strategy

In this study, we carried out an extensive literature search to identify cross-sectional surveys and qualitative studies related to SAP barriers between January 2000 and December 2020. A primary search was focused on published articles in English in different databases including individual journal websites PubMed, Europe PMC, PLoS and Google Scholar. The search terms included a combination of keywords such as barriers OR surgical antibiotic prophylaxis OR qualitative research OR surveys OR antimicrobial stewardship OR antibiotic resistance OR surgery OR surgeons. Additional relevant articles were identified by reviewing the reference list of all included articles. A secondary search was focussed mainly on reference articles, titles and abstracts. Articles that passed through primary screening were critically appraised for inclusion in the study analysis.

Study selection

The study was designed based on the PRISMA guidelines to produce a systematic review. The title and abstract of all articles were screened initially, and the full text of potential studies was retrieved and further reviewed by two reviewers (Shabaz Mohiuddin and Rana Kamran) independently to assess the eligibility.

Inclusion criteria

Articles were eligible for inclusion in the meta-analysis if they met all of the following inclusion criteria: (1) SAP articles discussing barriers, (2) cross-sectional and qualitative studies involving physicians and (3) other surgical prophylaxis studies (e.g. ophthalmology surgeries and dental studies).

Exclusion criteria

Articles were excluded if they were presented with any of the following reasons: (1) non-relevant topics, (2) superficial surgical procedures, (3) literature reviews, (4) bariatric surgery studies and (5) non-invasive surgeries. The exclusion criteria were selected to reduce the statistical biasness in our results.

Data collection

Using a predesigned and standardized data collection form for data extraction. The data from enrolled studies were extracted and collected independently. It includes; study characteristics (primary author, publication year, study design, sample size, research tools, number of study participants (physicians), interventions and comparisons, as well as information on the intended outcome variables. For each outcome, the reviewers extracted the mean (SDs) of the variable or number of patients in each study.

Outcome measures

The primary outcome of the study is to identify the cumulative prevalence of reported barriers in prescribing SAP. Primary variables are categorized into four themes: lack of guideline availability, lack of adherence to guidelines, lack of guideline knowledge and physician perceptions/off-label practices.

The secondary outcomes are to analyse different antibiotic regimens used in perioperative procedures. Secondary variables included type of surgery, antibiotic prescribed, inappropriate time of administration, proper administration time, SSI, % of SSI, % of physicians, redosing of antibiotics, lack of inter-professional collaboration, requirement of AMS intervention, sample size and response rate.

Quality assessment/assessment of the risk of bias

The quality of cross-sectional and qualitative studies was examined by three reviewers (S.M., R.K. and S.W) separately. Risk of bias of each study was assessed using critical appraisal tools. For cross-sectional studies AXIS checklist[11] of 20 questionnaires and for qualitative studies JBI checklist (The Joanna Briggs Institute)[12] of 10 questionnaires were used for quality assessment of studies. Articles included in the study met the requirements of above questionnaires and were defined as high-quality studies.

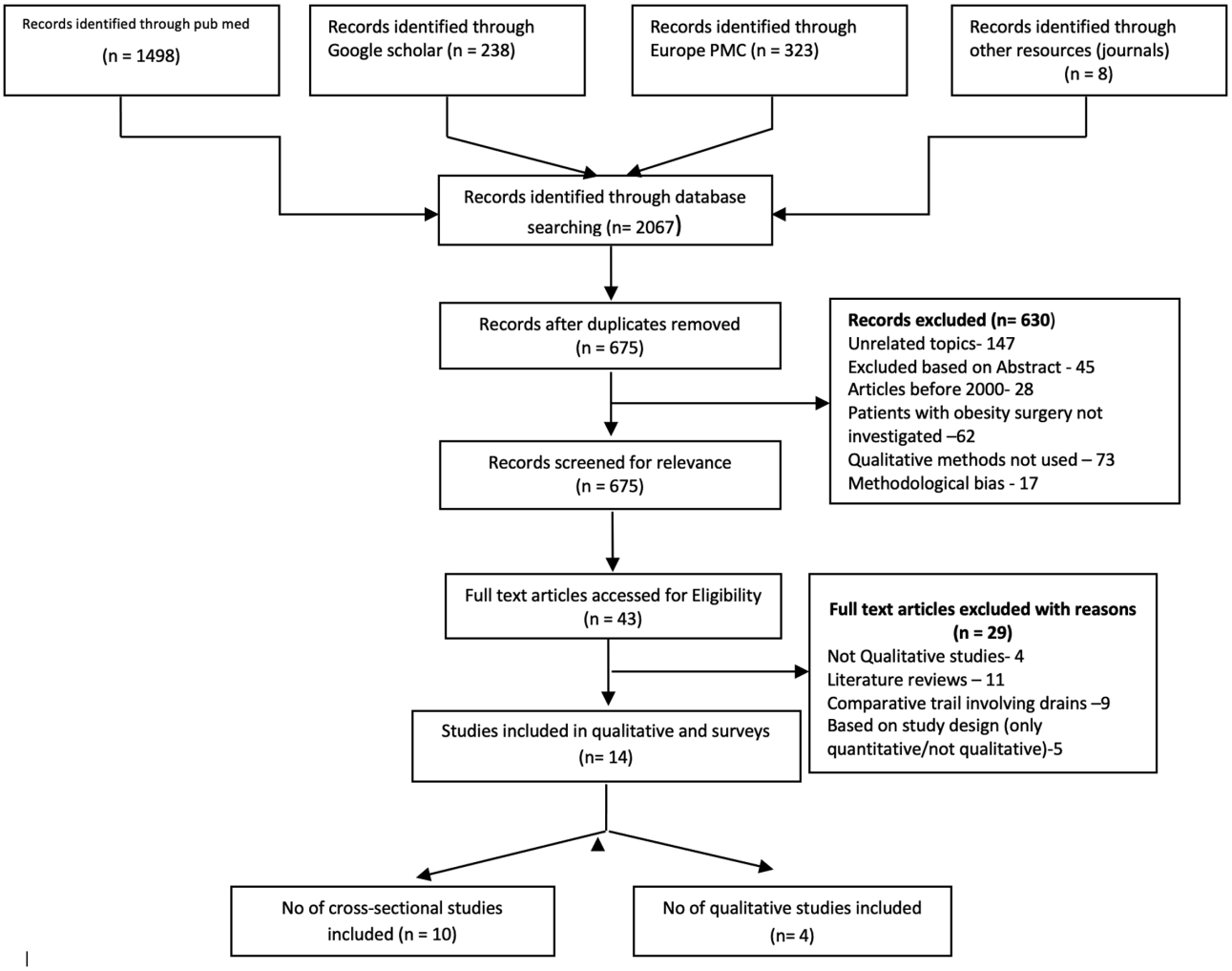

Figure 1 PRISMA diagram of the study selection process.

Results

General data

The PRISMA diagram is shown in Figure 1. The search retrieved a total of 2067 articles electronically from all the search databases. Titles and abstracts relevant for this study were analysed, resulting in removal of 675 duplicated articles. Out of 630 articles, 147 articles were unrelated topics, 45 were removed based on abstract, 28 articles were published before the year 2000, 62 articles with obesity surgery not clearly investigated, 73 articles with no proper qualitative methods and 17 were eliminated based on methodological bias. However, 45 articles were assessed for eligibility out of which 4 were excluded as not qualitative studies, 11 were literature reviews, 9 were comparative trials and 5 excluded based on study design. Finally, a total of 14 full-text articles were included for evidence synthesis and analysis.

Quality assessment data

A critical appraisal of the 14 studies showed some differences in methodological quality. A total of 4 studies were qualitative studies assessed using JBI tool and 10 studies were assessed with AXIS checklist according to the criteria for cross-sectional studies. All four qualitative studies have reported 80% or more concordance with the checklist. However, 1 out of 10 cross-sectional studies reported moderately low concordance (75%) with assessment checklist.

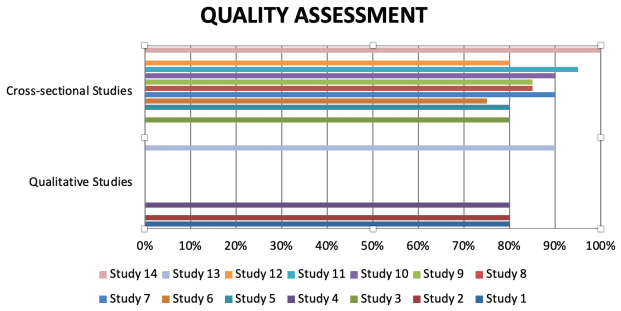

Figure 2 Quality assessment data.

Remaining all nine studies have reported 80% and above concordance (Figure 2).

Study characteristics

The total sample size of all studies included with a mean response rate of study characteristics is summarized in Table 1. All studies included were either cross-sectional surveys or qualitative studies representing different surgical procedures in different geographical areas of practice sites such as general surgery, neurosurgery, orthopeadic surgery, cardiothoracic surgery colorectal surgery, etc.

Table 1 Studies' characteristics for systematic review

Author's name	Country	Year	Title	Reference	Sample size	Methodology	Research tool	Practice site	Variable
Broom *et al.*, 2018	Australia	28 May 2018	Improvisation versus guideline concordance in surgical antibiotic prophylaxis	13	20 doctors	A qualitative study	Interview data were analysed using the framework approach	Tertiary referral hospital in Australia	Lack of adherence to guidelines and physicians' perceptions
Broom *et al.*, 2017	Australia	7 Nov 2017	How do professional relationships influence surgical antibiotic prophylaxis decision making	14	20 doctors	A qualitative study	Interview data were analysed using the framework approach	Tertiary referral hospital	Lack of adherence to guidelines and knowledge
Hosoglu *et al.*, 2003	Turkey	24 Oct 2003	A national survey of surgical antibiotic prophylaxis in Turkey	15	439 surgeons	Cross-sectional, country-wide survey study	A standardized data collection form	36 hospitals in 12 cities in Turkey	Lack of guideline knowledge and adherence
Waehle *et al.*, 2019	Norway	21 Jun 2019	Investigation of perioperative work processes in provision of antibiotic prophylaxis: a prospective, descriptive qualitative study across surgical specialties in Norway	16	19 doctors	A qualitative study	Observations and interviews	Operating theatres with different surgical specialities in three Norwegian hospitals	Lack of adherence to guidelines
Ahmed *et al.*, 2019	Sudan	11 Dec 2019	Knowledge, attitude and practice of surgical staff towards preoperative surgical antibiotic prophylaxis at an academic tertiary hospital in Sudan	17	56 doctors	Cross-sectional study	Multiple-choice questionnaire	Soba University Hospital, Sudan	Lack of guideline knowledge and adherence
Matsuda *et al.*, 2019	Japan	15 Jun 2019	Questionnaire survey regarding prevention of surgical site infection after neurosurgery in Japan: focus on perioperative management and administration of surgical antibiotic prophylaxis	18	255 doctors	Cross-sectional survey study	Questionnaires survey	Japan Society of Aesthetic Neurosurgery	Lack of guideline knowledge and adherence
Tanner *et al.*, 2013	England	15 Jan 2013	A benchmark too far: findings from a national survey of surgical site infection surveillance	19	156 hospital trusts	National survey.	Paper based or online questionnaires	NHS hospital trusts	Lack of adherence to guidelines
Acuna *et al.*, 2012	Columbia	31 Aug 2012	Determining the use of prophylactic antibiotics in breast cancer surgeries	20	88 breast surgeons	An online survey	The scope of the questions included demographics, clinical practice characteristics, Prophylatic Antibiotic prescription characteristics and the use of PAs in common breast surgical procedures	Breast surgeon members of the Colombian Association of Mastology, the only breast surgery society of Colombia	Lack of guideline availability and knowledge
Mylvaganam *et al.*, 2018	UK	May 2018	Adherence to best practice consensus guidelines for implant-based breast reconstruction: results from the iBRA national practice questionnaire survey	21	81 units from 79 NHS Trusts completed the questionnaire	Survey	Questionnaire developed using REDCap electronic data capture tools.	Breast and plastic surgical units across the UK	Lack of adherence to guidelines
Aiken *et al.*, 2013	England	31 Mar 2013	Use of antibiotic prophylaxis in elective inguinal hernia repair in adults in London and south-east England	22	245 doctors	Cross-sectional survey	Innovative trainee-led approach to collect these data	London and south-east England	Lack of adherence to guidelines and physicians' perceptions
Eskicioglu *et al.*, 2012	Toronto	Aug 2012	Surgical site infection prevention: a survey to identify the gap between evidence and practice in University of Toronto teaching hospitals	23	127 doctors	A web-based survey	Questionnaire	University of Toronto teaching hospitals	Lack of guideline knowledge and physician perceptions
Maharana *et al.*, 2018	India	26 Mar 2018	All India Ophthalmological Society members survey results: cataract surgery antibiotic prophylaxis current practice pattern	24	14 170 doctors	Questionnaire-based, cross-sectional study	Web-based anonymous survey	Ophthalmologists registered with the All India Ophthalmological Society	Lack of guideline knowledge

Table 1 Continued

Author's name	Country	Year	Title	Reference	Sample size	Methodology	Research tool	Practice site	Variable
Mattingly *et al.*, 2019	Ethiopia	17 Aug 2019	Qualitative outcomes of Clean Cut: implementation lessons from reducing surgical infections in Ethiopia	25	20 doctors	Qualitative study	Semi-structured interviews	4 hospitals	Lack of guidelines availability and knowledge
Trikha *et al.*, 2020	India	25 Aug 2020	Antibiotic prescribing patterns and knowledge of antibiotic resistance amongst the doctors working at public health facilities of a state in northern India	26	215 doctors	Cross-sectional study	Self-administered questionnaire	22 district hospitals	Lack of guidelines availability and knowledge

All the qualitative studies reported a response rate of 80% and above. A similar pattern was found with cross-sectional studies.

Lack of guideline availability

Of the total sample size of 323 HCPs, 282 HCPs (87.3%) perceived that there should be local or hospital guidelines available for SAP to provide optimum care for patients.[13–15] Since there was a non-availability of references, HCPs are involved in experience-based SAP prescribing.

Lack of adherence to guidelines

A total of 723 (56.3%) out of 1282 HCPs from nine different studies reported that there was a lack of adherence to guidelines during the perioperative process while using SAP which became a barrier for optimum utilization of SAP.[16–24] It is legitimate to follow the guidelines in practice that results in the best clinical outcomes for the patient.

Physician perceptions/off label practices

The majority in three studies, 318 (82%) out of 386 HCPs, reported that physicians' perceptions play a crucial role in prescribing SAP during surgeries. Physician perceptions can be a professional hierarchy, fear of infections, litigations, lack of confidence, mistrust in guidelines, career regressions, etc.[16, 24, 25] All HCPs should work as a team keeping aside all their perceptions while patient care is the utmost goal to deal within.

Antibiotics prescribed

Among 14 studies, 7 reported the choice of antibiotics used during different types of surgical procedures performed in their practice sites. Some commonly prescribed SAP were cefazolin, third-generation cephalosporins, ciprofloxacin, vancomycin, clindamycin, gentamycin, co-amoxiclav, piperacillin-tazobactam and cloxacillin. The selection of these antibiotics for SAP was based on antibiotic availability, insurance approvals for that particular drug, financial concerns, pressure from pharma companies and physician beliefs.[13, 15, 18, 20, 23, 24, 26] There is a need to follow clinical practice guidelines while prescribing SAP to reduce unwanted interventions that ultimately lead to antibiotic resistance.

Time of administration

Amidst 382 HCPs, 250 (65.4%) reported about the guideline-directed time of administration of SAP during surgical procedures in their practice sites. The average time found among different studies was 30–60 min for short-period surgeries (<3–4 h) and 60–120 min for longer surgeries (more than 6 h) with intraoperative dose.[13, 20, 24] It is clear that SAP administration time is crucial for any surgery to prevent SSIs during the perioperative process.

Surgical site infection

With regard to eight studies, a total of 4545 (30%) out of 15 090 HCPs perceived the evidence of SSI, but still the data was not clearly mentioned in some studies.[13, 15, 18, 21–23, 25, 26] Also some studies reported the percentage of SSIs that ranges from 0.5% to 50% according to type and duration of antibiotic administration, hand hygiene as well practice site.[13, 21, 25] Evidence proved that timely administration of SAP has a great impact in preventing SSIs.

Percent of physicians redosing antibiotics

In the majority of studies, 631 (84.4%) out of 747 HCPs reported that they will go with guidelines-directed redosing of SAP (every

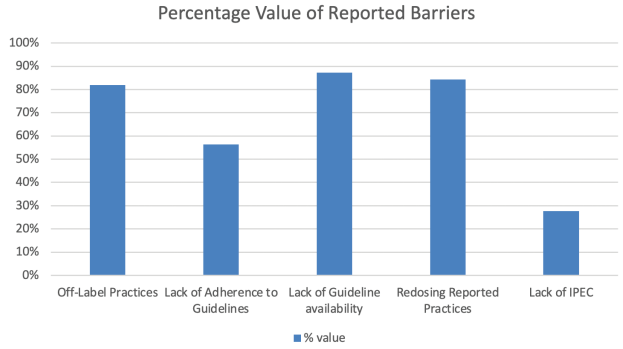

Figure 3 Percentage values of reported barriers in the study.

3–4h) in surgical procedures where required.[13, 16, 18, 20, 21, 26] Guidelines suggest that intra-operative dose is recommended for long surgical procedures which need to be taken seriously by all HCPs in their practice without fail (Figure 3).

Lack of inter-professional collaboration

Lack of communication between the teams in operation theatres impacting SAP administration during surgical procedures was reported in three studies. Out of 314, 87 (27.7%) HCPs outlined this as a barrier in prescribing SAP.[17, 20, 24] With proper sharing and effective communication, there will be a greater possibility of accepting the guidelines by HCPs.

AMS intervention required

However, four studies reported that AMS is required for proper antibiotic selection, dosing, dose, duration, administration time and time to stop SAP in the practice setting to prevent misuse or overuse of antibiotics as well as to prevent microbial resistance. [15–17, 19]

Discussion

SAP decision making is the most predominant role in perioperative procedures to prevent SSIs by applying some infection control measures such as hand hygiene and disinfecting the patient's surgical site before the procedure. The reviews from 14 studies have been able to identify some barriers in prescribing SAP which helps all HCPs for optimum patient care during surgical procedures.[27, 28] A total of 15 902 HCPs participated in 14 different studies with an average response rate of 64.7%. Among responded participants, more than 50% discussed different barriers for SAP administration in their practice site and the majorly mentioned barriers were discussed further. About 87% of HCPs discussed about the non-availability of guidelines in their practice site which was a consequential barrier need to be addressed which hinders the uptake of SAP guidelines. Local or standard guidelines should be readily accessible because it is a definitive source of information for all HCPs, and implementation is mandatory to the most possible way in improving clinical practice. [29, 30] Trikha *et al.*[15] perceived that AMR is a global problem and staff must be educated about AMR that needs to be integrated as an universal adaptation in every practice site.

In our study, a total of 56.3% reported that adherence to guidelines was one of the major concerns to HCPs. Findings from this review stated poor adherence mainly in the selection of prophylaxis antibiotic, dose, administration timing and duration due to lack of awareness of new version guidelines within the surgical settings. Ng and Chong also reported that development and implementation of local guidelines with multidisciplinary team members that include the pharmacist as a lead to monitor interventions of SAP, conduct workshops and seminars for educating staff, audit and feedback of SAP from time to time improve HCPs adherence to proposed guidelines.[31, 32] In another study, Abdel-Aziz *et al.*[33] outlined that the non-adherence to SAP in their practice site was mainly inappropriate antibiotic choice and prolonged use of antimicrobial prophylaxis against recommended duration leading to antimicrobial-resistant strains and highlights and recommends the potential opportunity of involving clinical pharmacist in the management of SAP across all surgical specialties and the need for adherence to guidelines.

Another major finding of our study is that physicians' perceptions towards SAP prescribing were reported to be about 82% which clearly states that there is a need for change in attitudes and behaviours by inter-specialty collaboration and effective communication that influence the SAP decision process.[16, 17] Eskicioglu *et al.*[25] reported that there is a professional hierarchy between the staff and career regression fear among junior doctors, lack of confidence in their knowledge, lack of evidence for their perception strategies in preventing SSIs and also stated that there was a gap between misconception of high-end or multiple antibiotics in prolonged therapy in preventing SSIs must be taken into consideration for optimum utilization of SAP.[32] Several studies proved that timely administration of antibiotics as per guidelines reduced the incidence of SSIs. Hosoglu *et al.*[18] discussed about antibiotic evaluation by following ways: indication of prophylaxis, antibiotic choice, timing for the first dose, length of prophylaxis and route of drug administration; if SAP procedure is performed as per the standard guidelines, it was documented as 'definitely appropriate', which can prevent irrational antibiotic use. SAP guidelines generally recommend a single dose of IV antibiotic in most of the procedures with regard to duration and dosage of antibiotic prophylaxis. Many studies stated that surgeons adhere to poor timely administration, using more than one dose than recommended. In a study by Acuna *et al.*,[13] 80% of surgeons reported using prophylaxis antibiotic before undergoing breast surgery, single preoperative fixed dose (27.7%), single preoperative fixed dose followed by a second fixed dose if the surgery was prolonged (44.7%), single preoperative fixed dose followed by one or more postoperative fixed doses for >24 h (10.6%) and single preoperative weight-adjusted dose (2.1%).[18]

AMS plays a crucial role in the quality improvement of antibiotic prescription and optimum antibiotic use. It is found that AMS interventions are reported to be low in surgical procedures. Availability of antibiograms within OT also helps the surgical team to implement appropriate antibiotics during the process. Therefore, it is recommended that a successful implementation of the AMS program should be initiated in every hospital setting which comprises an infection control practitioner, infection control nurse, clinical pharmacist, infectious disease physician, clinical microbiologist, consultant physician and surgeon and data analyst. With the help of these core elements (leadership commitment, accountability, pharmacy expertise, action, tracking, reporting and education) in the AMS team, a significant patient outcome can be achieved. Garcell *et al.*[34] reported that a focussed AMS team at any practice site improves timely administration and discontinuation of SAP.[35]

The study has certain limitations that we discussed for further evaluation. Limited availability of data on the specific type of surgery and antibiotic used in different countries. However, these data are from different countries so we cannot generalize it in the Gulf region. Few studies with little data are available from the Middle East and Asian countries. Therefore, the results are either exaggerating or undermining. A barrier-focussed research is required in the Gulf region to identify community-based practices.

Conclusion

The evidence from several studies in different countries concludes on irrational SAP optimization practices of HCPs. A high prevalence of non-availability and poor adherence to standard practice guidelines among HCPs are observed. This study also publicized varied prescribing patterns of antibiotics non-concordance with local/standard guidelines. Further studies are required on SAP appropriateness and prevention of SSIs.

Author Contributions

All the authors contributed equally to this work. The manuscript has been read and approved by all the authors, the requirements for authorship as stated earlier in this document have been met and each author believes that the manuscript represents honest work and the authors alone are responsible for the content and writing of the paper.

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Conflict of Interest

None declared.

Ethical Clearance

Not required.

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