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Antibiotic Prescription Trends & Adherence to Guideline in Surgeries Conducted in a Tertiary Hospital in Male' (IGMH)

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ABSTRACT *Infections from surgical sites are a global health concern. Even while surgical site infections may be avoided, they nonetheless have a substantial negative impact on patient outcomes, national budgets, and mortality rates. Inappropriate uses of surgical antimicrobial prophylaxis are increasing and worsening patients' quality of life. The evidence-based practice of using antibiotics prophylactically prior to surgery aims to avoid surgical site infections (SSIs). The aim of the study is to investigate the adherence to antibiotic guidelines. A retrospective observational research was done at IGMH during 2022-2023 utilizing a structured data abstraction methodology. The study included patients who underwent three surgeries: appendectomy, cholecystectomy, and hernia repair. Data were gathered from January to March 2024. A census sample method was used to choose 476 surgical cases. SPSS version 23.0 was used to perform descriptive statistics and chi-square analysis. The findings reported a total of 476 eligible surgical cases. Hernia repairs made up 42.9% of the cases, followed by cholecystectomy (33.3%) and appendectomy (23.8%). A significant portion of appendectomies (87.7%) were emergency surgeries. Surgical Antimicrobial Prophylaxis was prescribed in 456 patients (95.20%). Out of this, appropriate antibiotics according to evidence-based guidelines were given to only 244 (53.51%) patients, from which only 3 (1.23%) received the right dose according to the evidence based guideline. The route of administration was correct and according to recommendations. The timing of Surgical Antimicrobial Prophylaxis (SAP) was according to guidelines in 56.80% of patients (within 1 hour before surgical incision). Out of the patients for whom SAP was recommended, all received prophylaxis and out of those who had no indication, none received prophylaxis. Most patients received ceftriaxone (75.60%) as prophylactic antibiotic. Our study also found a statistically significant relationship between age, gender, type of surgery and elective and emergency surgeries with adherence to evidence based guidelines. We found poor treatment adherence to antibiotic prophylaxis guidelines regarding different types of surgeries. This study highlights the importance of implementing standardized antibiotic prescribing guidelines in the Maldives.*

Key Words: Appendectomy, Cholecystectomy, Hernia Repair, Adherence, Antibiotic Prophylaxis, Treatment Guidelines, Adherence to Guidelines

Introduction

Antibiotics play a crucial role in preventing and managing infections in surgical procedures. Its appropriate use is essential to reduce the risk of antimicrobial resistance and minimize adverse outcomes for patients (Lamb et al., 2021;

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Laxminarayan et al., 2013). Surgical Antimicrobial Prophylaxis (SAP) refers specifically to the administration of antibiotics before surgery to prevent Surgical Site Infections (SSI). It does not include preoperative decolonization or the treatment of established infections (Ierano et al., 2017). The World Health Organization (WHO) recommends a single preoperative dose as the preferred approach to minimize SSI risk while protecting patients' microbiota and reducing the potential for antimicrobial resistance (Lamb et al., 2021).

Antimicrobial resistance (AMR) remains a major concern in surgical care, as resistant organisms can significantly reduce the effectiveness of treatment for SSIs and increase patient morbidity and mortality (Naylor et al., 2022). This challenge highlights the importance of developing and following evidence-based guidelines that promote the rational use of antibiotics and prevent unnecessary exposure to broad-spectrum agents (Cantón et al., 2022).

Despite well-established recommendations, adherence to SAP guidelines is often inconsistent, leading to inappropriate antibiotic selection, incorrect timing, and prolonged durations that contribute to higher infection rates and resistance patterns. The WHO has emphasized the problem of irrational drug use since 1985, highlighting the need for standardized prescribing practices (Tadesse et al., 2022). To address this, many countries have adopted antibiotic stewardship programs that align prescribing with regional resistance trends (Lamb et al., 2021).

This study focuses on three common surgical procedures at IGMH: appendectomy, cholecystectomy, and hernia repair.

IGMH, as the largest tertiary care center in the Maldives, was selected because it manages the majority of both elective and emergency surgeries nationwide. The American Society of Health-System Pharmacists (ASHP) guidelines were used as they are widely recognized internationally and provide a robust benchmark for evaluating local adherence.

The aim of this study is to assess antibiotic prescription trends and adherence to SAP guidelines at IGMH. By identifying gaps in practice, the findings can help to guide the development of context-specific national guidelines and support efforts to reduce antimicrobial resistance.

Purpose of the Study, Objectives, and Research Questions

The Centers for Disease Control and Prevention (CDC) recommends enhancing antibiotic prescribing and patient care through an Antibiotic Stewardship Program (ASP) (CDC, 2020). This program optimizes treatment for specific patients, prevents harm, and reduces antimicrobial resistance, requiring careful analysis of prescription patterns in resource-constrained settings (Cantas et al, 2013). Antibiotics are very commonly inappropriately prescribed as found by Saleem et al., 2019 in their study with 70.3% participants having received inappropriate antibiotics. These findings are much higher than that was reported from studies in Australia and Turkey. (Saleem et al., 2019). According to evidence, antibiotic prescriptions in surgery are often made in the setting of ambiguous information and with a lack of precision (Charani et al., 2019). Therefore, the purpose of this study is to examine antibiotic prescription trends in patients undergoing surgical procedures. The findings of this study could inform the development of

interventions aimed at improving antibiotic prescription practices and adherence to guidelines in surgical procedures, ultimately optimizing patient outcomes and reducing the emergence of antibiotic resistance. It can also serve as a foundation for developing targeted interventions that consider various factors influencing prescription patterns and adherence to guidelines in surgeries.

The study focuses on identifying prevalent trends in antibiotic prescriptions within surgical procedures at IGMH. Through a comprehensive assessment, the research aims to determine the extent to which established antibiotic guidelines are adhered to. By delving into the prescription practices, the study also seeks to uncover the administration of SAP in elective and emergency cases, as well as the adherence to guidelines based on the type of surgery. By amalgamating these findings, the research will provide valuable insights and recommendations aimed at enhancing the alignment of antibiotic prescription practices with evidence-based guidelines.

Objectives

1. To analyze the current prescription trends of antibiotics in surgical procedures at IGMH
2. To assess the extent of adherence to selected internationally recognized antibiotic prescription guidelines during surgical procedures (Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery, ASHP)
3. To identify factors influencing prescription patterns and guideline adherence

Hypothesis

Ha: There is a relationship between type of surgeries and the level of adherence to evidence-based guideline.

H0: There is no relationship between type of surgeries and the level of adherence to evidence-based guideline.

Ha: There is a difference in adherence to an evidence-based guideline between elective and emergency surgeries.

H0: There is no difference in adherence to an evidence-based guideline between elective and emergency surgeries.

Ha: There is a difference in adherence to an evidence-based guideline between male and female.

H0: There is a no difference in adherence to an evidence-based guideline between male and female.

Ha: There is a correlation between age and adherence to an evidence-based guideline.

H0: There is no correlation between age and adherence to an evidence-based guideline.

Ha: The choice of SAP is appropriate in all type of surgeries.

H0: The choice of SAP is not appropriate in all type of surgeries.

Ha: There is no association between the type of surgery performed and the

indication for administering surgical antibiotic prophylaxis.

H0: There is an association between the type of surgery performed and the indication for administering surgical antibiotic prophylaxis.

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H0: There is an association between the type of surgery performed and the indication for administering surgical antibiotic prophylaxis.

Literature Review

Surgical antimicrobial prophylaxis (SAP) refers to the administration of antibiotics before a surgical procedure to prevent surgical site infections (SSI). Its effectiveness depends on several factors, including the correct choice of antibiotic, the timing of administration, the duration of prophylaxis, and the mode of delivery (Ng, 2012). Antibiotics have fundamentally changed surgical practice by reducing infections and improving patient outcomes. The World Health Organization (2018), recommends a single preoperative antibiotic dose as optimal prophylaxis, as this minimizes both the risk of SSI's and the impact on the patient's microbiota, while reducing the emergence of antimicrobial resistance (Lamb et al., 2021).

Despite clear recommendations, inappropriate antibiotic use remains a significant problem. As early as 1985, the WHO highlighted irrational prescribing practices, including overuse and misuse of antibiotics, during a conference on rational drug use (Tadesse et al., 2022). Today, the main objective of antibiotic prescribing guidelines is to ensure a standardized approach that aligns with local resistance trends while maintaining clinical effectiveness (Lamb et al., 2021).

SAP is most effective when antibiotic levels in serum and tissues reach bactericidal concentrations at the time of incision and remain therapeutic throughout the procedure and for a short duration afterward (Ng, 2012). Studies have consistently shown that poor adherence to guideline-recommended timing and selection contributes to higher infection rates, increased antimicrobial resistance, and unnecessary healthcare costs (Khan et al., 2020; Charani et al., 2019).

Globally, the level of adherence to SAP guidelines varies widely. In Pakistan, only 9.5% of patients received SAP exactly as recommended (Khan et al., 2020). Similar low adherence rates were reported in Italy (5.7%) and Brazil (3–5.8%) (Giordano et al., 2017; Schmitt et al., 2012). In contrast, higher adherence levels were observed in Greece (36.3%), India (52%), and the Philippines (44%) (Tourmousoglou et al., 2007; Parulekar et al., 2009; Nabor et al., 2015). Even in centers with better adherence, surgeons often struggle to follow all parameters such as timing, duration, and antibiotic selection (Gouvêa et al., 2015).

Inappropriate antibiotic choice remains one of the most frequent deviations from guidelines. For instance, ceftriaxone is often overused in many countries despite not being the first-line recommendation for most elective surgeries. In a Pakistani study, ceftriaxone was the most commonly prescribed prophylactic antibiotic (59.5%) (Khan et al., 2020), similar to findings in Ethiopia and Turkey (Mugada et al., 2021). However, third-generation cephalosporins such as ceftriaxone are less effective against staphylococci, which are the most common organisms responsible for SSIs, and their widespread use has been linked to increasing resistance (Moges

et al., 2020).

The challenges to guideline adherence are multifactorial. Surgeons may lack up-to-date knowledge of evolving guidelines, rely on personal clinical experience instead of evidence-based recommendations, or face hospital-level barriers such as limited antibiotic availability (Gouvêa et al., 2015). Even when institutional protocols exist, adherence often becomes a lower priority compared to other surgical considerations (Charani et al., 2019). Educational initiatives targeting prescribers have shown some benefit in improving compliance, but sustained change requires broader antimicrobial stewardship programs (Trikha et al., 2020).

The need for SAP also differs across surgical procedures. Acute appendicitis is the most common abdominal surgical emergency worldwide, with a lifetime risk of 8.6% for males and 6.9% for females (Körner et al., 1997). In appendectomy, prophylactic antibiotics significantly reduce the risk of wound infections and intra-abdominal abscesses (Andersen et al., 2005). Similarly, for complicated or strangulated hernias, SAP is recommended to prevent infections caused by skin flora or environmental organisms, especially in cases requiring bowel resection (Birindelli et al., 2017; Aufenacker et al., 2006). In acute cholecystitis, antibiotics also play a role alongside surgical intervention, and studies have shown that narrow-spectrum antibiotics can be as effective as broad-spectrum agents in managing infections while reducing hospital stays (Wu et al., 2020).

Although multiple international guidelines exist, including those by the American Society of Health-System Pharmacists (ASHP), their implementation varies by region. Factors such as local antibiotic availability, surgeon preference, and institutional policies influence practice (Hassan et al., 2021). In settings like the Maldives, where there are limited published data on SAP adherence, it becomes critical to evaluate existing prescription patterns and identify gaps. Understanding local trends can guide the development of tailored national guidelines and support antibiotic stewardship initiatives aimed at reducing resistance and improving surgical outcomes.

Methodology

This study was a quantitative retrospective observational study where we analyzed pre-existing data from Electronic Medical Records (EMR-HINAI) of surgical procedures performed at IGMH between 2022-2023.

The study included the three most common major surgeries performed in IGMH. A census sampling technique was used based on the total number of cases, eligible cases recorded by the Department of Surgery. The surgeries were appendectomy, cholecystectomy and hernia repair, all classified as clean and clean/contaminated surgeries according to CDC surgical wound classification.

A total of 691 cases were collected from Medical Records of IGMH and EMR-HINAI. Data collection was facilitated by structured data collection forms in digital format. These forms captured key information, including patient demographics (age, gender), surgical details (type of surgery), and antibiotic prescriptions (type of antibiotic, dosage, frequency, duration). These forms were adapted from "How to Investigate Antimicrobial Use in Hospitals: Selected Indicators" from USAID and WHO prescribing indicators ("Assessment of Antimicrobial Use Pattern

Using World Health Organization Prescribing Indicators at a Tertiary Hospital: A Prospective, Observational Study," 2018).

This study included all cases of adult patients (age ≥18 years) of both genders who underwent one of the three specified surgeries with complete and accessible medical records. And excluded any cases in which patients had multiple surgeries alongside the surgery of interest, contaminated surgeries, and cases with documented preoperative infections. Cases with missing or insufficient data were also excluded. After data cleaning and applying inclusion and exclusion criteria, 478 cases were included in the final analysis.

Data were entered digitally for efficiency and securely stored to maintain patient confidentiality. Excel and IBM SPSS were used for analysis, with descriptive statistics summarizing patients' demographics, surgery types, and antibiotic use.

Adherence to SAP guidelines was defined as compliance with the parameters recommended by ASHP (Bratzler et al., 2013). These included providing the correct antibiotics with the right dose, given for the right indications at the right time for the right duration. Any deviation from these parameters was considered non-adherence. To assess the level of compliance, adherence was stratified as Good (≥80% compliance), Moderate (50-79%), and Low (<50%) based on commonly used thresholds in SAP adherence studies. Subgroup analyses explored factors contributing to non-adherence. Additionally, trends in antibiotic prescriptions over the study period were visualized using graphical representations. The study had also employed trend analysis and chi-square analysis for comparison of adherence rates between different types of surgeries. This systematic approach aims to provide comprehensive insights into antibiotic prescription practices in surgical settings at IGMH, facilitating targeted interventions and policy development.

Results

Demographics and Surgery Types:

The average age group of patients in this study was found to be between 40 to 59 years (43.5%) (Figure 1.1) with a mean age of 45, and slightly more males (51.7%). Hernia repairs made up 42.9% of the cases, followed by cholecystectomy (33.3%) and appendectomy (23.8%). A significant portion of appendectomies (87.7%) were emergency surgeries. 78.1% of cases were elective cases. Over 98% of cholecystectomies and hernia repair were elective cases while 88% cases of appendectomy were emergency surgeries.

Figure 1.1. Percentage Of Age Distribution Of Patients

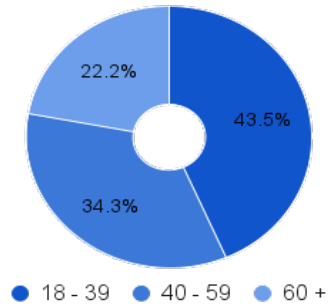


Figure 1.2. Percentage Of Gender Distribution Of Patients

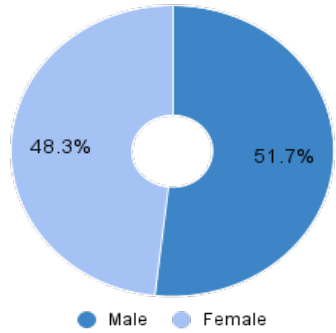


Figure 1.3. Percentage Of Types Of Surgeries Performed

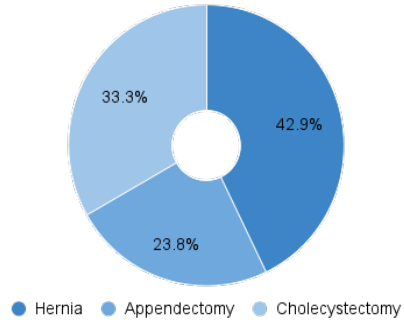
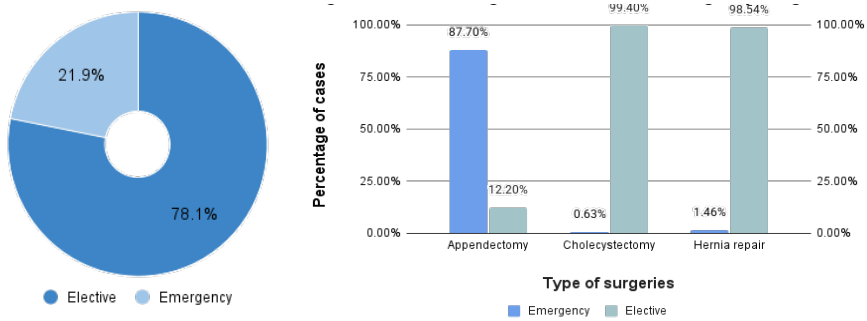


Figure 2.1. Percentage of Elective and Emergency Surgeries



Antibiotic Prescription Patterns:

Antibiotics were prescribed in 95.4% (n = 456) of cases. Ceftriaxone was the most commonly used (Figure 3.2), especially in appendectomies (93.9%) and cholecystectomies (96.9%), while Amoxicillin/Clavulanic acid was more frequently used for hernia repairs (50.2%).

Figure 3.1. Percentage Of Antibiotics Prescribed In All Surgeries

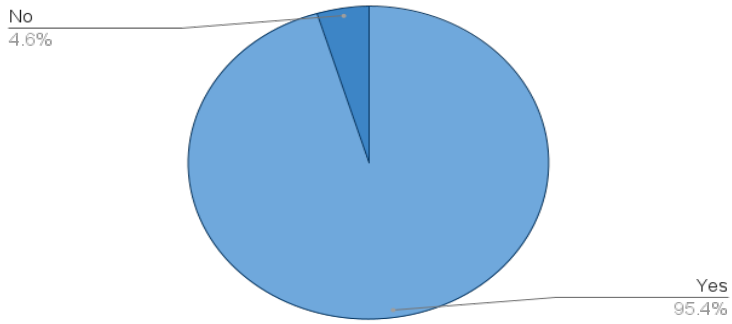


Figure 3.2. Percentage Of Types Of Antibiotics Prescribed In All Surgeries

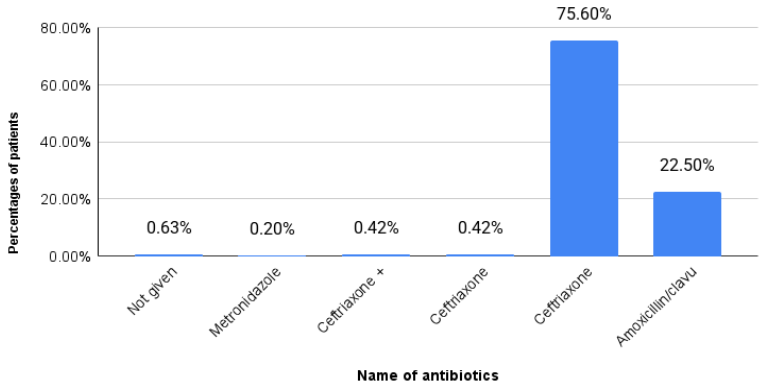


Figure 4.1. Types of Antibiotics Prescribed In Appendectomy

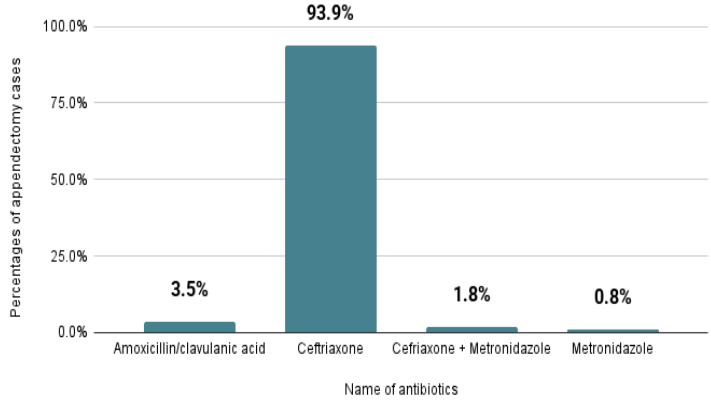


Figure 4.2. Types of Antibiotics Prescribed In Hernia Repair

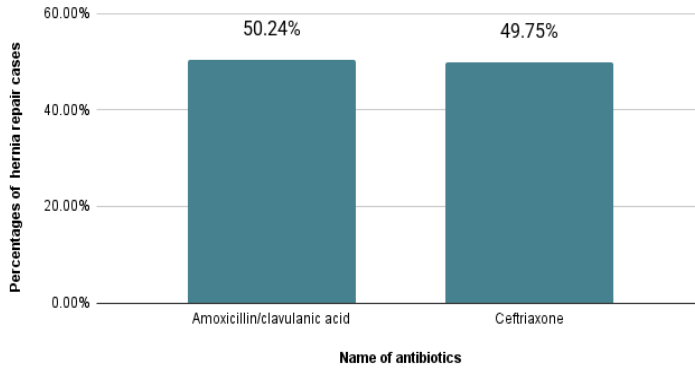
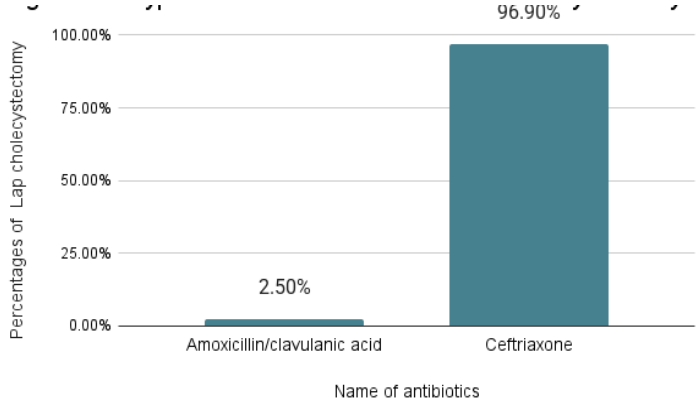


Figure 4.3. Types of Antibiotics Prescribed In Cholecystectomy



Adherence to Guidelines:

Antibiotics were correctly prescribed in 96% of cholecystectomies, 93% of appendectomies and 0% in hernia repair (Figure 4.1, Figure 4.2, Figure 4.3). Mean adherence for appendectomy was 64%, 79% for cholecystectomy and 38% for hernia repairs. For elective surgeries the mean adherence was 56% and for emergency cases, it was 62%. Our study demonstrated that over 62% of patients received their single dose of prophylactic antibiotic within the recommended 60 minutes before incision. Patients received their antibiotic dose after incision (26.3%) and more than 60 minutes prior to surgery (10.9%).

Figure 5.1. Percentage Of Time Of Antibiotic Administration

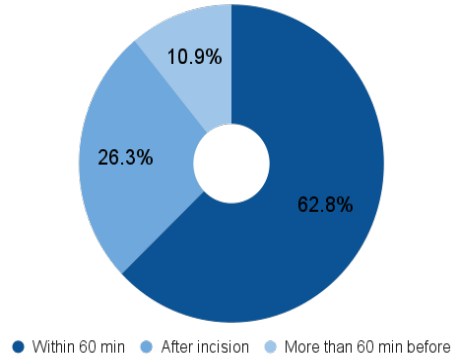


Table 6.1: The table presents the adherence levels to evidence-based guidelines in prescribing SAP across various demographic and clinical variables, including age, gender, type of surgery, and elective or emergency surgeries. The adherence levels are categorized as low, moderate, and good. Chi-square tests were conducted to assess the significance of differences in adherence levels across these variables.

The adherence to evidence based guidelines in SAP decreases with increasing age (Chi-square value = 51.899, $p < 0.001$). Younger patients (18-39 years) exhibit significantly better adherence rates compared to older age groups (60+). Furthermore, Female patients demonstrate significantly better adherence to evidence based guidelines in SAP compared to male patients (Chi-square value = 56.454, $p < 0.001$).

Additionally, there is a highly significant variation in adherence levels across different types of surgeries (Chi-square value = 393.121, $p < 0.001$). Cholecystectomy cases show the highest adherence rates, with 96.3% (n =153) of the cases of good adherence, while hernia repairs have notably poor adherence with no cases with good adherence.

Moreover, emergency surgeries exhibit significantly better adherence to guidelines compared to elective surgeries (Chi-square value = 47.587, $p < 0.001$) as well.

Table 6.1. Factors Influencing Adherence

Variable		Adherence						Chi Square	
		Low		Moderate		Good			
		n	%	n	%	n	%	Value	Significance
Age	18 - 39	28	13.46	41	19.71	139	66.83	51.899a	< 0.001
	40 - 59	37	22.56	49	29.88	78	47.56		
	60 +	37	34.91	43	40.57	26	24.53		

Gender	Female	36	15.58	37	16.02	158	68.4	56.454a	< 0.001
	Male	66	26.72	96	38.87	85	34.41		
Type of Surgery	Appendect-omy	21	18.42	3	2.63	90	78.95	393.121a	< 0.001
	Hernia Repair	77	37.56	128	62.44	0	0		
	Lap. Cholecyste-ctomy	4	2.52	2	1.26	153	96.23		
Elective/ Emergency	Elective	81	21.66	130	34.76	163	43.58	47.587a	< 0.001
	Emergency	21	20.19	3	2.88	80	76.92		

Table 6.2: SAP was prescribed in 456 patients (95.20%) surgical procedures. However, appropriate antibiotics according to evidence-based guidelines were given to only 244 (53.51%) patients, from which only 3 (1.23%) received the right dose according to the evidence based guideline. Two hundred and thirty five (51.54%) patients who received the wrong antibiotics with respect to guidelines were excluded while calculating the percentage who received the correct dose of antibiotics.

The route of administration was correct and according to recommendations. The timing of SAP was according to guidelines in 56.80% of patients (within 1 hour before surgical incision). Out of the patients for whom SAP was recommended, all received prophylaxis and out of those who had no indication, non received prophylaxis. Therefore, overall SAP indication was appropriate for all patients. None of the selected antibiotics were appropriate for the surgical procedures. Selection of the correct dose of antimicrobial agents, and selection of antimicrobial agents were the most common deviant from guideline recommendations.

Overall, the table highlights significant differences in adherence to guidelines across different types of surgeries, with Chi square values indicating strong statistical significance ($p < 0.001$) for all comparisons.

Table 6.2. Adherence Levels Of Surgery Based On Specific Guideline Components

		Type of Surgery							
Variable		**Appendect-omy**		**Hernia Repair**		**Lap Cholecystec-tomy**		**Chi square**	
		n	**%**	**n**	**%**	**n**	**%**	**Value**	**Significa-nce**
SAP Prescribed?	NO	20	86.96	2	8.7	1	4.35	52.497a	< 0.001
	YES	95	20.83	203	44.52	158	34.65		

Indication	**NO**	20	86.96	2	8.7	1	4.35	52.497a	< 0.001
	YES	95	20.83	203	44.52	158	34.65		
Prescribing According to Guideline	**NO**	25	10.59	205	86.86	6	2.54	377.623a	< 0.001
	YES	90	37.04	0	0	153	62.96		
Choice of SAP Appropriate	**NO**	24	10.21	205	87.23	6	2.55	379.905a	< 0.001
	YES	91	37.3	0	0	153	62.7		
Timing of Administration done according to guideline	**NO**	81	36.81	77	35	62	28.18	36.669a	< 0.001
	YES	34	13.13	128	49.42	97	37.45		
Doses of Administration Appropriate (Guideline)	**NO**	112	23.53	205	43.07	159	33.4	9.555a	0.008
	YES	3	100	0	0	0	0		
Type of surgery vs frequency	**NO**	25	10.64	205	87.23	5	2.13	381.334a	< 0.001
	YES	90	36.89	0	0	154	63.11		

Discussion

This study revealed significant gaps in adherence to SAP guidelines at IGMH. While most patients received prophylaxis, full compliance with ASHP-recommended parameters like appropriate antibiotic selection, timing, dose, and duration was suboptimal. Hernia repairs showed the poorest adherence compared to appendectomy and cholecystectomy, indicating the need for targeted interventions for specific surgery types.

Ceftriaxone was the most frequently used prophylactic antibiotic (75.6%), consistent with findings from Pakistan, Ethiopia, and Turkey (Khan et al., 2020; Mugada et al., 2021). However, third-generation cephalosporins like ceftriaxone are not recommended as first-line agents for most elective surgeries because they are less effective against staphylococci and contribute to antimicrobial resistance (Moges et al., 2020). This suggests that antibiotic selection at IGMH may be influenced by availability or surgeon preference rather than by guidelines.

Timing adherence was appropriate in only 62.8% of cases, similar to rates reported in Abu Dhabi (40.3%), Jordan (88.1%), and the Netherlands (50%) (van Kasteren, 2003; Alahmadi et al., 2020). Proper timing is critical for achieving bactericidal concentrations at incision (Ng, 2012), and poor compliance may compromise SAP effectiveness.

Adherence varied by surgery type. Cholecystectomy had the highest adherence (79%), followed by appendectomy (64%) and hernia repairs (38%). Comparable trends have been reported in Pakistan, where hernia repairs showed the lowest adherence (Khan et al., 2020). Emergency surgeries demonstrated better adherence (62%) than elective surgeries (56%), likely because most emergency

cases were appendectomies, which often require timely antibiotic intervention (Talan & DiSaverio, 2021; Moris et al., 2021) which had better compliance.

Demographic factors also influenced adherence. Younger patients and females showed higher adherence, reflecting the predominance of cholecystectomy among females and hernia repairs among older males, which had lower adherence. Similar age-related trends were observed in France (Dylis et al., 2019).

These findings highlight multifactorial reasons for poor adherence, including limited awareness of updated guidelines, reliance on clinical habit, lack of institutional protocols, and restricted antibiotic availability in the Maldives (Gouvêa et al., 2015; Charani et al., 2019). Inappropriate SAP increases SSIs, treatment costs, and antimicrobial resistance.

Internationally, adherence at IGMH aligns with low-to-moderate compliance levels reported in Pakistan, Italy, and Brazil (3–10%) (Pereira et al., 2024) and is lower than moderate adherence rates in Greece, India, and the Philippines (36–52%) (Tourmousoglou et al., 2007; Parulekar et al., 2009).

In summary, this study highlights critical gaps in SAP practice at IGMH, particularly inappropriate antibiotic selection and inconsistent timing, echoing long standing challenges documented in surgical literature (Gul et al., 2005). Surgery type, urgency, and demographics influenced adherence. Developing national guidelines tailored to local antibiotic availability, alongside surgeon education and institutional stewardship programs, is essential to improve adherence and reduce antimicrobial resistance.

Conclusion

This study showed that adherence to SAP guidelines at IGMH remains suboptimal. Younger patients and females had better adherence compared to older males. Among surgeries, cholecystectomy and appendectomy demonstrated good adherence, while hernia repairs had the poorest compliance. Emergency cases showed higher adherence than elective surgeries, largely due to the higher proportion of appendectomies in emergencies.

Although most patients received prophylaxis within the recommended timeframe, more than half of hernia repair cases were given broad-spectrum antibiotics that were not in line with the selected guideline. Ceftriaxone was the most commonly prescribed agent, despite not being the ideal choice for many procedures.

These findings highlight the need for context-specific guidelines and better antibiotic stewardship in the Maldives. Improving the choice of SAP tailored to each surgery, along with stronger adherence to timing and dosing recommendations, could enhance surgical outcomes and help reduce antimicrobial resistance.

Recommendations

It is recommended to develop and implement national SAP guidelines tailored to local antibiotic availability and resistance patterns. Further research should be conducted to identify the factors influencing adherence and to guide targeted interventions. In addition, enhancing the education and training of healthcare providers on the importance of appropriate antibiotic prescribing would be an

important step toward improving compliance.

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