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MIDDLE EAST UNIVERSITY
Amman - Jordan

Knowledge, Attitudes, and Practices Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units in Al-Jouf, Saudi Arabia

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Department of Pharmaceutical Sciences

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المعرفة والمواقف والممارسات بين الكادر الجراحي تجاه الوقاية بمضادات الميكروبات قبل الجراحة في وحدات الرعاية الثانوية في الجوف، المملكة العربية السعودية

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قُدمت هذه الرسالة استكمالاً لمتطلبات الحصول على درجة الماجستير في العلوم الصيدلانية

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Thesis Committee Decision

This thesis, titled **"Knowledge, Attitudes, and Practices Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units in Al-Jouf, Saudi Arabia"** by researcher **Mohammed Fahad Alsharaan** and was successfully defended and approved on 19/01/2026.

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بسم الله الرحمن الرحيم

﴿وَآخِرُ دَعْوَاهُمْ أَنِ الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ﴾ سورة: يونس ، آية: 10

الحمدُ لله شُكرًا وامتنانًا، فمَا تمَّ سعي ولا خُتم دربٌ إلا بفضلِه، أتقدَّم بخالصِ الشُّكر والتَّقدير إلى من أودَعت فينَا بذرة العِلم، فأتت اليَوم أُكلَها الدكتورة: سهى أبو دولة، كمَا يطِيبُ لي أن أخُصَّ بالشُّكر ووافِر التَّقدير لمن قبِلت بالإشرافِ على هَذا الإنجَاز فبرأيهَا رُسمت البدايَة وبتوجيههَا لُوِّنت النِّهاية " الدكتورة: مي تيم " والشُّكر موصُول لكافّة أعضَاء هيئةِ التَّدريس بِكليّة الصَّيدلة بجَامعَة الشَّرق الأوسّط.

Mohammed Fahad Alsharaan

Dedication

إلى من حفّـّني بِعنايَتهِ وأسبَغ عليَ من جزيلِ دُعاءه

لأصِل إلى ما وصلتُ إليه: والديّ العزيزين.

إلى من شدَّ الله به أزْرِي وشَاركنِي همَي: إخوتي.

إلى مُشكاة العلم ونورُ المعرِفة الذين مرّوا بي لكم منّي الشكر والتقْدير.

إلى الذي ولدْت فيهِ يافِعًا، وترَعرَعتُ به شَابًّا فرجلاً: وطني (المملكة العربية السعوديّة)

Mohammed Fahad Alsharaan

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List of Abbreviation

Abbreviation	Full term
ACS	American College of Surgeons
AMP	Antimicrobial prophylaxis
CDC	Centres for Disease Control and Prevention
IDSA	Infectious Diseases Society of America
KAP	Knowledge, Attitudes, and Practices
MOH	Ministry of health
NICE	National Institute for Health and Care Excellence
SAP	Surgical antibiotic prophylaxis
SIS	Surgical Infection Society
SSI	surgical site infection
WHO	World Health Organization

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Abstract

Introduction: Surgical site infections (SSIs) are one of the most consequential complications in patients undergoing surgeries and are associated with poor prognosis and increased hospital length of stays. Therefore, preoperative antimicrobial prophylaxis, administered within 60 minutes prior to surgery, is an important consideration aiming to prevent SSIs, and improve patient outcomes .

Aims: The present study aims to assess the knowledge, attitudes, and practices (KAP) of surgical teams, regarding preoperative antibiotic prophylaxis, along with their adherence in surgical units of secondary care hospitals in the Al-Jouf region of Saudi Arabia .

Methods: This is a descriptive cross-sectional study using a validated anonymous questionnaire assessing the KAP of 291 surgical staff of various specialties within fourteen secondary care units in Al-Jouf Health Cluster in the Al-Jouf province, Saudi Arabia .

Results: In this study, 92.8 % of all participants knew the purpose of antimicrobial prophylaxis, and 261 participants released that cefazolin is the antibiotic of choice in case of no penicillin allergy. However, only 24% of the participants “always” check for allergies between patients. Moreover, 34% of respondents showed agreement with the idea that the overuse of antibiotics is problematic in the hospital they work for. On the other hand, only 9% “always” observe non-compliance with preoperative antimicrobial prophylaxis guidelines .

Conclusions: This study demonstrates that the overall antimicrobial prophylaxis KAP was good, however, some principles regarding their practices should be monitored. Thus, multidisciplinary collaboration should be introduced. Furthermore, continuous training programs should be adopted in order to fulfil knowledge gaps and improve quality of surgeries.

Keywords: Knowledge, trends, practices, surgical staff, and microbial prevention in secondary care units, Al-Jouf, Saudi Arabia

المعرفة والمواقف والممارسات بين الكادر الجراحي تجاه الوقاية بمضادات الميكروبات قبل الجراحة في وحدات الرعاية الثانوية في الجوف، المملكة العربية السعودية

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الملخص

المقدمة: تُعدّ عدوى موقع الجراحة من أخطر المضاعفات التي تواجه المرضى الخاضعين للعمليات الجراحية، وهي مرتبطة بتوقعات سيئة للشفاء وزيادة مدة الإقامة في المستشفى. لذا، يُعدّ إعطاء المضادات الحيوية الوقائية قبل الجراحة، خلال 60 دقيقة قبل العملية، إجراءً هامًا للوقاية من هذه العدوى وتحسين نتائج المرضى.

الأهداف: تهدف هذه الدراسة إلى تقييم معارف ومواقف وممارسات الفرق الجراحية فيما يتعلق بالوقاية بالمضادات الحيوية قبل الجراحة، ومدى التزامهم بها، في وحدات الجراحة بمستشفيات الرعاية الثانوية بمنطقة الجوف في المملكة العربية السعودية.

المنهجية: هذه دراسة وصفية مقطعية تستخدم استبيانًا مجهولًا ومعتمدًا لتقييم معارف ومواقف وممارسات 291 من الكوادر الجراحية من مختلف التخصصات في 14 وحدة رعاية ثانوية في مجمع الجوف الصحي بمنطقة الجوف، المملكة العربية السعودية.

النتائج: في هذه الدراسة، كان 92.8% من المشاركين على دراية بهدف الوقاية بالمضادات الحيوية، وأفاد 261 مشاركًا بأن السيفازولين هو المضاد الحيوي المُفضّل في حال عدم وجود حساسية للبنسلين. مع ذلك، لم يقم سوى 24% من المشاركين بفحص الحساسية بين المرضى "دائمًا". علاوة على ذلك، أبدى 34% من المشاركين موافقتهم على أن الإفراط في استخدام المضادات الحيوية يُشكّل مشكلة في المستشفى الذي يعملون فيه. من جهة أخرى، لم يلحظ سوى 9% "دائمًا" عدم الالتزام بإرشادات الوقاية بالمضادات الحيوية قبل الجراحة.

الاستنتاجات: تُظهر هذه الدراسة أن المعرفة والمواقف والممارسات العامة للوقاية بالمضادات الحيوية كانت جيدة، إلا أنه ينبغي مراقبة بعض المبادئ المتعلقة بممارساتهم. لذا، ينبغي تطبيق التعاون متعدد التخصصات. إضافة إلى ذلك، ينبغي اعتماد برامج تدريبية مستمرة لسدّ الثغرات المعرفية وتحسين جودة العمليات الجراحية.

الكلمات المفتاحية: المعرفة ، الاتجاهات، الممارسات، الطاقم الجراحي، الوقاية من الميكروبات، في وحدات الرعاية الثانوية، الجوف، المملكة العربية السعودية.

Chapter One
Background and Problem Statement

1.1 Introduction

Surgical site infections (SSIs) are among the most common healthcare-associated infections and represent a major concern in surgical practice due to their impact on patient outcomes and healthcare systems. Antibiotic resistance is a global and significant healthcare issue that threatens the effectiveness of contemporary medical care and directly increases morbidity and mortality worldwide. The excessive and inappropriate use of antibiotics in healthcare institutions has contributed to the rise of hospital-acquired infections and to the reduced effectiveness of many essential antibiotics that previously served as a first line of defense against bacterial infections (Mthombeni *et al*., 2024). This growing problem has necessitated coordinated efforts across medical fields, particularly in surgery, where teams frequently encounter cases that require the administration of prophylactic antibiotics during operative care.

Surgical antimicrobial prophylaxis is a preventive intervention aimed at reducing the incidence of surgical site infections (SSIs). It involves administering an effective antibiotic either before surgery or during the procedure in order to achieve an adequate drug concentration in tissues at risk of infection (Yu, Steadman, & Chetty, 2023). Antimicrobial prophylaxis refers to the use of antimicrobials to prevent, rather than treat, infection in clinical settings, especially when the risk of microbial contamination is high (Ioannou et al., 2022). This approach aims to limit microbial burden at potential infection sites before pathogens multiply, thereby decreasing the likelihood of postoperative or procedure-related infections (Dhole *et al*., 2023).

In surgical practice, antimicrobial prophylaxis is typically implemented by selecting an appropriate antibiotic and administering it within a specific time window—commonly within 60 minutes before incision—to ensure adequate tissue levels during the period of highest risk for contamination (Lightner *et al.*, 2020). Such evidence-based timing and selection strategies are designed to maximize patient safety, reduce postoperative infection rates, minimize hospitalizations, and prevent complications related to SSIs (Singh Gill *et al*., 2018). Additionally, optimizing prophylactic antibiotic use supports antimicrobial stewardship by

targeting the most likely pathogens associated with specific procedures while helping reduce the development of antimicrobial resistance (Johnson *et al*., 2020).

Enhancing compliance with surgical prophylaxis protocols in Saudi hospitals supports the Saudi Vision 2030 goals of improving patient safety, reducing healthcare-associated infections, and strengthening evidence-based clinical practice (Ahmed et al., 2022). For this reason, a KAP (Knowledge, Attitudes, and Practices) approach is useful because it helps explain why guidelines are not always followed: it assesses what healthcare workers know about prophylactic antibiotics, how they feel about the protocols, and how they actually apply them in practice. By identifying misconceptions, training needs, and system-related barriers, KAP findings can guide targeted interventions to improve adherence to prophylaxis procedures and reduce the increasing risk of antimicrobial resistance in the Saudi healthcare sector (Zarei *et al.,* 2024). Although Saudi healthcare workers may have adequate theoretical knowledge, weak clinical implementation can lead to inappropriate antibiotic use, resulting in negative outcomes such as higher rates of surgical site infections (SSIs), increased treatment costs, and the progression of antimicrobial resistance (Binown *et al.*, 2021). Therefore, addressing this knowledge–practice gap is essential to improve the appropriate use of surgical antibiotic prophylaxis.

These issues are not local to the developing nations, but rather a global problem that is impacting healthcare systems of the middle- and high-income countries. The issue of full compliance with the recommendations of surgical prophylaxis continues to be influenced by work pressures, multiple duties, and knowledge differences among the members of the healthcare team, even in well-developed healthcare facilities (Mthombeni *et al.,* 2024).

The prevention of microbial resistance and infection control in Saudi Arabia a crucial issue to the Ministry of Health, which is considered in the context of the Saudi Vision 2030. This stipulates the increase in the efficiency of health services and the quality of care provided at every level.

Moreover, the evaluation of the knowledge, attitudes, and practices of surgical personnel in the secondary care unit of the Al-Jouf region is an important step to assess the compliance with the international and local recommendations on surgical antibiotic prophylaxis. The detection of knowledge or practice weaknesses can help in the creation of training programs that can be used to fill such areas and enhance the quality of surgical care.

Thus, the proposed research in the Saudi environment should serve two purposes: to determine the existing awareness and commitment rates of surgical staff toward surgical antimicrobial prophylaxis, and to make a contribution to the national strategies of preventing the emergence of antimicrobial resistance and improving patient safety. It is especially important to pay attention to the secondary care units, which are the bridge between primary care and advanced medical centres and, therefore, the enhancement of their practice has a significant influence on the entire public health system.

1.2 Antimicrobial Prophylaxis

Globally, SSIs are among the most widespread postoperative complications, which have led to higher morbidity and mortality rates, increased hospitalization stays, and escalation of healthcare costs (World Health Organization [WHO], 2024; JAMA, 2023; Preas *et al*., 2023). . Even after the development of new surgical practices, sterilization protocols, and provision of postoperative care, SSIs still remain a major problem within the health care setting (WHO, 2024; Preas *et al.*, 2023). The use of surgical antibiotic prophylaxis (SAP) during surgery is considered one of the most important tools in the prevention of SSIs (Centers for Disease Control and Prevention [CDC], 2024; Preas *et al*., 2023). Properly administered (usually 60 minutes prior to surgery), SAP lowers the microbial burden in the operating room, In accordance with the host's immune system's ability to control it, thus decreasing the chance of developing postoperative SSIs (CDC, 2024; Preas *et al.*, 2023).

Although several strong international guidelines, such as those of the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), the National Institute for Health and Care Excellence (NICE), and the Infectious Diseases Society of America (IDSA), are available (CDC, 2024; WHO, 2022; National Institute for Health and Care Excellence [NICE], 2023; Preas *et al.*, 2023), local guidelines are still essential because they adapt these recommendations to the country context, including local antimicrobial resistance patterns, hospital resources, and commonly performed procedures. However, compliance with surgical antimicrobial prophylaxis (SAP) remains inconsistent worldwide and may also vary between hospitals even when local guidelines exist (Khan et al., 2020; Ali *et al*., 2025). Evidence shows that errors in timing reduce the effectiveness of prophylaxis, and inappropriate antibiotic selection, dosing, or duration can negatively affect surgical outcomes (Khan *et al.*, 2020; Alves *et al.*, 2024). These discrepancies are often linked to differences in knowledge, attitudes, and practices among

surgical staff, as well as system-level limitations such as weak antimicrobial stewardship structures, limited oversight, and inconsistent professional training (Ali *et al*., 2025; PLOS Global Public Health, 2025).

1.2.1 Definition of the Term (Antimicrobial Prophylaxis)

In the surgical context, antimicrobial prophylaxis, particularly preoperative antibiotic prophylaxis (SAP), is defined as the administration of antimicrobial agents with the aim of reducing the incidence of surgical site infection (SSI), without being part of the treatment of an existing infection. This practice is a limited-duration and targeted preventive intervention, carefully planned and given at a specific time that ensures Effective concentrations within the tissue are reached at the moment when microbial contamination is most likely to occur, whether during the incision, during tissue exposure, or when the wound is closed (Brocard *et al.*, 2021). Although access to a fully sterile surgical environment is theoretically ideal, exposure to a certain amount of bacteria persists even with the highest standards of sterilization. Antibiotic prophylaxis aims to reduce the bacterial load to a level that the patient's immune system can handle efficiently, reducing the risk of infection developing. In general, antibiotic prophylaxis is a preventive, temporary, and targeted measure designed to target the most likely pathogens associated with the type of surgical intervention in question, and in accordance with the characteristics of the procedure, its location and the nature of the bacteria common in it (Preas *et al.*, 2023).

The efficacy of the SAP relies on several essential principles of pharmacokinetics and pharmacodynamics: the antibiotic needs to reach and ensure concentrations exceeding the minimum inhibitory concentration (MIC) of the targeted organisms during the highest risk. Furthermore, surgical procedures do not always need SAP; its need depends on the level of contamination, type of procedure, and risks associated with the patient. SAP protocols are informed by epidemiological trends, microbial susceptibility profiles, and surgical risk groupings in the literature (Komatsu *et al*., 2024).

In practice, SAP is part of a more incomplete infection diminution system, which includes observation to sterilization techniques, proper skin research, proper decontamination of tools and equipment, controller of environmental issues within the operating room, clean surgical techniques, and post-operative wound care. Although SAP is not the only component

of this system, its effect is critical in reducing SSIs rates, especially in clean and polluting processes. Its effectiveness can only be achieved through the application of evidence-based clinical judgment, clear institutional policies, and continuous follow-up and scrutiny to ensure adherence to the guidelines (Wolfhagen *et al.*, 2022).

1.2.2. Fundamental Principles (Timing, Selection, Dose, Duration)

The use of antibiotics before the procedure is one of the most important basic principles for surgical prevention in SAP. Sommerstein *et al.,* 2023; De Jonge *et al.,* 2021) agreed that antibiotics should be given within 60 minutes before the incision in order to ensure adequate levels of blood and tissue when any potential contamination occurs, while in some cases vancomycin and fluoroquinolones can be given up to 120 minutes before the incision. Furthermore, studies have shown that not adhering to this ideal timing is associated with an increased risk of developing an SSI (Khaitovych & Vityuk, 2025). This is seen as the concentration of antibiotic in the tissues may decrease during surgery to below the effective concentration, especially if the duration of the operation is longer than the half-life of the drug, redosing during the procedure is necessary to ensure that adequate therapeutic levels are maintained throughout the surgery if the dose is not re-dosed when needed, antibiotic levels in the tissues may drop below the minimum inhibitory concentration by the time of closure, increasing the risk of infection). Wound site (Sommerstein *et al.,* 2023).

The prophylactic antibiotic should cefazolin be chosen to balance between efficacy and safety, spectrum of activity, and resistance management. In the majority of practices, a narrow-spectrum antibiotic to cover those organisms most commonly linked with SSIs (Staphylococcus aureus, coagulase-negative Staphylococci, and chosen Gram-negative organisms) is favored over the broad-spectrum drugs. Local microbial epidemiology and resistance patterns should be used to select them in order to provide adequate coverage, but to prevent unjustified exposure to antimicrobials. The overuse of broad-spectrum agents leads to the risk of antimicrobial resistance, Clostridium difficile infection, and other undesired outcomes. Calderwood *et al.,* (2023) emphasized that the selection of antibiotics should be related to the nature of surgery and local susceptibility information to achieve the highest level of prophylaxis.

Practically, non-adherence to the recommended antibiotic choices is still prevalent. As an example, several tertiary hospitals have reported inappropriate use of third-generation cephalosporin as routine prophylaxis, although guidelines do not recommend their use in clean procedures. It was found that this tendency correlates with increased SSI rates and highlights the implications of incorrect prescriptive behavior (Vippadapu *et al.,* 2022).

Regarding dosage, the prophylactic antibiotic must achieve sufficient plasma and tissue concentrations above the minimum inhibitory level of the potential antibiotic, taking into account patient factors (such as weight and renal function). Standard dosing regimens are often adequate for patients of average weight, but in obese or overweight patients, an increased dose may be required to achieve the same tissue permeability. Some guidelines suggest weight-adjusted dosage or "dose doubling" for overweight patients (Calderwood *et al.,* 2023). Moreover, regarding the route of administration, an intravenous route is usually chosen to ensure rapid and reliable bioavailability compared to oral formulations. Mis-dosing (underdosing or overdosing) impairs efficacy or increases the risk of toxicity (Coates *et al.,* 2022).

Additionally, the duration of prophylaxis should be as short as possible, preferably a single dose preoperatively, with the possibility of repeating the dose intraoperatively if necessary, and not extended beyond 24 hours in most cases (Castro-Balado et al., 2024). Evidence suggests that continuing prophylaxis into postoperative period confers no added benefit and may increase side effects, antimicrobial resistance, and costs. For example, in a study comparing single-dose and multiple-dose regimens in abdominal surgery, the multiple-dose approach did not demonstrate a significant advantage over single-dose prophylaxis in preventing surgical wound site infection (Ryan *et al.,* 2022). Therefore, many guidelines advise against routinely continuing postoperative antibiotics. Review studies have consistently found that prophylaxis extended beyond 24 hours is associated with diminished outcomes and an increased risk of resistance (Calderwood *et al.,* 2023).

1.2.3 International Recommendations and Guidelines (CDC, WHO, NICE, IDSA)

The recommendations regarding surgical antimicrobial prophylaxis (SAP) offered by major international organizations, such as the CDS, WHO, and NICE, are closely compatible. In these guidelines, the main principles are taking antibiotics prior to the incision (within 60 minutes or within 120 minutes in case of agents that should be given

as a long-term infusion), choice of narrow-spectrum antibiotics, redosing during prolonged procedures or excessive blood loss, as well as the non-recommendation of using antibiotics after wound closure (WHO, 2022; Preas et al., 2023; NICE, 2020). Despite its broad similarity, there are some slight differences: the WHO suggests a wider 120-minute range to accommodate various global contexts; CDC guidance contains stronger emphasis on pharmacokinetic-based redosing; and the NICE places a high priority on institutional auditing and the limitation of continuing the use of the postoperative antibiotics, especially with regard to implant-related procedures.

The guidelines used nationally in Saudi Arabia are a product of the Ministry of Health (MOH) and the Saudi Center of Disease Prevention and Control (Weqaya) and reflect these global standards. It also suggests the use of the antibiotics prior to incision (within 60 minutes according to local antibiogram patterns), the choice depending on local microbial patterns, weight-adjusted dosing, redosing during the operation when needed, and discontinuation within 24 hours of surgery (Saudi MOH, 2021). This is in line with the world best practices and reinforces other antimicrobial stewardship activities and patient-safety priorities inherent in Saudi Vision 2030.

1.2.4 Challenges in Implementation of Antimicrobial Prophylaxis (Barriers)

Scorn widespread mindfulness of guidelines, the practical employment of surgical antibiotic prophylaxis is tense with challenges. One of the most momentous challenges is poor adherence. Numerous studies reported frequent deviations: administering antibiotics too early or too late, using broad-spectrum or inappropriate agents, not repeating doses during long surgeries, and prolonging postoperative prophylaxis. Khan et al. (2020) described this shortcoming as stemming from a lack of knowledge, attitudinal resistance, and entrenched clinical habits (Khan *et al.,* 2020). In many cases, surgical and anesthesia teams operate independently of pharmacy or administrative oversight, weakening accountability. Another significant challenge lies in systemic and logistical constraints. In secondary or resource-constrained hospitals, shortages of recommended antibiotics, delays in procurement, poor coordination between the pharmacy and the operating room, lack of reminder/order entry systems, and workforce constraints hinder treatment adherence (Niyomugabo et al., 2023). For example, in an Indian setting, Khan et al. (2020) found that although the majority of prophylactic antibiotics in the secondary hospital studied were cephalosporins, prescribing practices remained variable, with some

patients being given combination regimens (penicillin + aminoglycosides) or nitroimidazoles without clear justification (Castro-Balado *et al.,* 2024). In a teaching hospital in Uttarakhand, an evaluation of 258 surgical cases found instances of inappropriate antibiotic selection and use, highlighting gaps between ideal standards and practice (Rajkumar, 2019). Clinicians may also overprescribe antibiotics due to low confidence in recommendations or fear of blame if infection occurs, which can lead to unnecessary or prolonged prophylaxis (Wood *et al.,* 2019). According to a qualitative study by Wood et al. (2019) conducted in Nigeria, inadequate compliance with instructions was linked to weak feedback systems, poor enforcement, difficulty changing long-term habits, and ineffective communication between professional groups. In this context, pharmacists can play a simple but important role by supporting local SAP guidelines, checking antibiotic choice, dose, and timing, and providing feedback or education to improve adherence. Similarly, obstetrics and gynecology stewardship programs led by pharmacists showed improved compliance, supporting dedicated antibiotic stewardship roles as part of surgical teams (Abubakar, Seed-Sulaiman, and Adesun, 2019). In addition, concerns about antibiotic resistance, side effects, and medical and legal risks may paradoxically hinder optimal prophylaxis. Some clinicians may extend prophylaxis "just in case" even when evidence does not support benefit, which increases risks such as Clostridium difficile infection, antimicrobial toxicity, and antimicrobial selection pressure. Wrong SAP due to poor timing, unwarranted extension, or improper drug choice is closely linked with increased incidences of SSIs. In a systematic review published in 2023, inappropriate prophylaxis was associated with poorer postoperative outcomes, including higher SSI rates, compared with guideline-adherent prophylaxis, showing that misuse of antibiotics does not protect patients and may increase resistant strains (Niyomugabo *et al.,* 2023).

1.3 Problem Statement

Surgical site infections remain a major issue in most health facilities, and secondary care hospitals in the Al-Jouf region of Saudi Arabia are not an exception in terms of the variability in the use of preoperative antibiotic prophylaxis. Hospital manager reports, and practices' patterns reveal that there are variations in knowledge on the best timing of surgical staff, the choice of appropriate antibiotics, and the right dose, all of which constitute key elements of effective prophylaxis. This implies a possible discrepancy

between what staff members are expected to know and what is in actual practice throughout the surgical work processes. The results of foreign research only support the importance of the problem: Tefera and Melaku (2019) have shown that the lack of knowledge and improper dosage may negate the effectiveness of prophylaxis, while Mthombeni et al. (2024) have indicated that positive intentions are not always accompanied by a proper use of antibiotics.

Moreover, Kovy Arteaga-Livias *et al.* (2022) have shown that the absence of coordination and the temptation to deviate from the recommended guidelines could compromise the quality of outcomes Although these investigations are not internal, they represent the general issue at a global scale and remind the potential probability that these gaps can exist in Al-Jouf. However, there is still no data on the real levels of knowledge, attitudes and practices among surgical personnel of this region. The absence of localized evidence is a serious issue, since hospitals will not be able to develop specific interventions or stewardship strategies before defining the nature and scale of such gaps.

With a Saudi background, there is a dearth of research examining the understanding, attitudes, and practices of surgical personnel in relation to antibiotic prophylaxis.The absence of recent local information on compliance with accepted guidelines leads to knowledge gaps hindering the formulation of effective national policies to decrease surgical infections and antibiotic resistance. Thus, the issue of the given research is the necessity to examine the truth of the knowledge, attitudes, and practices of the surgical staff in secondary care units within AL-Jouf Health Cluster, in Al-Jouf region, and determine the factors that influence adherence to the protocols in order to establish the scientific premises of the quality improvement interventions and continuous education on the discussed crucial topic. Moreover, this research is the first study, up to our knowledge, to examine the KAP and adherence of different surgical team professions in the Al-Jouf region in Saudi Arabia and bridges the gap in the literature on this topic of research.

1.4 Questions of study

1. What is the level of knowledge among surgical staff regarding preoperative antibiotic prophylaxis in secondary care hospitals in the Al- Jouf region?
2. What attitudes do surgical staff members hold toward implementing preoperative antibiotic prophylaxis?
3. What practices do surgical staff members actually follow when implementing antibiotic prophylaxis protocols?
4. What factors influence the level of knowledge, attitudes, and practices regarding preoperative antibiotic prophylaxis? For example familiarity with evidence-based guidelines, and institutional support for training.
5. What is the level of adherence to the local guidelines among surgical staff regarding preoperative antibiotic prophylaxis in secondary care hospitals in the Al Jouf region?

1.5 The aim and the objectives of the Study

This research aims to evaluate the knowledge, attitudes, and practices' levels of surgical teams toward preoperative antibiotic prophylaxis in surgical units of secondary care hospitals in the Al-Jouf province in Saudi Arabia. This aim can be achieved by the following objectives:

1. To identify the level of knowledge, attitudes, and practices among surgical staff regarding the application of preoperative antibiotic prophylaxis in secondary care hospitals in the Al-Jouf region, Saudi Arabia.
2. Understanding the attitudes of surgical staff members towards preoperative antibiotic prophylaxis.
3. Identifying the actual practices followed by surgical staff members during the application of antibiotic prophylaxis protocols, and comparing them with what is stipulated in the approved protocols.
4. To identify the factors associated with the level of knowledge, attitudes, and practices among surgical staff.
5. To determine the level of adherence to the local guidelines among surgical staff regarding preoperative antibiotic prophylaxis in secondary care hospitals in the Al-Jouf region.

1.6 Significance of the Study

1.6.1 The Importance of the Theoretical Study:

The conceptual importance of the research is that the knowledge level, attitudes, and practices of surgical staff about preoperative antibiotics prophylaxis in secondary care units are enriched. The study is the first study to investigate the knowledge, attitudes, and practices of preoperative antibiotic prophylaxis of surgical staff in secondary care hospitals within the Al-Jouf region of Saudi Arabia.

The results of the study lead to an understanding of the gaps between theory and practice in the hospital environment. In addition, it offers a theoretical model to explain the correlation between knowledge, professional behaviour and treatment adherence. Moreover, the study may also be used as an academic source in the future by researchers who may aim to explore the effect of training and education in enhancing the practice of medical staff or how to formulate models in the assessment of the professional performance in the area of surgical antibiotics prophylaxis.

1.6.2 The Importance of the Applied Study:

The practical significance of this research is that it will give recommendations on practical measures to be implemented to enhance the quality of surgical care and minimize the rate of postoperative infections. The results of the study provide good data on the strengths and weaknesses of the knowledge and practices of surgical staff to allow the administrators of hospitals and healthcare units to create specific training and awareness programs. Moreover, the findings our study is in of international “observational” following the preventive measures and the rational use of antibiotics, which will also aid in reducing the emerging issue of antimicrobial resistance and positively influence the patient’s outcomes in the long term.

Chapter Two
Theoretical Framework and Previous Studies

2.1 Introduction

Surgical site infections (SSIs) remain one of the most significant contributors to healthcare-associated infections (HAIs) worldwide, leading to considerable postoperative morbidity, prolonged hospital stays, and increased healthcare costs. Owens and Stossel (2008) estimated that SSIs account for approximately 20% of all HAIs, highlighting their role as one of the most frequent postoperative complications among hospitalized patients. This burden is particularly evident in low- and middle-income countries, where overcrowding, resource constraints, and inconsistent adherence to infection control practices further elevate risk. Beyond postoperative pain and delayed recovery, SSIs may progress to deep tissue involvement, sepsis, or death, resulting in substantial pressure on health systems globally (Reichman & Greenberg, 2009).

To understand why SSIs remain prevalent despite advances in surgical care, it is necessary to consider their multifactorial pathogenesis. SSIs emerge through the interaction of patient characteristics, procedure-related factors, and exposure to microorganisms. Common sources of contamination include the patient's endogenous flora, surgical instruments, aerosols, and contact transmission via healthcare workers' hands. The pathogens most frequently implicated include *Staphylococcus aureus*, coagulase-negative staphylococci, and various Gram-negative bacteria (Owens & Stossel, 2008). Supporting the importance of environmental and procedural controls, Whyte and Healy (1979) demonstrated that airborne particles in operating rooms can readily accumulate in open surgical incisions, emphasizing the need for robust environmental regulation and infection prevention measures. Accordingly, recognizing how these exposures occur is essential for strengthening prevention strategies and implementing effective control measures (Whyte & Healy, 1979).

Within the broader prevention framework, surgical antimicrobial prophylaxis (SAP) before incision is recognized as a cost-effective and evidence-based approach to reduce SSIs. When administered correctly—typically within 60 minutes prior to incision—antimicrobial prophylaxis reduces microbial burden at the surgical site and lowers infection risk (Pan et al., 2017). However, incorrect dosing, inappropriate agent selection, or suboptimal timing can reduce prophylactic benefit and contribute to antimicrobial resistance. Reflecting this concern, the 2016 update of the American College of Surgeons

(ACS) and Surgical Infection Society (SIS) guidelines emphasized evidence-based antibiotic use tailored to the type of surgery and patient risk stratification (Pan et al., 2017). While guideline adherence is therefore essential for patient safety and stewardship, multiple studies have reported persistent gaps in adherence across healthcare systems, including those in high-income settings.

Importantly, consistent implementation of SAP depends not only on the existence of guidelines but also on the knowledge, attitudes, and practices (KAP) of the surgical team. Leaper et al. (2014) noted that poor adherence is often associated with insufficient knowledge and variable attitudes among surgical staff. Misconceptions regarding antibiotic effectiveness, safety, and optimal administration time—combined with hierarchical decision-making within operating rooms—may hinder compliance with best practice standards. In addition, variation in institutional protocols and limited continuous professional education can further worsen non-adherence. For these reasons, assessing KAP among surgical staff is essential for identifying barriers to implementation and designing interventions that address real-world determinants of practice (Leaper *et al.,* 2014).

In Saudi Arabia, the Saudi Vision 2030 reform agenda has supported substantial improvement in healthcare quality. Nonetheless, challenges remain in ensuring standardized care across different regions, particularly in secondary care settings, including hospitals in Al-Jouf. These facilities serve wide geographic areas and large populations, yet may face constraints such as limited training opportunities and uneven availability of standardized protocols (Alshamrani et al., 2025; Alkaaki *et al.,* 2021). Despite the availability of broader SSI-related data, research focusing on SAP adherence and the KAP of healthcare workers in Al-Jouf remains limited. Therefore, investigating adherence patterns and KAP in this region is important for strengthening antimicrobial stewardship and improving surgical outcomes (Alghamdi et al., 2025; Abalkhail *et al.,* 2021).

Building on this local context, the literature consistently indicates that adherence to SAP guidelines is a cornerstone of SSI prevention, yet remains suboptimal worldwide. Leaper et al. (2014) observed that even when guidelines are available, healthcare providers frequently diverge from recommended practices due to time constraints, clinician preferences, and unclear or inconsistent regional protocols. In secondary care environments, limited resources and variable training further intensify these challenges (Leaper *et al.,* 2014). Nevertheless, structured care bundles implemented with high

fidelity have demonstrated the potential to reduce SSI rates substantially—by up to 40%—indicating that improvements in implementation can lead to meaningful clinical gains (Pan *et al.*, 2017).

At the same time, the success of antimicrobial stewardship initiatives is strongly influenced by behavioral and organizational determinants. Prescribing patterns may be shaped by habitual practice, fear of legal repercussions, and the routine preference for broad-spectrum agents (Reichman & Greenberg, 2009). Moreover, organizational culture—especially in operating rooms—may discourage junior staff from challenging inappropriate practices, reinforcing non-adherence. In this regard, behavior-change approaches such as audit and feedback, reminders, and peer comparison have shown promise for shifting entrenched prescribing habits. Consequently, KAP assessment should extend beyond knowledge measurement to include behavioral drivers and institutional contexts in order to guide practical, implementable interventions (Reichman & Greenberg, 2009).

Positioning SSIs within the broader HAI landscape further underscores the urgency of prevention. HAIs affect millions of patients annually and generate billions in healthcare costs (Magill *et al.*, 2014). In a large U.S. point-prevalence survey, Magill *et al.* (2012) identified SSIs as the second most common HAI, following pneumonia, emphasizing their contribution to hospital-acquired morbidity. Viewing SSIs through this broader safety lens supports stronger institutional prioritization, resource allocation, and integration of SSI prevention into comprehensive patient safety strategies.

Despite global emphasis on infection control, data from regions such as Al-Jouf remain insufficient. This lack of province-specific evidence limits the development of tailored policies that reflect local realities. Additionally, Niyomugabo *et al.* (2023) emphasized that international guideline applicability must be evaluated in local contexts because cultural, educational, and institutional variables can influence implementation outcomes. Accordingly, this study aims to address this gap by assessing the knowledge, attitudes, and practices of surgical staff in Al-Jouf regarding SAP.

Given the combined challenges of postoperative morbidity, economic burden, and antimicrobial resistance, generating accurate and context-specific evidence on SAP practices is critical. This study therefore tests the hypothesis that gaps in surgical staff knowledge, attitudes, and practices significantly contribute to inadequate compliance

with SAP standards and, consequently, higher SSI rates. Exploring these factors in Al-Jouf secondary care settings may strengthen infection control policy, support rational antibiotic use, and improve surgical outcomes in alignment with national and global priorities for antimicrobial stewardship and patient safety (Velozo *et al.,* 2024).

2.2 Surgical Site Infections (SSIs) and the Associated Clinical Burden

SSIs are among the most common complications in modern surgical services, affecting healthcare systems in both low- and middle-income countries (LMICs) and high-income countries. Despite advances in aseptic technique, prophylactic antibiotic use, and postoperative care, SSIs continue to cause substantial morbidity and mortality and frequently lead to prolonged hospitalization and additional procedures (Berríos-Torres et al., 2017). The resulting increase in reoperations, ICU admissions, and antibiotic use places considerable financial and logistical strain on health systems (Reichman & Greenberg, 2009). Thus, SSI rates reflect not only surgical performance but also the effectiveness of institutional infection prevention strategies and antimicrobial stewardship.

This clinical burden is further intensified by the growing prevalence of antimicrobial-resistant organisms, which compromise both prophylactic and therapeutic effectiveness. Multidrug-resistant pathogens—particularly *S. aureus* and methicillin-resistant *S. aureus* (MRSA)—represent major challenges for prevention and treatment (Schaberg, 1994). Evidence indicates that failure to adhere to prophylaxis guidance, inappropriate broad-spectrum selection, and errors in timing or duration contribute to resistant postoperative infections (Berru et al., 2022). These risks are amplified in many LMIC settings due to variability in clinical practice, limited standardization, and weaker infrastructure for infection-control oversight (Yu, Steadman, & Chetty, 2023; Farley *et al.,* 2019).

2.2.1 Scientific Definition and Classifications of SSIs

SSIs can be classified by anatomical depth, timing of onset (early versus late), and degree of surgical contamination (clean, clean-contaminated, contaminated, or dirty/infected). Clean procedures—where no infection is present and no entry occurs into respiratory, gastrointestinal, reproductive, or urinary tracts—tend to carry lower SSI risk, whereas contaminated and dirty surgeries present higher risk (Reichman & Greenberg, 2009). SSIs are also commonly categorized as superficial incisional, deep incisional, or organ/space infections, including infections extending into body cavities or involving

prosthetic material. These classifications support standardized surveillance, reporting, and benchmarking across institutions.

The clinical rationale behind classification is that depth and anatomical involvement influence pathogen access, virulence, antibiotic penetration, and host immune response. Superficial infections typically present with redness, discharge, and localized symptoms, while deep or organ/space infections are more severe and may include fever, abscess formation, and the need for reoperation. Because deep infections may involve implants or internal cavities, they are often more complex and associated with higher morbidity (Reichman & Greenberg, 2009).

2.2.2 Global and Local Epidemiological Statistics

Globally, SSIs account for a substantial proportion of HAIs, though reported rates vary by procedure type and healthcare setting. In some contexts, SSI rates exceed 10–20%, reflecting resource limitations, patient complexity, and gaps in infection control. For instance, a meta-analysis reported SSI rates ranging from 4.09% to 26.7% in abdominal surgeries, with an average occurrence of approximately 13% (Marzouk et al., 2023). Likewise, pooled analyses of pancreaticoduodenectomies reported a combined SSI rate of about 23%, with deep and organ/space infections frequently observed (Annals of Medicine and Surgery, 2024). These findings illustrate the scale of SSI burden in high-risk surgical procedures.

Within the Middle East, meta-analyses have reported SSI rates following cesarean delivery in the range of approximately 4% to 6%, with variation across institutions and patient groups. Although local data remain limited, these findings suggest that SSI burden persists even in comparatively resource-rich settings such as Saudi Arabia, especially in secondary or peripheral hospitals where preventive adherence may be less consistent (Cai *et al.*, 2022).

Beyond incidence rates, SSIs significantly contribute to prolonged hospitalization, readmission, reoperation, increased antibiotic use, and mortality. Database studies indicate that deep SSIs in trauma patients are associated with longer ICU stays, extended mechanical ventilation, reduced likelihood of discharge home, and higher in-hospital mortality compared to patients without deep SSI (Rayzah, 2025). Similarly, economic analyses have shown that SSIs markedly increase length of stay and overall treatment costs, placing substantial strain on surgical services and healthcare systems (de Lissovoy et al., 2009).

2.2.3 Risk Factors Associated with SSIs

SSI risk is influenced by multiple patient, surgical, and perioperative factors. Diabetes and perioperative hyperglycemia impair neutrophil function and microvascular perfusion; intensive glycemic control has been linked to reduced infection risk in cardiac surgery (Zer *et al*., 1997). Malnutrition and hypoalbuminemia weaken immune responses, while obesity increases infection risk through impaired tissue perfusion and reduced antibiotic penetration (Chen *et al.,* 2007; Marzouk et al., 2023). Additional recognized risk factors include smoking, immunosuppression, older age, anemia, and higher risk classifications such as elevated ASA score (Neumayer et al., 2007; Marzouk *et al.,* 2023).

Procedure-related factors also play a major role. Longer surgical duration, significant blood loss or transfusion, emergency procedures, open approaches, reoperation, contaminated or dirty wounds, and intraoperative spillage increase infection risk (Marzouk et al., 2023). Evidence from colorectal surgery indicates male sex, obesity, diabetes, smoking, high ASA class, intraoperative transfusion, and longer operative time as independent predictors of postoperative infection (Cai *et al.,* 2022).

However, risk patterns can vary by specialty. In neurosurgery, Magni et al. (2024) identified CSF leakage, reoperation, emergency surgery, prolonged operative time, longer hospitalization, and use of intracranial pressure monitoring devices as key predictors of SSI after craniotomy. Notably, factors common in other specialties (e.g., BMI, diabetes, sex, implant use) did not consistently predict infection risk in neurosurgical patients, highlighting that SSI prevention should be adapted to procedure-specific risk profiles rather than applying a uniform approach (Magni *et al.,* 2024).

2.2.4 Relationship between SSIs and Misuse of Antibiotics

Misuse of Antibiotics use in surgical prophylaxis is closely linked to SSI incidence and antimicrobial resistance. Incorrect timing, inappropriate dosing, unnecessarily prolonged courses, or unjustified broad-spectrum agents may fail to maintain adequate tissue concentrations at the critical contamination window and may promote selective pressure favoring resistant organisms (Mirahmadi *et al.,* 2025). Studies in LMICs have repeatedly demonstrated associations between non-adherence to prophylaxis guidelines and higher SSI rates (Arteaga-Livias *et al*., 2022; Yu, Steadman, & Chetty, 2023).

For example, evidence from obstetrics and gynecology surgeries in Peru indicates persistent adherence gaps. Arteaga-Livias et al. (2023) reviewed 529 surgeries across two hospitals and reported that while prophylaxis was frequently indicated, overall adherence remained limited. Only 55.5% of patients received the appropriate antibiotic, and just 31.2% achieved full guideline adherence across timing, dose, route, and other procedural standards. Cefazolin was most commonly used, but correct implementation was inconsistent. Such variability may elevate postoperative infection risk and reinforces the need for more rational and standardized antibiotic use.

2.3 Antimicrobial Resistance (AMR) in the Surgical Context

Antimicrobial resistance (AMR) refers to the ability of microorganisms—such as bacteria, viruses, parasites, and fungi—to withstand antimicrobial agents, reducing treatment effectiveness. In surgical contexts, AMR constitutes a major threat because it reduces the effectiveness of prophylaxis and increases the risk and complexity of SSIs. AMR arises through microbial genetic adaptation, and it is accelerated by inappropriate antibiotic use (Schaberg, 1994). As resistant organisms become more prevalent, infections become more difficult to treat and may require more toxic or costly therapies.

Of particular concern in surgical units are multidrug-resistant organisms such as MRSA and vancomycin-resistant Enterococci (VRE). Postoperative infections caused by such organisms can lead to treatment failure and increased clinical and economic burden (Owens & Stossel, 2008). The CDC has described AMR as among the most serious threats to health, with surgical settings representing high-risk environments due to frequent antibiotic exposure and invasive procedures (Berríos-Torres *et al.,* 2017).

AMR also increases hospitalization duration, costs, and readmissions. Patients with resistant wound infections often require isolation measures, intensive monitoring, and more aggressive management, which burdens staff and hospital resources. The WHO has recognized antibiotic misuse in both prophylactic and therapeutic contexts as a major driver of AMR globally (Allegranzi *et al.,* 2016). Therefore, improving stewardship within surgical practice is essential, and because surgical teams directly influence antibiotic decision-making, their knowledge and practices play a critical role. Continuous professional education on AMR and rational antibiotic use is fundamental for strengthening stewardship and improving outcomes (Ban *et al.,* 2017; Al-Tawfiq & Al-Tamami, 2018).

2.3.1 Surgical Practices as a Source of Resistance

Surgical practice contributes to AMR primarily through irrational antibiotic prophylaxis, including deviation from evidence-based standards, unnecessarily prolonged prophylaxis, and unjustified broad-spectrum use (Leaper et al., 2014; Van Kasteren *et al.,* 2003). Such patterns are often sustained by outdated routines, limited access to updated evidence, or reliance on institutional habits rather than evidence-based decision-making.

Evidence from multiple settings—including Saudi Arabia and Turkey—indicates widespread variation from local and international prophylaxis guidelines. In a Saudi tertiary hospital, Al-Ghamdi *et al.* (2020) reported low adherence to recommended timing and selection of prophylaxis, increasing concerns regarding unnecessary antibiotic exposure. Similarly, Karali et al. (2020) found that many surgeons in Turkey continued to prescribe prophylaxis for prolonged durations despite evidence discouraging this approach. These examples illustrate a global pattern where practice norms may override guideline recommendations.

This issue can be amplified in complex procedures and settings with weaker infection control systems. Prolonged prophylaxis beyond 24 hours remains common in orthopedic surgery, despite limited benefit and increased risks such as resistance and *C. difficile* infection (Onikwelu *et al.,* 2017; Krader & Varakalu, 2025). Such patterns suggest that surgery can contribute to AMR both directly (through misuse of antibiotics) and indirectly (by reinforcing cultures of non-adherence). Addressing this requires targeted interventions at training, policy, and hospital system levels to ensure stewardship is supported rather than undermined (Reichman & Greenberg, 2009; Abubakar *et al.,* 2020).

2.3.2 Studies Linking Irrational Prophylaxis to AMR

Global evidence indicates that inappropriate prophylaxis contributes to AMR through delayed administration, prolonged duration, and unnecessary broad-spectrum use, creating selective pressures within surgical environments. In Dutch hospitals, Van Kasteren et al. (2003) reported increased infection risks when recommended prophylaxis regimens were not followed, highlighting how deviations can influence microbial ecology and resistance patterns.

Similar concerns have been documented in the Middle East. Al-Ghamdi et al. (2020) described variable selection practices and misuse in Saudi settings, while Al-Tawfiq and Al-Tamami (2018) reported that antibiotic administration often continued beyond recommended limits in major referral centers. Collectively, these findings suggest that routine prescribing behaviors in operating rooms can shape resistance trajectories and broader public health outcomes.

Evidence also indicates that institutional interventions can improve outcomes. A multicenter Turkish survey of 7,978 surgical patients found that only one-fifth received full guideline-recommended prophylaxis, with many patients receiving antibiotics beyond recommended timing and duration, and 4,652 discharged with unnecessary prophylaxis (Çelik Ekinci et al., 2024). In contrast, a multidisciplinary quality improvement program at King Hussein Cancer Center in Jordan improved adherence and reduced inappropriate antibiotic use (Telfah et al., 2015). Together, these studies highlight that both systemic shortcomings and institutional governance influence SAP performance and that sustainable improvement requires accountability and structured implementation.

2.3.3 Importance of Changing Surgical Staff Behavior

In practice, antibiotic use during surgery is often driven more by daily routines and professional norms than by written guidelines. Research suggests prescribing decisions may be influenced by habit, social culture, and fear of complications, leading to unnecessary or extended prophylaxis and increased resistance risks. Binown et al. (2021) reported that many orthopedic surgeons in Saudi Arabia held positive attitudes toward SAP but still demonstrated inconsistent practices, particularly regarding timing and duration. Encouragingly, interventions that revise local procedures, integrate clinical pharmacists, and provide targeted education have improved adherence and reduced inappropriate antibiotic use (Telfah et al., 2015). Recent work also emphasizes that sustainable improvement requires behavior-oriented strategies, including audit, feedback, and engagement of surgical leadership (Kourbeti et al., 2024).

Evidence also links education directly to outcomes. In South Africa, Yu et al. (2023) demonstrated that improved knowledge and practice among surgeons and anesthesiologists correlated with lower postoperative infection rates and that structured training improved compliance. Similarly, Mthombeni et al. (2024) reported that professional commitment and

the involvement of clinical pharmacists supported stronger guideline adherence and successful stewardship implementation. These findings reinforce that continuous education and system-level reinforcement are central to improving SAP compliance.

2.4 Secondary Care Units and the Role of Surgical Staff

Secondary care hospitals serve as essential providers of surgical services, particularly in regions where they represent the primary referral facilities for large populations. Their infection prevention capacity and stewardship practices are therefore critical. Evidence suggests that secondary hospitals may face limited antimicrobial stewardship infrastructure and fewer organized training programs, contributing to weaker adherence to SAP practices (Ajao et al., 2020). These limitations directly affect surgical outcomes because daily decisions made by surgeons, anesthesiologists, and nurses determine whether SAP is implemented correctly in terms of timing, choice, and duration. Differences in institutional policy, high workload, and insufficient continuing education are repeatedly identified as key drivers of poor SAP practice in secondary-level hospitals (Telfah et al., 2015). Strengthening these facilities through standardized procedures, periodic audits, and targeted training is therefore necessary—particularly in Al-Jouf, where local evidence remains limited.

2.4.1 Composition and Roles of the Surgical Team

The surgical team in secondary care hospitals typically includes surgeons, anesthesiologists, operating room nurses, surgical assistants, and technical staff, all of whom contribute to infection prevention (Chaudhary & Gat, 2021). While surgeons commonly determine SAP choice and timing, effective implementation depends on coordinated teamwork across all roles. However, available evidence indicates that prescribing behavior is often influenced by routine practice, peer pressure, and institutional norms rather than guideline-directed decisions, leading to wide variability in SAP practice (Khorasani et al., 2019).

These challenges become more pronounced when structured training is absent. Bani Saadi et al. (2016) highlighted that training variation contributed to practice gaps among thoracic surgeons in Iran, reflecting how local institutional context shapes adherence patterns. Additionally, communication problems within operating rooms may lead to delays or errors in prophylaxis administration, undermining infection control. Therefore,

acknowledging team interdependence is essential when designing training, audits, and stewardship strategies. Strengthening SAP training and implementation can improve compliance and reduce SSIs and resistance in secondary care hospitals (Ali et al., 2025).

2.5 The KAP Model – Knowledge, Attitudes, and Practices

The Knowledge, Attitudes, and Practices (KAP) model is a key analysis tool applied to determine the nature of the understanding, perception, and practice of clinical guidelines among healthcare professionals. KAP, in the case of (SAP), can be used to understand why the practice generally falls short of the recommended way, even with evidence-based guidelines available.

Knowledge indicates the degree to which the Doctors, nurses, pharmacists, infection control specialists are aware of the suggested time of administration, choice, and period of prophylaxis antibiotics. Attitudes reflect how they value and believe in the SAP effectiveness and readiness to follow guidelines. Practices indicate real-world behavior involved in a clinical setting, such as how and when antibiotics are used (Ahmed et al., 2019).

These three components do not theoretically interact directly, but are related by specific relationships supported by empirical evidence. Ahmed et al. (2019) found in their cross-sectional study of 165 surgical staff members in Sudan that only 42% were able to correctly determine the recommended time to administer surgical antibiotic prophylaxis (SAP), which is within 60 minutes of the incision procedure, and about 38% believed that prolonged use The Knowledge, Attitudes, and Practices (KAP) model is widely used to assess how healthcare professionals understand, perceive, and apply clinical guidelines. In the context of SAP, the model helps explain why practice may remain inconsistent even when evidence-based recommendations exist. Knowledge refers to clinicians' awareness of recommended antibiotic selection, timing, and duration. Attitudes reflect beliefs about SAP effectiveness, safety, and willingness to follow guidelines. Practices describe real-world behaviors, such as when antibiotics are administered and for how long (Ahmed et al., 2019).

Although these components are distinct, empirical evidence indicates meaningful relationships among them. Ahmed et al. (2019) found in a cross-sectional study of 165 surgical staff in Sudan that only 42% correctly identified the recommended SAP timing (within 60 minutes before incision), while 38% incorrectly believed that prolonged postoperative antibiotics reduce infection risk despite guideline evidence to the contrary.

More than half of participants reported practices inconsistent with national protocols or WHO guidance. Importantly, higher knowledge scores were associated with more positive attitudes toward adherence ($p < 0.05$), and knowledge showed a moderately positive correlation with practice ($r \approx 0.47$), suggesting that improved understanding can support better prescribing behavior.

These findings indicate that knowledge gaps can shape attitudes and, in turn, influence clinical practice. Clinicians who misunderstand timing recommendations may be more likely to administer unnecessary postoperative antibiotics, illustrating how misconceptions translate into inappropriate prescribing. Similar patterns have been observed in other settings, supporting the view that KAP gaps represent a widespread challenge across healthcare systems (Özgüler et al., 2022).

Additional evidence from Saudi Arabia reinforces this issue. Al-Sheikh and Al-Otaibi (2023) reported that although plastic surgeons recognized the importance of hygiene and infection prevention, misconceptions related to antimicrobial resistance and local microbial patterns contributed to deviations from protocols. This supports the importance of assessing each KAP domain separately and examining their interaction. A robust KAP assessment provides clearer insight into where and why noncompliance occurs, enabling more targeted interventions. Accordingly, KAP study outcomes can guide policymakers, educators, and hospital administrators in designing training, audit, and feedback systems that address barriers to optimal SAP use (Al-Mutairi et al., 2024).

2.5.1 The Interconnection Between Knowledge, Attitudes, and Practices

The KAP model proposes that clinician knowledge shapes perceptions of guideline relevance, which then influences the likelihood of adherence. In surgical practice, this relationship is dynamic: knowledge informs decision-making, while attitudes may evolve through experience and institutional culture. Evidence indicates that insufficient knowledge of SAP is strongly associated with weaker commitment to guideline adherence (Özgüler et al., 2022). As shown by Ahmed et al. (2019), clinicians who understood SAP recommendations were more likely to value prophylaxis and administer antibiotics at the correct time, whereas those with limited understanding treated guidelines as optional, resulting in poorer compliance.

However, knowledge alone may not fully explain behavior. Benaoun et al. (2021) reported inconsistencies in SAP behavior even among surgeons with similar knowledge levels, suggesting that attitudes are influenced by additional factors such as hierarchy, patient expectations, and fear of complications. In these situations, organizational support and leadership play an important role in reinforcing guideline adherence.

In this study, the KAP components are measured using a structured questionnaire. Knowledge is assessed through questions related to SAP guidelines, attitudes are evaluated using statements reflecting perceptions and beliefs toward SAP, and practices are measured through self-reported behaviors related to antibiotic use (Ahmed et al., 2019).

Despite its usefulness, the KAP approach has some limitations. Since practices are self-reported, responses may be affected by recall bias or social desirability bias. However, KAP remains a practical and appropriate method for this study, as direct observation is time-consuming, resource-intensive, and may influence clinicians' behavior. Therefore, KAP is considered sufficient to identify key gaps and barriers related to SAP adherence (Al-Mutairi et al., 2024).

2.5.2 Impact on Quality of Surgical Care

The KAP framework is closely linked to surgical care quality, particularly in SSI prevention and AMR control. Strong KAP among surgical teams supports infection prevention, reduces complications, shortens hospital stays, and lowers costs. Conversely, deficits at any point—limited knowledge, weak attitudes toward guideline relevance, or inconsistent implementation—can increase patient risk (Ahmed et al., 2019). Benaoun et al. (2021) suggested that improper SAP often reflects misinformation or poor clinical judgment, contributing to higher infection rates, delayed recovery, and increased dependence on broad-spectrum antibiotics, thereby accelerating resistance and weakening institutional performance.

Supporting this relationship, Al-Mutairi et al. (2024) reported in Kuwait that obstetricians and gynecologists with higher practice and attitude scores were more consistent in prophylaxis adherence and demonstrated lower postoperative infection prevalence. Beyond individual competence, KAP is also a collective team characteristic influencing communication, decision-making norms, and the overall culture of care.

Teams that support evidence-based practice promote shared responsibility and continuous learning, strengthening patient safety and service quality (Özgüler et al., 2022).

2.5.3 The Importance of Studying KAP for Behavioral Change

Assessing KAP among surgical staff provides a practical pathway for behavior change by identifying the cognitive, motivational, and organizational determinants of noncompliance with SAP guidelines (Ahmed et al., 2019). Rather than relying on generic training, KAP evaluation enables targeted interventions based on real barriers to adherence.

Evidence from multiple regions demonstrates persistent knowledge and practice gaps. Tefera and Melaku (2019) in Ethiopia reported that many clinicians had inadequate knowledge of international prophylaxis guidance and relied heavily on personal experience rather than standardized protocols. Rodríguez et al. (2021) in Argentina identified low compliance with prophylaxis recommendations linked to insufficient knowledge and limited accountability, with prolonged postoperative antibiotics persisting despite stewardship principles. Similar findings were reported in Peru, where weak oversight and lack of ongoing training were associated with poor timing and non-concordant antibiotic selection in obstetric and gynecologic surgeries (Peru et al., 2022).

Across both low-resource and high-resource contexts, hierarchical norms and organizational culture repeatedly emerge as strong influences on practice. Al-Mutairi et al. (2024) observed that clinicians may follow senior surgeons' preferences even when these contradict established protocols, making leadership engagement central to behavior-change efforts. Notably, tailored interventions may yield stronger results than standardized education. Al-Sheikh and Al-Otaibi (2023) showed improved SAP adherence when feedback addressed personal attitudes and habitual practices, indicating that behavior-focused strategies can be more effective.

At the policy level, integrating KAP findings into routine audits and continuing professional development supports more sustainable improvement. Benaoun et al. (2021) emphasized that KAP-based assessment strengthens implementation, improves accountability, and promotes continuous performance monitoring. Thus, KAP functions not only as a diagnostic tool but also as a structured pathway for aligning clinical behavior with evidence-based standards and improving surgical outcomes.

Finally, although research on SAP is increasing, much of the literature remains focused on single professional groups—most commonly surgeons—rather than the entire surgical team, including anesthesiologists, nurses, and operating room staff. This gap is particularly clear in Saudi Arabia, where no published research has comprehensively assessed KAP across the full surgical workforce in the Al-Jouf Health Cluster. Given that Al-Jouf includes multiple secondary hospitals with high surgical activity and multidisciplinary teams whose behaviors directly affect SAP compliance and patient outcomes, evaluating their KAP is essential for designing targeted regional interventions. Addressing this gap aligns with Saudi Vision 2030 priorities related to healthcare quality, patient safety, and antimicrobial stewardship. Generating local evidence in Al-Jouf therefore represents a critical step toward improving surgical care and strengthening stewardship in the region.

Chapter Three
Methodology (Methods and Procedures)

3.1 Introduction

The chapter addresses the study methodology that has been employed in this research, the objective of the study, and the answering of the study questions. It also gives a detailed account of methodological procedures involved in data collection and analysis. The reliability of the results and their generalizability are improved by the application of a clear and strict scientific approach (Creswell & Creswell, 2018). The chapter is relevant considering that methodology plays a crucial role in health research, especially issues regarding preoperative antibiotic prophylaxis. It is a highly relevant topic that is closely correlated with the quality of healthcare and patient safety since surgical site infections (SSIs) rank among the most frequent post-surgical complications, and they usually prolong the duration of stay, increase the costs of treatment, and elevate mortality rates (Allegranzi et al., 2016). Thus, the present chapter includes a step-by-step description of the study design, its population, sample, selection mechanism, research instrument applied to gather data, the mechanism of verification of its psychometric qualities (validity and reliability), study procedures, and analysis statistical procedures of collected data.

3.2 Study Design

The study was a descriptive cross-sectional survey that involved using an anonymous, validated, and pilot-tested structured questionnaire among surgical staff members in secondary care units in Aljouf Health Cluster, Aljouf province, Saudi Arabia, regarding preoperative antimicrobial prophylaxis. Prior to the main data collection, the questionnaire was pilot-tested in a similar secondary care setting within the same cluster to assess clarity, feasibility, and the average time needed for completion, and to ensure that the items and response options were understandable and appropriate for the clinical context. Feedback from pilot participants was used to refine the tool through minor modifications, including rephrasing unclear questions, simplifying wording, improving instructions, adjusting the sequence of items to enhance flow, and refining response options where necessary. The pilot responses were reviewed to identify any items with frequent missing answers or inconsistent interpretation, and the pilot findings were used only to improve the questionnaire and confirm its practicality; therefore, pilot data were

not included in the final study analysis. This design was regarded as one of the most widespread designs used in health studies as it provides a clear picture of the current situation during a specific time period without manipulation or control of variables, while allowing exploration of relationships between study variables (Setia, 2016). This method also enables the researcher to distribute the instrument promptly to the target population, analyze the collected data, and generate reliable scientific conclusions. The present design is also applicable to research concerning healthcare practitioners' behavior due to its ability to highlight gaps between practical implementation and theoretical understanding (Wang et al., 2023).

3.3 Study Setting

The present research was carried out in Secondary Care Units located in Aljouf Health Cluster in Aljouf province, Saudi Arabia. The cluster delivers healthcare services through 14 general and specialized government hospitals that provide a range of surgical services. Data were collected from the main surgical and perioperative areas within the participating secondary hospitals, including general surgery, orthopedics, obstetrics and gynecology, urology, ENT, and anesthesia/operating room services, to capture variation in surgical antimicrobial prophylaxis (SAP) practices across different clinical contexts. The selection of this region was based on the availability of multiple surgical specialties, which ensured a broad representation of medical staff involved in the current research. Moreover, the number of surgeons, resident physicians, surgical nurses, and clinical pharmacists directly involved in the planning, implementation, and oversight of prophylactic antimicrobial use is relatively large. Conducting the study in Aljouf hospitals enabled an accurate and objective assessment of staff knowledge, adherence, and routine practices in relation to national and international guidelines for surgical antimicrobial prophylaxis.

3.4 Study Population and Sample

3.4.1 Study Population

The surgical staff of several specialities in secondary care units of Aljouf Health Cluster of Aljouf region, Saudi Arabia, was be the focus of this study, comprising surgeons, surgical residents, operating room and surgical department nurses, and clinical pharmacists, which amounts to about 962 employees (Consultant surgeon, Specialist surgeon, Resident surgeon, Surgical nurses, Clinical Pharmacist). This population was

chosen due to its direct relation to the prevention of surgical infections by the use of antimicrobials and their experience and working experience to predict and provide relevant information on the use of prophylactic antibiotics.

3.4.2 Sample Size

The sample of the members of the surgical staff in the hospitals belonging to Aljouf region was chosen in a representative manner. The researcher distributed an electronic questionnaire in coordination with the hospitals, which ensured delivery of the questionnaire to the target community. The current sample size was calculated by the online Raosoft sample size calculator (https://www.raosoft.com/samplesize.html), the recommended sample size were (275) employees. A total of 291 questionnaires were retrieved, forming the study sample. This sample is considered appropriate to meet the scientific requirements of cross-sectional studies in terms of the target community, with a statistical confidence of 95% and a margin of error of 5% (Lwanga & Lemeshow, 1991).

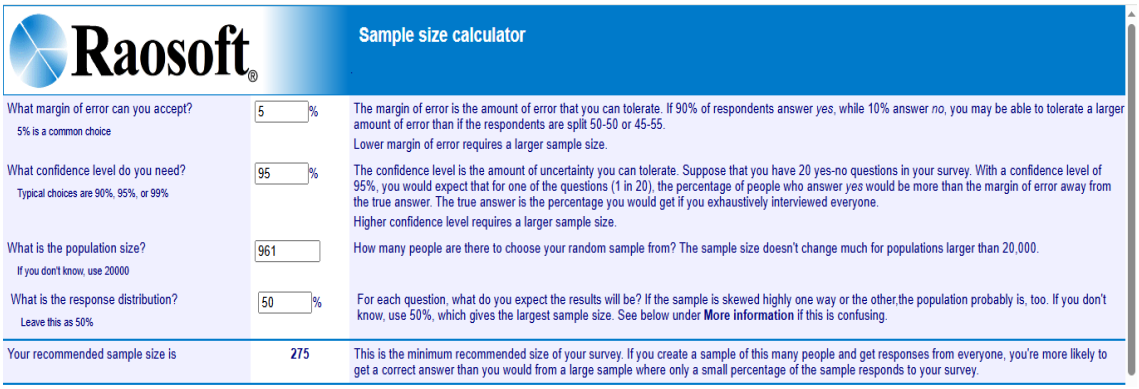

Figure 3.1 Study Sample Calculation

3.4.3 Sampling Technique

The current study sample was selected using convenient sampling, to ensure the participation of all categories of surgical staff in the study.

3.4.4 Participant recruitment

In coordination with the hospitals under study, participants were recruited, with the study objectives explained, and informed consent, data confidentiality, and use for research purposes only were emphasized. Each participant is entitled to submit only one response.

- **Inclusion Criteria**

1. Surgical staff members directly involved in surgical procedures or the administration of prophylactic antibiotics.
2. Voluntarily consenting to participate in the study.

- **Exclusion Criteria**

1. Employees currently not employed (leaving work, long leave).
2. Employees who are not directly involved in administering prophylactic antibiotics before surgery.

3.5 Study Instrument

The current study depends on a structured questionnaire adopted from previously validated published instruments of KAP studies evaluating preoperative AMP. Such as (Ahmed et al. Patient Safety in Surgery, 2019؛ Binown KA, Alhabradi FA, Aljahani AM, Shadid AM. Saudi orthopedic surgeons' knowledge, attitude, and practice regarding surgical antibiotic prophylaxis, 2021). This questionnaire consists of five sections collecting demographic data, knowledge, attitudes, practices, and adherence regarding the use of preoperative AMP aiming to prevent (SSIs).

Section One: Demographic Information

The first section of the questionnaire capture respondents' background data to enable descriptive analysis:

1. Age Group
2. Gender
3. Professional
4. Specialty
5. Years of clinical experience
6. Work schedule
7. Receiving training on surgical antimicrobial prophylaxis in the last 2 years.

Second section was used to assess surgical staff's knowledge of preoperative antibiotic prophylactic, regarding the types of procedures requiring their use, dosage timing, duration, and appropriate antibiotic selection. The items were developed based on scales used in previous studies, such as (Abdaljaleel et al., 2025؛ Al-Azzam et al.,

2012؛Amanna & Nwankwo, 2025؛ Binown et al., 2021). This section contained twelve items to identify knowledge gaps among surgical staff that may impact adherence to local and international guidelines related to the use of preoperative antibiotics. all questions were based on multiple-choice format where participants were asked to select the most appropriate answer according to their prior knowledge.

To facilitate the comparison between the participants' responses regarding the items of this section, the correct answer was coded as (1) and the incorrect answer as (0), and the total of the participants' responses to the section items was calculated. According to Barakat & Abougalambou (2023) the levels of knowledge can be classified into three categories, as follows:

Table 3.1 Scoring of Knowledge Towards Preoperative Anti-Microbial Prophylaxis

Level	%	Scoring
Good Knowledge	80 - 100%	9-11
Moderate Knowledge	60 % - 79%	7-8
Poor Knowledge	Less than 60%	0-6

Section 3 was used to assess surgical staff's beliefs and attitudes toward adherence to preoperative prophylaxis, confidence in selecting the appropriate prophylaxis agent, their beliefs about the importance of prior and ongoing training, and the importance of collaboration among surgical staff, as well as their responsiveness to updated national and international guidelines. These items were developed based on scales used in previous studies, such as (Abdaljaleel et al., 2025؛ Al-Azzam et al., 2012؛Amanna & Nwankwo, 2025؛ Binown et al., 2021). This section contained six items, and a five-point Likert scale (strongly agree to strongly disagree) was used to assess the level of positive attitudes toward these practices.

Section 4 was used to assess participants' actual practice, including adherence to antibiotic use according to the preoperative antimicrobial protocol. This section include questions related to the number of times the surgical team administered antibiotics according to guidelines, the number of times they checked the patient's allergy before prescribing/administering antibiotics, ensuring the antibiotic was given 30–60 minutes before the surgical incision, the number of times the timing of prophylactic antibiotic administration was documented, re-evaluating the need to continue antibiotic therapy, how often you participated in audits or reviews of antimicrobial prophylaxis in your

department, and the observed adherence to the Antimicrobial Stewardship Program guidelines. This section includes seven items to link actual practice and identify gaps in practical application. A five-point Likert scale (always, often, sometimes, rarely, never) was used to enable participants to accurately assess their responses.

Section 5 assessed participants' level of adherence to national guideline in terms of correct dosing and repeat dosing, consideration of each patient's health status, and reporting violations. This section consisted of eight items using a five-point Likert scale (always, often, sometimes, rarely, never), two multiple-choice question, and one open-ended question, leaving participants free to make any suggestions they deem appropriate.

3.6 Validity of Study Instrument

The content validity of the survey was verified by presenting it to a specialized committee of physicians and faculty members with expertise in clinical pharmacy and surgery from Jordanian universities and hospitals (n=12). This was done to provide suggestions for developing the tool items, ensure that the scales measure the objectives they were designed to measure, and verify the linguistic and scientific accuracy of the items and their representation of the field to which they belong. The evaluation committee provided its proposed modifications, which included modifying some items, deleting others, and adding new items. The researcher adhered to making the proposed modifications to develop the tool and ensure its reliability.

3.7 Pilot Study

A pilot sample of 35 employees from the study population was used to test the reliability of the questionnaire. The reliability of the instrument was verified by calculating the internal consistency coefficient, Cronbach’s alpha, for each section. According to Tavakol and Dennick, (2011). The statistically approved value for reliability in health research is (0.70 and above).

Table 3.2 Cronbach's alpha coefficients of study variables

Variables	No. of Items	Cronbach's alpha coefficients
Knowledge	11	0.799
Attitude	6	0.721
Practice	7	0.733
Adherence	11	0.782

Table 3.1 illustrate that Cronbach's alpha coefficients ranged between (0.721-0.799) which indicates the reliability of the study instrument according to what was recommended by (Tavakol and Dennick, 2011), where Cronbach's alpha coefficients were > 0.70.

3.8 Data Collection Procedure

Data for the current study were collected through a self-administered questionnaire distributed electronically to the target community to save time and effort and to overcome the difficulty of accessing all hospitals, after obtaining administrative and ethical approvals. Coordination was carried out with administrators in the surgical departments and the human resources department to ensure that the questionnaire reached the target groups. The data collection process took approximately 60 days from June to August 2025, with periodic follow-up and continuous communication with the relevant authorities to maximize the response rate and achieve balanced representation.

However, this approach has some limitations. First, more motivated staff may have been more likely to respond, which may affect the representativeness of the sample. Second, practices were self-reported, so some participants may have reported ideal or guideline-based behaviors rather than their actual routine practice. In addition, missing or incomplete responses may have reduced the usable data. Finally, unequal access to electronic systems or differences in communication channels across hospitals may have influenced participation rates among different groups.

3.9 Ethical consideration

Approval was obtained from the Scientific Research Committee at Middle East University (2025/2024-1497), the Saudi Ministry of Health, and relevant hospitals in the Aljouf region of Saudi Arabia before distributing the questionnaires. The researcher also

assured the confidentiality of the data and that it would be used for scientific research purposes only.

3.10 Data Analysis

Data analysis was performed using the statistical package of the social sciences (SPSS) version 26, and coding were used in Excel. Frequencies and percentages of correct and incorrect responses were used to measure the knowledge of the participants. The frequencies, percentages, means, and standard deviations were calculated to identify the degree of adherence, practices and attitudes of the participants. Moreover, Multivariate Analysis of Variance (MANOVA) was utilized to examine the correlation between socio-demographic and occupational features of the participants and their knowledge, attitudes, practice, and adherence. The criterion ($p<0.05$) was chosen to represent the presence of statistically significant differences between the responses of the participants. The correlation coefficient was also determined by Pearson in order to analyze the relationships between the study variables.

Chapter Four

Results of the Study

4.1 Introduction

The structured questionnaire was used by the researcher to obtain data of the target group, to be analyzed using the statistical analysis program (SPSS), where the appropriate statistical methods were used to ascertain the way the participants are distributed in terms of their demographic data, the extent to which they exhibit the required level of knowledge, attitudes, and practices and eventually find the extent to which the participants adhere to the approved guidelines utilizing the descriptive analysis program of the grounded data.

4.2 Demographic Data

The demographic data of the involved participants (age, gender, profession, speciality, years of clinical practice experience, work schedule, and training on surgical antimicrobial prophylaxis during the past 2 years) will be analyzed in this section. Percentages and frequencies were determined. Table 4.1 shows demographic findings.

Table 4.1 Participants' Demographic Information

Variables	Categories	N	Percentage%
Age Group	Under 25	34	11.7
	25–34	90	30.9
	35–44	92	31.6
	45–54	61	21.0
	55 and above	14	4.8
Gender	Male	157	54.0
	Female	134	46.0
Professional	Consultant surgeon	46	15.8
	Specialist surgeon	55	18.9
	Resident surgeon	26	8.9
	Surgical nurses	34	11.7
	Clinical Pharmacist	113	38.8
	Other	17	5.8
Specialty	General Surgery	44	15.1
	Orthopaedic Surgery	34	11.7
	Ear, Nose and Throat	32	11.0
	Obstetrics & Gynaecology	68	23.4
	Urology	24	8.2
	Plastic surgeon	20	6.9
	Cardiothoracic surgeon	25	8.6

Variables	Categories	N	Percentage%
	Other	44	15.1
Years of clinical experience	Less than 1 year	39	13.4
	1–5 years	84	28.9
	6–10 years	78	26.8
	More than 10 years	90	30.9
Work schedule	Full time	120	41.2
	Part time	85	29.2
	Shift duty	76	26.1
	Rotation	10	3.4
Receiving training on surgical antimicrobial prophylaxis in the last 2 years	Yes	224	77.0
	No	67	23.0
Total		**291**	**100%**

According to Table 4.1, the total number of subjects approached was (291). As the age variable indicated, the results revealed that 31.6 per cent of the sample were aged 35-44 years, and then 30.9 per cent of respondents who were aged 25-34 years. In the meantime, the least frequent were those participants more than 55 years old 4.8%. In terms of gender, (54%) of the respondents were males, with females making up (46%), with both sexes being represented in a fairly equal proportion. Regarding professional qualification, the greatest percentage of participants was in clinical pharmacists (38.8%), then specialist surgeons (18.9%). On examining the percentages of the categories of surgical specialties, it was discovered that obstetrics and gynecology had the highest representation (23.4%), then there was general surgery (15.1%), and plastic surgeons had a percentage representation of (6.9%). Regarding the years of clinical experience, 30.9% of participants had more than 10 years of experience, followed by 28.9% for participants with 1-5 years of experience (28.9%), while 13.4% of participants had less than 1 year. The results also showed that full-time work was the most common (41.2%), followed by part-time work (29.2%), while rotation was the least common (3.4%). Furthermore, our data revealed that 77% of all participants had received training about AMP within the past two years, while (23%) had not received any training.

4.3 Surgical Staff's Knowledge regarding Preoperative Anti-Microbial Prophylaxis

This section presents the results related to Knowledge among SSI towards preoperative Anti-Microbial Prophylaxis(PAMP) in secondary care units. The section provides an analysis of the questions related to the participants' knowledge about

preoperative prophylactic antibiotics, including the main purpose of using these antibiotics, the procedures that require their use, the appropriate timing for their administration, the reasons that determine the appropriate type of antibiotic, identifying the potential outcomes of improper antibiotic use, as well as the recommended duration for prophylactic antibiotics in most surgical procedures involving clean prosthetic implants, and the cases that require administering additional doses during surgery. Frequencies and percentages of participants' responses to the items in this section were calculated. The following tables present the results related to the items in this section.

Table 4.2 The frequencies and percentages of Surgical Staff's Knowledge regarding Preoperative Anti-Microbial Prophylaxis (n=291)

Questions	Answers	N	%	Participants who answer correctly
What is the main purpose of preoperative antimicrobial prophylaxis?	To treat active infections	15	5.2	270 (92.8%)
	To prevent surgical site infections	270	92.8	
	To reduce pain after surgery	1	0.3	
	To shorten hospital stay	5	1.7	
What are the types of procedure requiring surgical site preoperative antimicrobial prophylaxis?	Clean prosthetic/ implant involving procedure	221	75.9	221 (75.9%)
	Clean non-prosthetic procedure	46	15.8	
	Clean-contaminated surgery	11	3.8	
	Contaminated surgery	7	2.4	
	Dirty surgery	6	2.1	
When should prophylactic antibiotics ideally be administered before incision?	30–60 minutes before incision	282	96.9	282 (96.9%)
	Immediately after incision	1	0.3	
	1 hour after incision	5	1.7	
	At the end of surgery	3	1.0	
Which of the following is most important when choosing a prophylactic antibiotic?	Type of surgery and local resistance patterns	282	96.9	282 (96.9%)
	Patient's height	2	0.7	
	Patient's blood group	2	0.7	
	Surgeon's preference	5	1.7	
Which of the following is a potential consequence of inappropriate antimicrobial prophylaxis use?	Antimicrobial resistance	277	95.2	277 (95.2%)
	Shorter hospital stays	3	1.0	
	Decreased resistance	3	1.0	

Questions	Answers	N	%	Participants who answer correctly
	Increased surgical success	8	2.7	
Are broad-spectrum antibiotics routinely recommended for surgical prophylaxis?	No	255	87.6	255 (87.6%)
	Yes	33	11.3	
	Only in pediatric cases	2	0.7	
	Only in elderly patients	1	0.3	
What is the recommended duration for antimicrobial prophylaxis in most clean- prosthetic surgical procedures?	Single preoperative dose	266	91.4	266 (91.4%)
	1–3 days	13	4.5	
	3–5 days	6	2.1	
	Until patient discharge	6	2.1	
When should an additional intraoperative dose of antibiotics be given?	In case of prolonged surgery procedure (≤ 4 hours)	260	89.3	260 (89.3%)
	In case of excessive blood loss (< 1,500 mL of blood)	18	6.2	
	In case of high IV fluid administration	1	0.3	
	Never	12	4.1	
What is the first line surgical antimicrobial prophylaxis for cardiac stent insertion procedures?	Cefazolin	261	89.7	261 (89.7%)
	Cefuroxime	3	1.0	
	Gentamicin	2	0.7	
	Amoxicillin clavulanate	15	5.2	
	Ciprofloxacin	2	0.7	
	Ceftriaxone	3	1.0	
	Other	5	1.7	
What is the second line for surgical antimicrobial prophylaxis in case of penicillin allergy for cardiac stent insertion procedures?	Clindamycin	256	88.0	256 (88%)
	Vancomycin	23	7.9	
	Cefazolin	5	1.7	
	Cefuroxime	5	1.7	
	Gentamicin	2	0.7	
How should MRSA carriers be managed before surgery according to the guideline?	Use nasal mupirocin and chlorhexidine body wash	264	90.7	264 (90.7%)
	They should not undergo surgery	8	2.7	
	Use cefazolin and ignore the colonization	13	4.5	
	Give metronidazole only	6	2.1	

Table 4.2 displays the frequencies and percentages of Surgical Staff's Knowledge regarding Preoperative Anti-Microbial Prophylaxis. The results of Table 4.2 showed that

most of the participants (92.8%) knew that the main purpose of preoperative antimicrobial prophylaxis which is preventing surgical site infections, while (5.2%) of the participants stated that the purpose was to treat active infections, however only one participant stated that the purpose was to reduce pain after surgery. Moreover, the results indicated that participants had good knowledge about procedures requiring preoperative antibiotic prophylaxis. (75.9%) of participants knew that clean prosthetic/implant-involving procedures require preoperative antimicrobial prophylaxis, while 15.8% of participants reported that clean non-prosthetic procedures were the type of surgeries requiring AMP. On the other hand, only2.1% of participants reported that dirty surgeries required AMP prophylaxis. Besides, the results revealed that most participants (96.9%) were aware of the optimal timing of prophylactic antibiotic administration of prophylaxis before incision. Moreover, (1.7%) of the participants reported that the optimal timing was one hour after the incision. However, only one participant indicated that the appropriate timing of AMP administration was immediately after incision. Table 4.2 showed that participants had good knowledge of the basic principles of antibiotic selection regarding the most important factor when selecting a prophylactic antibiotic, with 96.9% of them indicating that the most important factor when selecting a prophylactic antibiotic is Type of surgery and local resistance patterns. A few participants chose other factors such as patient's height and patient’s blood group (0.7%, 0.7%). In addition to, results revealed that the majority of participants (95.2%) indicated that the most potential consequence of inappropriate antimicrobial prophylaxis use was antimicrobial resistance. This is consistent with medical reports and international guidelines that have highlighted the negative effects of antibiotic misuse. In contrast, 2.7% of participants selected the answer "Increased surgical success” as the potential consequence of inappropriate antimicrobial prophylaxis, while six participants thought that "Shorter hospital stays," and "Decreased resistance” are the potential consequences to inappropriate selection. Furthermore, results presented that (87.6%) of participants confirmed that broad-spectrum antibiotics are not recommended for routine use in surgical prophylaxis, indicating participants' good knowledge of international and local a guidelines’ recommendations, emphasizing that the use of these antibiotics are based on the type of operation and resistance pattern within healthcare institutions to reduce the risk of antimicrobial resistance. Nonetheless, 11.3% of participants indicated that they use broad spectrum antimicrobial prophylaxis routinely. However, only 0.7% and 0.3% of participants reported their use of broad

spectrum AMP in special cases such as children and the elderly, respectively. Additionally, the results showed that the majority of participants (91.4%) had good knowledge of the international guidelines regarding the duration of antimicrobial prophylaxis in most clean- prosthetic surgical procedure, as they reported that the duration for antimicrobial prophylaxis in most clean-prosthetic surgical procedures is one single dose before the operation. In contrast, some participants indicated the duration of antibiotic use should be 1-3 days, 3-5 days, 3-5 days or until the patient is discharged from the hospital with percentages equal to 4.5%, 2.1% and 2.1%, respectively. the results of the participants' responses regarding the cases in which additional doses of antibiotics should be given. (89.3%) of participants identified that the primary reason for additional antimicrobial dose is a prolonged surgery procedure (≤ 4 hours). Nevertheless, 6.2% of participants indicated that the need for additional antibiotic dose is needed in case of excessive blood loss (< 1,500 mL of blood), while 4.1% of participants indicated that no additional doses are required, and only one participant indicated that the reason after prescribing additional antimicrobial dose is high IV fluid administration to the patient undergoing surgical procedure. The results showed that (89.7%) of the participants reported that cefazolin is considered the first line surgical antimicrobial prophylaxis for cardiac stent insertion procedures, which is consistent with international and local guidelines that recommend the use of Cefazolin for its effectiveness against bacteria causing surgical site infections. furthermore, some participants thought that the following antibiotics are the first line prophylaxis in cardiac procedures: Amoxicillin clavulanate (5.2%), Cefuroxime (1%), Ceftriaxone (1%), Gentamicin (0.7%), and Ciprofloxacin. The results of Table 4.2 showed that 88% of participants correctly selected clindamycin as the second line for surgical antimicrobial prophylaxis in cases of penicillin allergy for cardiac stent insertion procedures. This is consistent with the recommendations of international and national guidelines that indicate the use of clindamycin in patients with penicillin allergy. Moreover, the results regarding preoperative management of MRSA carriers according to guidelines showed that 90.7% of participants agreed on the importance of using nasal mupirocin and chlorhexidine body wash, consistent with clinical recommendations for the prevention of surgical site infections associated with MRSA.

Total knowledge score was calculated for each participant, by summation the total of correct answer. The following table show the frequency and percentage of level of surgical staff's knowledge regarding preoperative anti-microbial prophylaxis.

Table 4.3 Level of surgical staff's knowledge regarding preoperative anti-microbial prophylaxis

Level (Total Score Range)	N	%
Good Knowledge (9-11)	250	85.9%
Moderate Knowledge (7-8)	22	7.6%
Poor Knowledge (0-6)	19	6.5%

It is evident from Table 4.3 that 85.9% of the participants have good knowledge regarding preoperative anti-microbial prophylaxis, while 7.6% of them have moderate knowledge, and 6.5% have poor knowledge.

4.4 Surgical Staff Attitude Towards Preoperative Anti-Microbial Prophylaxis using in Secondary Care Units

This section presents the results related to attitude among surgical staff towards preoperative Anti-Microbial Prophylaxis in secondary care units. Frequencies, percentages, mean, standard deviation of participants' responses to the items in this section were calculated. The following table present the results related to the items in this section.

Table 4.4 Analysis of Attitude Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

Items		Level of Agreement					Mean	SD
		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree		
Do you think antimicrobial prophylaxis is essential in reducing surgical site infections?	Freq.	1	1	3	206	80	4.25	0.52
	%	0.3	0.3	1.0	70.8	27.5		
How the confidence in selecting the appropriate antibiotic for prophylaxis and whether antibiotic prophylaxis is necessary to reduce surgical site infections.	Freq.	0	0	12	55	224	4.73	0.53
	%	0	0	4.1	18.9	77.0		
Do you believe overuse of antibiotics is a problem in your hospital?	Freq.	5	24	84	99	79	4.77	1.00
	%	1.7	8.2	28.9	34.0	27.1		
	Freq.	4	13	68	109	97	3.97	0.93

Items		Level of Agreement					Mean	SD
		Strongly Disagree	Disagree	Neutral	Agree	Strongly agree		
Should regular antimicrobial prophylaxis training be mandatory for surgical staff?	%	1.4	4.5	23.4	37.5	33.3		
Is the collaboration between surgeons, anesthesiologists, and pharmacists important for antimicrobial prophylaxis?	Freq.	0	1	7	207	76	4.23	0.50
	%	0	0.3	2.4	71.1	26.1		
If new guidelines were introduced, would you be willing to change your current practice?	Freq.	0	2	21	210	58	4.11	0.54
	%	0	0.7	7.2	72.2	19.9		
	Attitude						**4.18**	**0.38**

The results of Table 4.4 showed that participants expressed positive attitudes toward Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units (mean = 4.18, SD = 0.38). The results showed that the arithmetic mean values of the items in this section ranged between (3.97-4.77) which means surgical staff had a positive attitude toward items. Results indicated that 70.8% of respondents agreed that the use of prophylactic antibiotics is necessary to reduce surgical site infections, while 27.5% strongly agreed. In contrast, 2 respondents (0.6%) expressed varying levels of disagreement. In addition, 224 participants (77%) strongly agreed that they are confident in selecting the appropriate antibiotic, and none of the participants expressed disagreement. Furthermore, 34% of participants strongly agreed that the overuse of antibiotics represents a problem in their hospital, while 8.2% did not agree. Moreover, 37.5% agreed that regular training on the use of prophylactic antibiotics should be mandatory for surgical staff, whereas 4.5% disagreed. With regard to collaboration among surgeons, anesthesiologists, and pharmacists, 71.1% agreed that such collaboration is important for the appropriate use of prophylactic antibiotics, while 0.3% did not agree. Additionally, 72.2% of participants expressed their agreement to change their current practice if new guidelines are issued, whereas 0.7% did not agree.

4.5 Surgical Staff Practice Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

This section presents the results related to practice among surgical staff towards preoperative Anti-Microbial Prophylaxis in secondary care units. Frequencies, percentages,

mean, standard deviation of participants' responses to the items in this section were calculated. The following table present the results related to the items in this section.

Table 4.5 Surgical Staff Practice Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

Items		Level of Agreement					Mean	SD
		Never	Rarely	Sometime	Often	Always		
How often do you administer antimicrobial prophylaxis according to guidelines?	Freq.	1	3	7	28	252	4.81	0.55
	%	0.3	1.0	2.4	9.6	86.6		
How often do you check for patient allergies before prescribing/administrating antibiotics?	Freq.	8	11	181	21	70	3.46	0.99
	%	2.7	3.8	62.2	7.2	24.1		
How often do you ensure the antibiotic is given 30–60 minutes before incision?	Freq.	3	3	8	23	254	4.79	0.64
	%	1.0	1.0	2.7	7.9	87.3		
How often do you document the timing of antimicrobial prophylaxis administration?	Freq.	6	4	10	30	241	4.70	0.78
	%	2.1	1.4	3.4	10.3	82.8		
After surgery, how often do you reassess the need for continued antibiotics?	Freq.	4	3	23	29	232	4.66	0.78
	%	1.4	1.0	7.9	10.0	79.7		
How often do you feel involved in antimicrobial prophylaxis audits or reviews in your department?	Freq.	7	8	36	197	43	3.90	0.77
	%	2.4	2.7	12.4	67.7	14.8		
How often do you observe non-compliance with AMP guidelines in your unit?	Freq.	9	23	202	32	25	3.14	0.80
	%	3.1	7.9	69.4	11.0	8.6		
Practice							**4.17**	**0.36**

The results of Table 4.5 revealed that the overall surgical staff practice of preoperative antimicrobial prophylaxis in secondary care units was positive (mean= 4.17; SD= 0.36), indicating staff adherence to clinical guidelines. The results showed that 252 (86.6%) always administer antimicrobial prophylaxis according to guidelines, 70 (24.1%) reported that they always check patients' susceptibility before administering antibiotics, and 181 (62.2%) reported that they sometimes check. The results also confirmed that 254 (87.3%) of the participants always ensure the antibiotic is given 30–60 minutes before incision. Also, 241 (82.8%) participants reported that they always documented the timing of antimicrobial prophylaxis, while 4 (1.4%) did not. Regarding re-evaluating the need to continue taking antibiotics after surgery, 232 (79.7%) participants indicated that they always re-evaluated, while 4 (1.4%) did not. Furthermore, the results indicated that 197 (67.7%) often felt involved in antibiotic prophylaxis audits or reviews in their department, 43 (14.8%) always felt involved, while 7 (2.4%) did not. Finally, the results concluded that 202 (69.4%) of the participants noticed non-compliance with AMP guidelines in their unit, while 32 (11%) often noticed non-compliance, while 9 (3.1%) of them never noticed it.

4.6 Surgical Staff Adherence to use Surgical Antimicrobial Prophylaxis Local Guidelines

This section presents the results related to surgical staff adherence to use surgical antimicrobial prophylaxis local guidelines. Frequencies, percentages, mean, standard deviation of participants' responses to the items in this section were calculated. The following table present the results related to the items in this section.

Table 4.6 Surgical Staff Adherence to use Surgical Antimicrobial Prophylaxis Local Guidelines

Items		Level of Agreement					Mean	SD
		Never	Rarely	Sometimes	Often	Always		
Do you follow national or institutional guidelines when administering preoperative antimicrobial prophylaxis?	Freq.	2	4	5	23	257	4.82	0.59
	%	0.7	1.4	1.7	7.9	88.3		
When administering prophylactic antibiotics, how often do you ensure they are given within the recommended time frame?	Freq.	1	3	7	36	244	4.78	0.57
	%	0.3	1.0	2.4	12.4	83.8		
How often do you redose antibiotics during surgery in accordance with guideline recommendations?	Freq.	4	6	189	28	64	3.49	0.90
	%	1.4	2.1	64.9	9.6	22.0		
	Freq.	13	14	187	27	50	3.30	0.96

Items		Level of Agreement					Mean	SD
		Never	Rarely	Sometimes	Often	Always		
In your current practice, how often do you screen for allergies before selecting a prophylactic antibiotic?	%	4.5	4.8	64.3	9.3	17.2		
How often do you adjust the choice of prophylactic antibiotics based on patient-specific factors such as comorbidities or known colonization with resistant organisms (e.g., MRSA)?	Freq.	2	5	13	34	237	4.71	0.69
	%	0.7	1.7	4.5	11.7	81.4		
How frequently do you consider redosing antibiotics intraoperatively if there's excessive blood loss (>1500 mL) or prolonged surgery (>4 hours)?	Freq.	4	6	11	32	238	4.70	0.76
	%	1.4	2.1	3.8	11.0	81.8		
How often do you report any deviations from antimicrobial prophylaxis protocols in your department?	Freq.	21	191	23	21	35	2.51	1.12
	%	7.2	65.6	7.9	7.2	12.0		

Items		Level of Agreement					Mean	SD
		Never	Rarely	Sometimes	Often	Always		
. How often do you receive updates or educational materials about surgical site infection (SSI) prevention and antimicrobial prophylaxis guidelines?	Freq.	4	8	205	36	38	3.33	0.79
	%	1.4	2.7	70.4	12.4	13.1		
Overall							**4.08**	**0.34**

Table 4.6 indicated that the surgical staff was adherence to use surgical antimicrobial prophylaxis local guidelines (mean= 4.08; SD=0.34). The results demonstrated that 257 (88.3%) participants always followed national or institutional guidelines when administering preoperative antibiotic prophylaxis, while 2 (0.7%) did not. When administering prophylactic antibiotics, 244 (83.8%) participants indicated that they always ensured that they were administered within the recommended timeframe, while only 1 participant did not do so frequently. The results also indicated that 189 (64.9%) participants sometimes repeated the intraoperative antibiotic regimen according to guidelines, while 4 (1.4%) did not. The results also concluded that 237 (81.4%) participants always adjusted the choice of prophylactic antibiotics based on patient-specific factors such as comorbidities or known colonization with resistant organisms (e.g., MRSA), and 238 (81.8%) participants always considered repeating the intraoperative antibiotic dose in cases of excessive blood loss (>1500 ml) or prolonged surgery (>4 hours). Furthermore, the results revealed that 191 (65.6%) participants rarely reported any deviations from their department's antibiotic prophylaxis protocols, while 205 (70.4%) participants reported receiving updates or educational materials on surgical site infection (SSI) prevention and antibiotic prophylaxis guidelines sometime. Means for the items in this section ranged between (2.51-4.82), indicating that adherence to local guidelines among surgical antibiotic prophylaxis was at a good level of agreement.

4.6.1 Analysis of the most common reasons for non-adherence to the guideline

among surgical staff in facility

Figure4.1 shows the frequencies and percentages of participants' responses about the most common reasons for non-adherence to the guideline among surgical staff in facility.

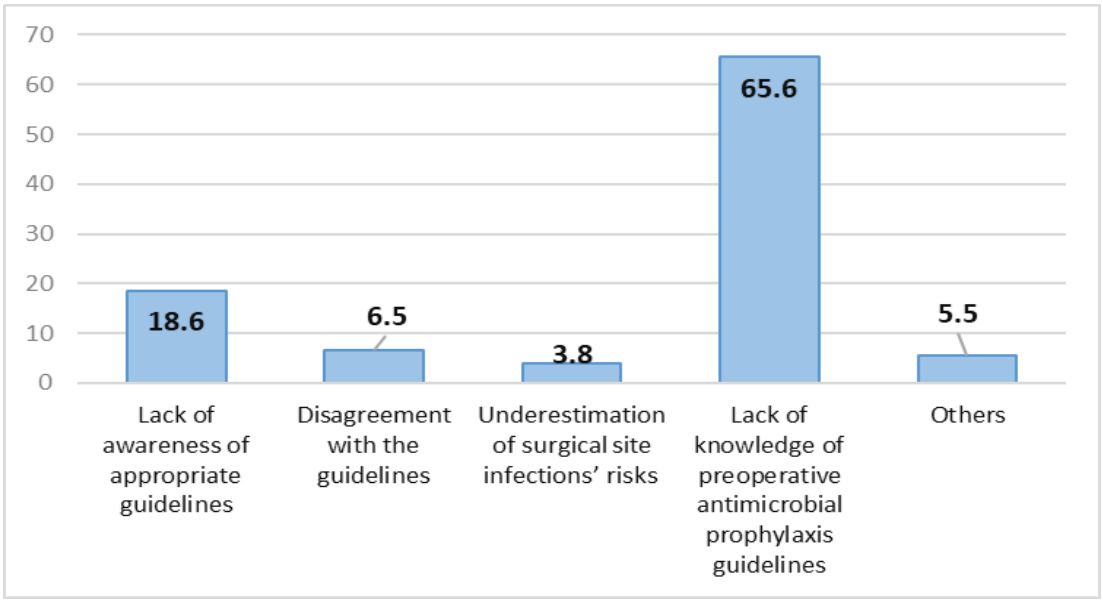

Figure 4.1 The most common reasons for non-adherence to the guideline among surgical staff in facility

The results of figure 4.1 indicated that 191 (65.6%) of the participants believed that the most common reasons for non-adherence to the guideline among surgical staff in a facility related to lack of knowledge, while 54 (18.6%) of them believed that the reason was lack of awareness of appropriate guidelines, in addition 11 (3.8%) of the participants believed that the reason was underestimation of surgical site infections' risks.

Figure 4.2 show the frequencies and percentages of participants' responses about the applicability and practicality of current guidelines to all types of surgical procedures performed in the unit.

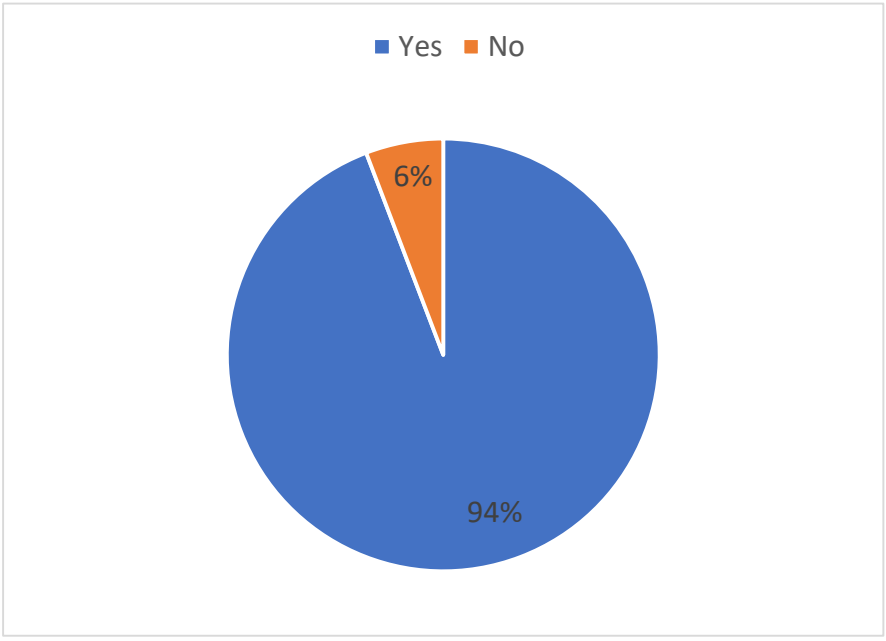

Figure 4.2 Applicability and practicality of current guidelines to all types of surgical procedures performed in the unit

Figure 4.2 concluded that 274 (94.2%) of the participants believed that the current guidelines were applicable and practical for all types of surgeries performed in the unit, while 17 (5.8%) did not believe so. The following figure show participants' responses about the applicability and practicality of current guidelines to all types of surgical procedures performed in the unit.

Participants' suggestions to improve adherence to the surgical antimicrobial prophylaxis guideline in your hospital

Figure 4.3 show the frequencies and percentages of participants' suggestions to improve adherence to the surgical antimicrobial prophylaxis guideline in your hospital.

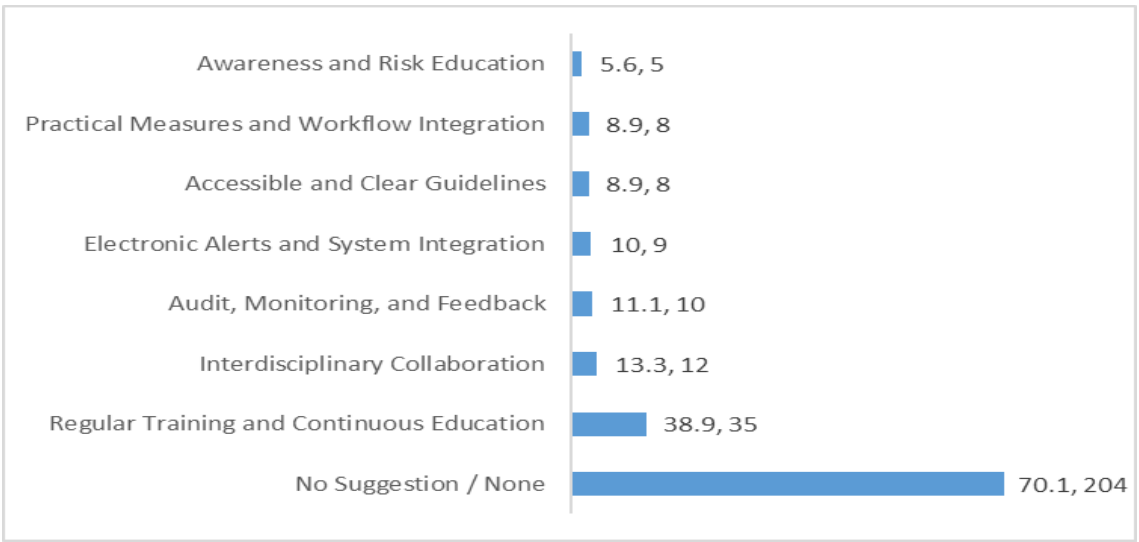

Figure 4.3 participants' suggestions to improve adherence to the surgical antimicrobial prophylaxis guideline in your hospital (%,N)

Figure 4.3 concluded that 204 (70.1%) of participants did not provide any suggestions, while 35 (38.9%) of the participants suggested regular training and continuous education. 12 (13.3%) suggested Interdisciplinary Collaboration, and 10 (11.1%) added the importance of audit, monitoring, and feedback, 9 (10%) of them also stressed the importance of electronic alerts and system integration. In addition, 8 (8.9%) of them suggested accessible and clear guidelines, and 8 (8.9%) of them suggested practical measures and workflow integration.

4.7 Relation between participants socio-demographic and professional characteristics with knowledge, attitude, practice and Adherence scores

The following table show the results of ANOVA test which is aim to test the relation between participants socio-demographic and professional characteristics with knowledge, attitudes, practices and adherence among surgical staff towards preoperative anti-microbial prophylaxis in secondary care Units in Aljouf.

Table 4.7 relation between participants socio-demographic and professional characteristics with knowledge, attitudes, practices and adherence score

Variables	Knowledge Mean (± SD)	P-value	Attitude Mean (± SD)	P-value	Practice Mean (± SD)	P-value	Adherence Mean (± SD)	P-value
Gender								
Male	9.80 (2.05)	0.154	4.21 (0.39)	0.061	4.19 (0.32)	0.317	4.10 (0.29)	0.266
Female	10.12 (1.76)		4.13 (0.36)		4.15 (0.40)		4.05 (0.39)	
Age range								
Under 25	9.79 (2.66)	0.054	4.25 (0.35)	0.343	4.07(0.57)	0.181	3.97 (0.49)	0.042
25–34	10.41 (1.36)		4.11 (0.38)		4.18 (0.34)		4.06 (0.34)	
35–44	9.65 (2.15)		4.19 (0.38)		4.14 (0.36)		4.10 (0.29)	
45–54	9.93 (1.80)		4.18 (0.37)		4.23 (0.21)		4.08 (0.32)	
55 and above	9.29 (1.54)		4.25 (0.50)		4.26 (0.25)		4.29 (0.26)	
Professional								
Consultant surgeon	10.04 (1.32)	0.000	4.25 (0.36)	0.005	4.13 (0.34)	0.059	4.11 (0.27)	0.000
Specialist surgeon	9.45 (1.58)		4.30 (0.40)		4.21 (0.32)		4.21 (0.32)	
Resident surgeon	10.27 (2.22)		4.15 (0.30)		4.25 (0.30)		4.13 (0.27)	
Surgical nurses	10.41 (2.18)		4.01 (0.35)		4.30 (0.11)		4.12 (0.15)	
Clinical Pharmacist	10.23 (1.86)		4.13 (0.36)		4.13 (0.42)		4.03 (0.37)	
Other	7.94 (2.44)		4.23 (0.51)		4.04 (0.45)		3.74 (0.46)	
Years of clinical experience								
Less than 1 year	9.87 (2.53)	0.000	4.26 (0.39)	0.003	4.09 (0.53)	0.000	3.97 (0.47)	0.089
1–5 years	10.70 (0.89)		4.08 (0.27)		4.27 (0.19)		4.11 (0.15)	
6–10 years	10.33 (1.65)		4.14 (0.36)		4.23 (0.26)		4.12 (0.32)	
More than 10 years	8.93 (2.14)		4.27 (0.45)		4.06 (0.42)		4.05 (0.41)	
Receiving training								
Yes	10.25 (1.74)	0.000	4.13 (0.37)	0.000	4.21 (0.31)	0.001	4.10 (0.31)	0.056
No	8.93 (2.16)		4.32 (0.38)		4.04 (0.47)		4.01 (0.43)	

Results in table 4.10 concluded that:

Gender:

There is no statistically significant difference was found in knowledge scores between males and females (p = 0.154). Besides, there are no significant differences were observed in attitude (p = 0.061) or practice (p = 0.317) or adherence (p= 0.266) scores across gender, indicating comparable levels of knowledge, behavioral implementation and adherence among both groups.

Age Range:

Age did not show a statistically significant influence on knowledge (p = 0.054), attitude (p = 0.343), or practice (p = 0.181). While, Age show a statistically significant influence on adherence (p = 0.042), a descriptive trend suggests that respondents aged 55 years and above had higher adherence (M = 4.29, SD = 0.26) scores compared to younger participants.

Professional:

Professional exhibited a significant association with knowledge (p = 0.000), attitude (p = 0.005) and adherence (p = 0.000) though not with practice (p = 0.059). Surgical nurses recorded the highest mean knowledge score (M = 10.41, SD = 2.18). Besides, Specialist surgeon recorded the highest mean attitude score (M = 4.30, SD = 0.40) and highest mean adherence (M=4.21, SD= 0.32).

Years of Experience:

Experience level had statistically significant association with knowledge (p = 0.000) or attitude (p = 0.003) or practice (p= 0.000), but was not significantly associated with adherence (p = 0.089). Participants who had experience between (1-5) years recorded the highest mean knowledge score (M = 10.70, SD = 0.89) and practice score (M= 4.27, SD= 0.19). While, participants who had experience more than 10 years recorded the highest mean attitude score (M = 4.27, SD = 0.45).

Receiving training

Receiving training had statistically significant association with knowledge (p = 0.000) or attitude (p = 0.000) or practice (p= 0.001), but was not significantly associated with adherence (p = 0.056). Participants who receiving training recorded the highest mean

knowledge score (M = 10.25, SD = 1.74) and practice score (M= 4.21, SD= 0.31). While, participants who have no receiving training recorded the highest mean attitude score (M = 4.32, SD = 0.38).

4.8 Correlations between knowledge, attitude, practice and adherence

Table 4.11 illustrate correlations between knowledge, attitude, practice and adherence, Pearson correlation coefficients were calculated.

Table 4.8 Correlations between knowledge, attitude, practice and adherence

Variable	Pearson correlation coefficient	P-value
Knowledge and attitude	0.115	0.051
Knowledge and practice	0.285**	0.000
Attitude and practice	0.025	0.668
Adherence and practice	0.693**	0.000
Adherence and attitude	0.022	0.707
**. Correlation is significant at the 0.01 level (2-tailed).		

As shown in Table 4.11 there was a positive significant linear correlation between knowledge and practice (r=0.285, p=0.00). A non-significant correlation was found between knowledge and the attitude (r=0.115, p=0.051). No significant correlation was found between attitude and practice (r=-0.025, p=0.668). A significant positive correlation was also found between adherence and practice (r=0.693, p=0.000), but the results indicated that there is no significant correlation was found between attitude and adherence (r=0.022, p=0.707).

Chapter Five
Discussion of Findings and Recommendation

5.1 Introduction

This chapter discusses and analyzes the findings of the study in the light of previous literature. It also provides a summary of the most important conclusions and proposes a set of recommendations that can be used in the future**.**

5.2 Discussion

5.2.1 Knowledge Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

In light of the primary objective of prophylactic antibiotic use in surgical practices, the study results demonstrated a high level of awareness among participants; the results indicated that 92.8% of participants were aware that the primary reason for using prophylactic antibiotics was to prevent surgical site infections. This is in light of awareness of the health and economic risks of infection by the participants; hence, awareness of the significance of prevention. This high level of awareness could be explained by the fact that the surgical staff has a considerable level of training and experience because of dealing with similar cases, and being familiar with and concerned with the rules of health provided by specialized medical institutions. This observation has been proved by a number of earlier studies, which state that Saudi surgical staff are highly aware of the significance of infection prevention with the help of antibiotics (Binown et al., 2021). Conversely, 5.2% of the respondents indicated that they used them to cure the infection. This can mean that they are dependent on personal contact over following medical guidelines in this respect, or that they simply lack experience and knowledge (Alahmadi et al.,2020).

Moreover, the findings indicated that the participants were well educated about procedures in which the majority of patients needed preoperative antibiotic prophylaxis Binown et al., (2021) study showed that orthopedic surgeons had sufficient knowledge and a positive attitude towards prescribed prophylaxis to antibiotics used, (75.9%) of respondents stated that clean prosthetic/implant-involving procedure was the procedure that required most antibiotic prophylaxis to be used. This outcome was evidence of the

knowledge and understanding of high and low risk procedures by the surgical team and the capacity to evaluate risks and use theoretical information to determine risks in operations. It also indicates the consciousness of the team to the existence of foreign bodies or implants that can lead to the possibility of infection and prophylactic usage of antibiotics. This level of awareness can either be a result of years of experience or simple instructions and guidelines within healthcare facilities (Khan, 2013).

The findings also established that 96.9% of the participants were able to select the correct antibiotic based on the type of surgery and pattern of resistance. It means that the staff realizes that it is necessary to make sure the antibiotic is effective and specific to common bacteria, and they are eager to avoid the unjustified use of broad-spectrum antibiotics (Crader & Varacallo, 2025). A minor population of respondents were dependent on other reasons, like personal patient factors and surgeon orientation. The reason is the fact that they are based on personal experience and do not update past information and practices in that matter (Tefera and Melaku, 2019). Research conducted by Seyferth et al. (2025) demonstrated that the proper preventive usage of antibiotics practice was diverse in reference to the kind of speciality, the type of patient, and the program of antibiotic care. These findings indicate the beneficial impact of antibiotic management programs, as well as, there are gaps which can be targeted using interventions, especially in antibiotic selection and the timing of discontinuation. In reference to the findings about the side effects of antibiotic misuse, the results revealed that 95.2 percent responded that antibiotic resistance is the most common and anticipated side effect. This proves the awareness of the surgical staff concerning the risks of bacterial resistance and infection spread caused by the misuse of prophylactic antibiotics. That is what earlier research already demonstrated, and it confirms that there is a correlation between antibiotic abuse and higher health costs and antibiotic resistance (Onyekwelu et al., 2017; Abubakar et al., 2020).

In reference to taking broad-spectrum antibiotics, the findings showed that 87.6% of respondents did not take them regularly, with a minor proportion taking them regularly or in exceptional situations. This finding supports the fact that participants are aware of medical principles and need to restrict their intake of antibiotics unless it is necessary to prevent bacterial resistance (Crader and Varacallo, 2025; Abubakar et al., 2020). Another factor that the researcher uses to explain the low use of these antibiotics is past experience

and the absence of administration control which highlights the need to establish the relevant policies that can be used to reverse resistance and adherence to the policies established(Temkin et al., 2021).

It was also found that most participants felt that a single dose of antimicrobial prophylaxis in the majority of clean-prosthetic operations was adequate pre-operative even though a small proportion felt that they could use it longer. The given finding is associated with the participants receiving continuous training and campaigns to decrease antibiotic resistance in hospitals (Abubakar et al., 2020), and with the ability of the participants to be informed and follow the global guidelines provided by the World Health Organization and the Saudi Ministry of Health, which promoted that a single dose suffices in the majority of cases and may be prolonged in very few cases. It also indicates a recent change in clinical practice as the appropriate use of antibiotics can cause a frequency of resistant strains to emerge in overuse(Tefera & Melaku, 2019). This finding can also be explained by the fact that the Saudi Ministry of Health embraces standardized guidelines on surgical site infections prevention(Seyferth et al., 2025).

Also, the research findings indicated that supplement dosage could be needed in special circumstances because 89.3 percent of the study participants concurred that more dosing is needed when it comes to prolonging surgery (a maximum of 4 hours) and 6.2 percent of respondents felt that more dosing is required in case of excessive blood loss (< 1,500 mL of blood). This denotes how surgical team comprehends the clinical and pharmacological principles applied to the administration of antibiotics, and their conformity to the scientific guideline that has been issued by the CDC and WHO that characterized these cases as cases of the need to repeat the dose of antibiotics (Van.Kasteren et al., 2003). This finding also suggests clinical encounters with past instances of surgical infection where the staff understands that time spent and blood loss could decrease the concentration of the antibiotic in the tissues, and the dose will be needed to be increased (Binown et al., 2021).

In that regard, the findings demonstrated that the vast majority of patients were well-informed regarding preventive measures in particular situations, including cardiac catheterization and the use of MRSA patients (Allegranzi et al., 2016). This result means that the surgical staff is able to manage critical cases, and they are dedicated and conscious of the appropriate international standards as numerous prior studies have

indicated regarding preventive practices of surgical staff in special cases (Tefera and Melaku, 2019); Binown et al., (2021) found that orthopedic surgeons have adequate knowledge and positive attitudes towards surgical prevention related to antibiotics. Nevertheless, their practices varied, which can be explained by the lack of adherence to antibiotic surgical prevention guidelines. The low level of those that failed to follow the guidelines could be explained by their few years' experience in this sphere and specialization. According to Tefera and Melaku, 2019, the respondents were well informed but the practice and the attitude lacked among the majority of the respondents and thus the researchers are of view that clarification on this area should be emphasized in order to encourage rational use of prophylactic antibiotics during surgery.

5.2.2 Attitude Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

The findings concluded that the surgical staff demonstrated favourable attitudes towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units, and the overall mean was 4.18 with a standard deviation of 0.38. This demonstrates their high confidence in the value of this procedure in mitigating the risk of surgical site infections. 98.3% of respondents indicated their belief in its ability to prevent the occurrence of surgical site infections. This implies that they understand the necessity of prophylaxis with antibiotics as an effective and scientifically proven intervention. This is in line with the provisions of the international bodies as one of the aspects that minimise infection following surgical operations (Neumayer et al., 2007). This can be explained by the practical experience of the surgical personnel and the knowledge of infection control measures in health facilities. Furthermore, the proportion of respondents who thought selecting the correct antibiotic is a necessary measure of ensuring the successful prevention is 95.9% which implies the professional tendency of the surgical employees regarding the correct selection of an antibiotic according to the reasonable understanding of antibiotic properties and awareness of the role and the necessity of the correct selection of an effective antibiotic in each operation (Crader & Varacallo, 2025). This notion is evidenced by a study (Binown et al., 2021) that revealed that the surgical staff in Saudi Arabia is also in the positive attitudes concerning antibiotic prevention and the understanding of the need to select the right antibiotic. It was found that about 85 percent of the participants expressed positive attitude toward prescribed prophylaxis antibiotics.

Concerning the findings of the matter of excessive use of preventive antibiotics, this study revealed that 61.2% of the respondents regarded excessive use as an observable phenomenon at their hospital, which testifies to the fact that the medical staff understands the risks of antimicrobial resistance and the need to adhere to specific professional approaches in rationalizing the use of drugs.

5.2.3 Practice Among Surgical Staff Towards Preoperative Anti-Microbial Prophylaxis in Secondary Care Units

Practices among surgical staff towards preoperative anti-microbial prophylaxis in secondary care units were high Based on participants' responses, indicating their commitment to clinical guidelines, as 86.6% of them confirmed that they were given preventive antibiotics according to the approved protocol. This reflects awareness and application resulting from the correct understanding of medical recommendations and the presence of institutional systems in Saudi hospitals for medical recommendations and guidelines that oblige specialists to the appropriate and specific timing and dose(Alahmadi et al.,2020). It is worth noting that the Saudi Ministry of Health has witnessed a noticeable shift in the field of awareness of the rational use of antibiotics, in addition to the strict protocols and administrative oversight practiced by some hospitals to enhance compliance with internationally approved medical guidelines (Binown et al., 2021; Ahmed et al., 2019).

Moreover, 31.3% of the respondents stated a commitment to use antibiotic susceptibility testing (AST) results or resistance information that is available at the time of antibiotic selection, whereas 62.2% do not habitually use it. This can reflect the lack of recent preoperative implant or allergy test results because prophylactic antibiotics are typically administered before an infection sets in, which is why it relies on accepted procedures and local resistance patterns (Antibiogram) more than on individual allergy tests (Tefera and Melaku, 2019).

The findings also affirmed the awareness of the participants regarding the timing of antibiotic intake, where 87.3% of the respondents reaffirmed that the dose must be taken between 30 and 60 minutes before the operation. This is in line with their interpretation of the guidelines given by the World Health Organization (WHO) that the antibiotic must be given on time to make sure that the therapeutic target is achieved early in the surgical

procedure (Neumayer et al., 2007). Moreover, they showed their dedication to the administrative component of preventive practice, which is a significant predictor of quality control and clinical performance, by mentioning that 82.8% stated that the time of the intake of antibiotics was reflected in medical records.

5.2.4 Adherence to Surgical Antimicrobial Prophylaxis Local Guidelines

With the arithmetic mean of 4. ±0.34, the researchers found a high level of compliance with surgical antibiotic prophylaxis guidelines by surgical staffs in secondary care units, which means that they are aware and strongly believe in the need to follow medical guidelines in this regard (Binown et al., 2021). This represents the level of their awareness and a firm belief in the necessity of following medical guidelines in the context of reducing the risk of surgical site infection. Moreover, hospitals have a supportive organizational culture, which contributes to increasing adherence rates by the surgical staff to these guidelines, furthermore, they are provided with specialized training on infection control and patient safety. In addition, hospitals have an infection control committee or clinical pharmacists that use a monitoring and supervision system, which was discovered in Alahmadi et al., 2020. Non-compliance with the medication plan is grossly harmful to the patients and exacerbates the incidence rate of the antibiotic resistance among particular groups, including post-surgical patients.

The findings also decided that 81.4% of the participants chose the correct antibiotic relying on patient-specific aspects, including MRSA and chronic illnesses. This can be explained by the fact that most Saudi hospitals have in place policy that requires one-on-one preoperative evaluation of patients in conjunction with the clinical pharmacists and the infection control team. This is a preventive measure, which serves as an indicator of compliance and decreases the chance of infection. The findings also showed that 65.6 percent of respondents hardly ever experienced any form of violations or non-compliance to antibiotic prophylaxis guidelines. This can be attributed to shortcomings in administration and culture and employee apprehension of administrative responsibility. This indicates that there is a necessity to instill a culture of no blame and the desire to encourage reporting as a quality improvement tool.

In addition, the findings indicated that 70.4% of the sample was provided with educational resources related to prevention of surgical site infections, which implies that

not enough training is being conducted. This can be attributed to insufficient education resources and the unwavering dedication of the administration to lifelong education. Among the factors that contribute to better adherence to preventive guidelines, there are training and continuous education, as well as expected feedback (Abubakar et al., 2020).

In terms of motivation of non-adherence to the guidelines provided, 65.6 percent of the participants affirmed that they did not know all the specifics of the prevention guidelines, then on awareness of the right guidelines (18.6%). The outcome indicates that the surgical staff lacks the knowledge of the latest recommendations and guidelines and this fact is demonstrated by the differences in the rates of practice across departments. Poor knowledge of guidelines is ranked among the single crucial factors of poor compliance, though the staff realizes the significance of prevention (Tefera and Melaku, 2019; Alahmadi et al.,2020). More than 3.8% of them suggested the cause might be that they underestimated the risks of getting infected, and it can be explained by the fact they did it because they did not have tools and training on how to apply the guidelines properly.

In terms of reevaluation of the necessity of further antibiotic use following surgery, 79.7% of the respondents reported following the 1LK well-known of the risks of the excessive use of these medications as well as their knowledge of the dangers of their overuse, their awareness of the possibility of bacterial resistance development and their obedience to the particular set of criteria, as well as their confirmation that the state of the considered patient warrants the use of antibiotics further. The awareness of surgical staff regarding the potential dangers of the overuse of prophylactic antibiotics also contributed to the enhancement of their postoperative practice (Abubakar et al., 2020). 67.7% of them also said that they were willing to take part in an audit and review associated with the utilization of prophylactic antibiotics, which showed that the professional environment was in place, and they were ready to participate in the process of the quality improvement. Nevertheless, a high percentage do not practice this which might mean that not all members of the staff involved in a surgery actively participate in the audit and review process and are not actively involved in regulation. Conversely, 69.4 of the surgical employees affirmed the presence of incidences of incompliance with the standards pertaining to the application of antibiotics. This can be explained by the fact that, there is gap between guidance and implementation, there are disparities in practical and professional experience in members of the surgical staff, and there are inconsistent

protocols across the various surgical departments. This confirms the existence of gaps in the implementation of guidelines despite good knowledge of general principles (Tefera & Melaku, 2019).

Finally, the results concluded that 94.2% of participants believe that the current guidelines are applicable and appropriate for all surgical procedures. This is attributed to the fact that the approved guidelines were designed in a scientific, practical, and flexible manner that takes into account the nature of different surgical procedures. Conversely, 5.8% indicated the need to amend these guidelines, considering them impractical due to the lack of administrative support and sufficient resources to implement some provisions. Furthermore, some specialties are precise and complex, requiring specific protocols.

5.2.5 Relation between participants' socio-demographic and professional characteristics with knowledge, attitude, practice and Adherence scores

The results showed that there is no statistically significant difference was found in knowledge or attitude or practice or adherence scores between males and females. This result is attributed to the homogeneity of professional practices and work procedures in the health sector, which adhere to unified protocols that do not distinguish between males or females, as well as the fact that job tasks and training are identical between the two genders, which reduces the likelihood of the presence of any differences between genders where there was no agreement on its study (Abdaljaleel et al., 2025).

Besides, age did not show a statistically significant influence on knowledge, attitude or practice. This result is due to the fact that health institutions usually apply similar standard protocols to employees regardless of their ages, and training is available to everyone(Seyferth et al., 2025)In the health sector, employees are usually evaluated according to their experiences and skills, not their ages Indicators show a statistically significant effect on adherence, descriptive trends indicate that participants aged 55 years and over had a percentage of adherence This result may be explained by the accumulated experiences of older pharmacists, as they acquire more experience and have better professional awareness of surgical protocols and preventive procedures. Moreover, this group is more aware of the importance of adherence in reducing occupational risks.

Moreover, Professional exhibited a significant association ($p = 0.059$) with knowledge, and adherence Surgical nurses recorded the highest mean knowledge score,

due to the nature of their work, which requires them to have direct and continuous contact with surgical procedures, which provides them with a high level of knowledge in the field of surgical protocols and policies. Besides(Ahmed et al., 2019; Abdaljaleel et al., 2025), Specialist surgeon recorded the highest mean attitude score and highest mean adherence. This result is considered logical, since surgeons are responsible for making clinical decisions and applying surgical guidelines(Alahmadi et al.,2020).

Furthermore, experience level had statistically significant association with knowledge or attitude or practice. Participants who had experience between (1-5) years recorded the highest mean knowledge score and practice score. This result may be attributed to the fact that this group may be more exposed to scientific updates and more engaged in training courses to enhance their skills and knowledge, which increases their level of knowledge and their ability to practice better preventive procedures regarding the use of antibiotics before surgical operations(Crader & Varacallo, 2025 Tefera & Melaku, 2019). While, participants who had experience more than 10 years recorded the highest mean attitude score. This result shows that long experience may contribute to building positive attitudes toward the use of antibiotics as a result of previous experiences and the many cases they have dealt with, and therefore they have become more knowledgeable about the professional convictions related to the use of prophylactic antibiotic. Pharmacists' practical experience plays a key role in shaping their attitude toward the use of topical corticosteroids. Pharmacists with more years of experience tend to provide more accurate and reliable advice regarding drug dosages, treatment duration, and potential side effects compared to junior or fresh graduates. Experience equips pharmacists to handle complex cases and recognize signs of misuse that novices might miss, thus reinforcing their responsible approach to providing advice (Makeen et al., 2024). Whereas, experience level was not significantly associated with adherence, this result may be attributed to the fact that the level of adherence may be similar among the participants, as all of them have an awareness of the importance of adhering to the preventive protocols and guidelines regardless of their experience. In addition, adherence may be related to administrative and organizational factors such as workload and hospital policies.

In addition to, receiving training had statistically significant association with knowledge or attitude or practice, participants who receiving training recorded the highest mean knowledge and practice score, this result showed the role of training programs in enhancing practical practices and specialized theoretical knowledge in the uses of

prophylactic antibiotics, which enhances the proper application of health protocols (Nakamura et al., 2017; Lu et al., 2010). Pharmacists' knowledge and practice are influenced by several key factors, including their educational level and academic training (Gray, Boardman, & Symonds, 2011). While participants who have not received training recorded the highest mean attitude score, this result is attributed to the fact that attitude is usually associated with the professional convictions and personal experience of the medical staff and the extent of their knowledge of the protocols and guidelines. Whereas receiving training was not significantly associated with adherence, this result is attributed to the fact that adherence is directly related to the medical staff's awareness of the protocols and guidelines for the use of prophylactic antibiotics and the importance of adhering to them and using them according to their specific requirements. In addition, adherence may be related to hospital policies or workload more than it is related to training programs (Neumayer et al., 2007).

5.2.6 Correlations between knowledge, attitude, practice and adherence

The results indicated that there was a positive significant linear correlation between knowledge and practice. The researcher attributes this result to the fact that theoretical knowledge contributes to enhancing the surgical staff's ability to apply proper practices related to the protocols and guidelines for the use of prophylactic antibiotics, as the availability of professional and scientific foundations enables the surgical staff to make reliable decisions when choosing the dose, type of antibiotic, and its timing (Kang et al., 2020). This finding shows that it is crucial to pay attention to training that complements theoretical knowledge and correlates it with practical activities. There are various important factors that affect the knowledge and practice of pharmacists such as their academic training and education level, years of practice, understanding local health laws and regulations, and the influence of awareness campaigns and scientific resources that would affect their daily knowledge and practice (Gray, Boardman, and Symonds, 2011).

Besides, a significant positive correlation was also found between adherence and practice. This result is attributed to the fact that adherence to therapeutic measures and protocols reflects the professional and behavioral aspect of the surgical staff, as it translates what they have acquired from knowledge and attitudes into practical practices that comply with the approved standards and protocols, such as choosing the appropriate dose, timing, and type of antibiotic (Chhabra et al., 2021). This result highlights the importance of

adherence among the medical staff as an important factor in enhancing practices and protocols in a safe and effective manner. Therefore, it emphasizes the need to provide a supportive work environment and continuous and effective training (Binown et al., 2021).

Whereas, the results indicated that there is no significant correlation was found between attitude and adherence. This result indicates that positive attitudes toward the use of prophylactic agents do not directly translate into the actual adherence of the surgical staff to protocols, as previously mentioned, adherence is influenced by numerous organizational and administrative factors such as supervision and inspection, personal commitment, sense of responsibility, personal values, and workload pressure, which means that enhancing adherence requires an integrated system that includes training and education and the provision of a supportive work environment (Alahmadi et al., 2020).

5.3 Conclusion

The study concluded that the surgical staff in secondary care units in Al-Jouf region have high levels of knowledge, positive attitudes and good practices, with a clear commitment to local guidelines for the prevention of surgical antibiotics, with a need to strengthen reliance on microbial data and standardize surveillance to ensure sustainable compliance. This establishes the level of awareness among the staff regarding the necessity of following the preventive measures to minimize surgical site infections. It was noted that participants stressed that timing dose administration, adequate medication with the right antibiotic, and the need to repeat doses in particular situations like bleeding or long surgery (>4 hours) are crucial in this matter. This indicates the presence of guidelines in hospitals and the desire to change the nature of care and limit the number of infections through the implementation of guidance and training programs. To sum up, the research proves that the implementation of antibiotic prophylaxis programs can be successful provided that one is moving beyond focusing on personal awareness to developing a comprehensive institutional strategy that guarantees healthy habits and cuts down on overmedication using antibiotics. It also underlines the implementation of an institutional system that effective implementation of the medically recommended guidelines is achieved and that is demonstrated in the quality of services, the success of the surgical interventions as well as the safety of the patients involved. The findings also presented that the right practices concerning use of prophylactic antimicrobials are directly related to knowledge and adherence, but not attitudes, because attitudes are governed by

organizational and environmental empirical factors. This shows the value of training, enhancing organizational policies, and improving the practical competencies and abilities of the surgical staff.

5.4 Implications

The research findings made it clear that several vital implications for educational planning, clinical practice, and the policies at health care institutions towards the prevention of surgical site infections with antibiotics should be noted, in particular:

5.4.1 Clinical Implications

According to the research findings, compliance with the local and medical health recommendations should be increased with regular follow-ups and performance reviews. The findings also lead to the fact that cooperation and coordination of the work of the surgical staff, characterizing the surgeons, pharmacists, and anesthesiologists, should be improved to make possible some preventative measures to control the use of antibiotics and, at the same time, to recognize risks. The researcher also expects that there is an urgent requirement to formulate accurate policies on the use of antibiotics during surgical operations, consideration of risk factors and backup of preventive policies in hospital plans to minimise the risk of surgical site infections, as they have a major share of decreasing costs attributed to reoperation, protracted patient stay and treatment of complications.

5.4.2 Educational Implications

The findings of the study point to the necessity to create specific and structured training programs to be able to deepen the knowledge and skills of the surgical staff through workshops and learning courses, as well as to be open to local and regional experience to facilitate the exchange of experience. They also emphasise the necessity to foster a culture of interactive learning among the surgical staff members through discussing the cases related to clinical practice, examining the impact of non-adherence to health guidelines and correcting the behaviors. The researcher is also of the opinion that there is a need to incorporate the knowledge pertaining to surgical prophylaxis using antibiotics both in the academic coursework and in the clinical training of students and

residents, with a view to inform the students and residents on the essence of sticking to the health protocol associated with prophylactic antibiotics early in the course.

5.4 .8 Limitation

The study faces the following limitations:

- More motivated staff answer
- Staff report ideal practice
- Missing data
- Unequal access

5.5 Recommendations

The researcher proposes the following, in accordance with the study findings:

1. Develop focused training programs to enhance antibiotic knowledge and update information on bacterial resistance, with a particular emphasis on cases with the lowest adherence rates.
2. Implement electronic reminders immediately before surgical procedures to confirm appropriate dosages and administration times.
3. Review cases where protocol violations occurred and analyze the reasons behind them to provide practical guidance to minimize potential future deviations.
4. Leverage positive results by creating a monthly report detailing adherence levels for each department or surgical team, and provide rewards or incentives for the most compliant teams.
5. Enhance the existing database to include a direct correlation between protocol adherence and patient outcomes, thereby promoting evidence-based clinical decision-making and demonstrating the positive impact of adherence on quality of care.

5.6 Future Researches

The findings of the present study lead to new study areas to be investigated by future researchers in relation to prophylactic antibiotics. The following studies should be carried out in order to be suggested by the researcher:

6. Developing an electronic system that includes smart alerts and reminder systems to enhance adherence to the protocol, and comparing its implementation results with those of traditional follow-up.
7. Assessing the knowledge, attitudes, and willingness of students and resident physicians to adhere to modern protocols regarding the use of prophylactic antibiotics and identifying their future training needs.
8. Conducting similar studies involving hospitals from several regions in the Kingdom of Saudi Arabia to determine the feasibility of generalizing the results to the Saudi health sector.
9. Conducting future studies on the side effects resulting from the excessive and incorrect use of prophylactic antibiotics.

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Appendices

Appendix 1: Questionnaire:

Section 1: Demographic Information

(Please select the most appropriate option)

1. Age group:
   A. Under 25
   B. 25–34
   C. 35–44
   D. 45–54
   E. 55 and above

2. Gender:
   A. Male
   B. Female

3. Profession:
   A. Consultant surgeon
   B. Specialist surgeon
   C. Resident surgeon
   D. Surgical nurses
   E. Clinical Pharmacist
   F. Pharmacist

4. Specialty:
   A. General Surgery
   B. Orthopaedic Surgery
   C. ENT
   D. Obstetrics & Gynaecology
   E. Urology
   F. Plastic surgeon
   G. Cardiothoracic surgeon
   H. Other

5. Years of clinical experience:
   A. Less than 1 year
   B. 1–5 years
   C. 6–10 years
   D. More than 10 years

6. Work schedule:
   A. Full time
   B. Part time
   C. Shift duty
   D. Rotation

7. Have you received training on surgical antimicrobial prophylaxis in the last 2 years?
   A. Yes
   B. No

Section 2: Knowledge

(Choose the best answer for each question)

1. What is the main purpose of preoperative antimicrobial prophylaxis?

   A. To treat active infections
   B. To prevent surgical site infections
   C. To reduce pain after surgery
   D. To shorten hospital stay

2. What are the types of procedure do not require surgical site preoperative antimicrobial prophylaxis?

   A. Clean prosthetic/ implant involving procedure
   B. Clean non-prosthetic procedure
   C. Clean-contaminated surgery
   D. Contaminated surgery
   E. Dirty surgery

3. When should prophylactic antibiotics ideally be administered before incision?

   A. 30–60 minutes before incision
   B. Immediately after incision
   C. 1 hour after incision
   D. At the end of surgery

4. Which of the following is most important when choosing a prophylactic antibiotic?

   A. Type of surgery and local resistance patterns
   B. Patient's height
   C. Patient’s blood group
   D. Surgeon’s preference

5. Which of the following is a potential consequence of inappropriate antimicrobial prophylaxis use?

    A. Antimicrobial resistance
    B. Shorter hospital stays
    C. Decreased resistance
    D. Increased surgical success

6. Are broad-spectrum antibiotics routinely recommended for surgical prophylaxis?

    A. No
    B. Yes
    C. Only in paediatric cases
    D. Only in elderly patients

7. What is the recommended duration for antimicrobial prophylaxis in most clean-prosthetic surgical procedures?

    A. Single preoperative dose
    B. 1–3 days
    C. 3–5 days
    D. Until patient discharge

8. When should an additional intraoperative dose of antibiotics be given?

    A. In case of prolonged surgery procedure (≤ 4 hours)
    B. In case of excessive blood loss (< 1,500 mL of blood)
    C. In case of high IV fluid administration
    D. Never

9. What is the first line surgical antimicrobial prophylaxis for cardiac stent insertion procedures?
    A. Cefazolin
    B. Cefuroxime
    C. Gentamicin
    D. Amoxicillin clavulanate
    E. Ciprofloxacin
    F. Ceftriaxone
    G. Other

10. What is the second line for surgical antimicrobial prophylaxis in case of penicillin allergy for cardiac stent insertion procedures?
    A. Clindamycin
    B. Vancomycin
    C. Cefazolin
    D. Cefuroxime
    E. Gentamicin

11. How should MRSA carriers be managed before surgery according to the guideline?
    A. Use nasal mupirocin and chlorhexidine body wash
    B. They should not undergo surgery
    C. Use cefazolin and ignore the colonization
    D. Give metronidazole only

Section 3: Attitude

(Choose the option that best reflects your opinion)

1. Do you think antimicrobial prophylaxis is essential in reducing surgical site infections?

    A. Strongly agree
    B. Agree
    C. Neutral
    D. Disagree
    E. Strongly disagree

2. How confident are you in selecting the appropriate antibiotic for prophylaxis?

    A. Strongly agree
    B. Agree
    C. Neutral
    D. Disagree
    E. Strongly disagree

3. Do you believe overuse of antibiotics is a problem in your hospital?

    A. Strongly agree
    B. Agree
    C. Neutral
    D. Disagree
    E. Strongly disagree

4. Should regular antimicrobial prophylaxis training be mandatory for surgical staff?

    A. Strongly agree
    B. Agree
    C. Neutral
    D. Disagree
    E. Strongly disagree

5. Is the collaboration between surgeons, anesthesiologists, and pharmacists important for antimicrobial prophylaxis?

    A. Strongly agree

B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

6. If new guidelines were introduced, would you be willing to change your current practice?

A. Strongly agree
B. Agree
C. Neutral
D. Disagree
E. Strongly disagree

Section 4: Practice

(Choose the most accurate answer for your usual practice)

1. How often do you administer antimicrobial prophylaxis according to guidelines?

A. Always
B. Often
C. Sometimes
D. Rarely
E. Never

2. How often do you check for patient allergies before prescribing/administrating antibiotics?

A. Always
B. Often
C. Sometimes
D. Rarely
E. Never

3. How often do you ensure the antibiotic is given 30–60 minutes before incision?

A. Always
B. Often
C. Sometimes
D. Rarely
E. Never

4. How often do you document the timing of antimicrobial prophylaxis administration?

A. Always
B. Often
C. Sometimes
D. Rarely
E. Never

5. After surgery, how often do you reassess the need for continued antibiotics?

    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never

6. How often do you feel involved in antimicrobial prophylaxis audits or reviews in your department?

    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never

7. How often do you observe non-compliance with AMP guidelines in your unit?

    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never

Section 5: Adherence to Surgical Antimicrobial Prophylaxis Local Guidelines

1. Do you follow national or institutional guidelines when administering preoperative antimicrobial prophylaxis?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never
2. When administering prophylactic antibiotics, how often do you ensure they are given within the recommended time frame?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never
3. How often do you redose antibiotics during surgery in accordance with guideline recommendations?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never

4. In your current practice, how often do you screen for allergies before selecting a prophylactic antibiotic?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never
5. How often do you adjust the choice of prophylactic antibiotics based on patient-specific factors such as comorbidities or known colonization with resistant organisms (e.g., MRSA)?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never
6. How frequently do you consider redosing antibiotics intraoperatively if there's excessive blood loss (>1500 mL) or prolonged surgery (>4 hours)?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never
7. How often do you report any deviations from antimicrobial prophylaxis protocols in your department?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never.
8. How often do you receive updates or educational materials about Surgical Site Infection (SSI) prevention and antimicrobial prophylaxis guidelines?
    A. Always
    B. Often
    C. Sometimes
    D. Rarely
    E. Never.

9. In your opinion, what are the most common reasons for non-adherence to the guideline among surgical staff in your facility?
    A. Lack of awareness of appropriate guidelines
    B. Disagreement with the guidelines
    C. Underestimation of surgical site infections' risks
    D. Lack of knowledge of preoperative antimicrobial prophylaxis guidelines
    E. Others

10. Do you feel the current guideline is applicable and practical for all types of surgeries performed in your unit?
    A. Yes
    B. No
11. What suggestions do you have to improve adherence to the surgical antimicrobial prophylaxis guideline in your hospital?

Appendix 2: Ethical approval from Al-Jouf Health Cluster

من: إدارة البحوث والدراسات في تجمع الجوف الصحي
تم الإرسال: 29/ذو الحجة/1446 09:04 ص
إلى: مستشفى الأمير متعب بن عبدالعزيز بسكاكا; مستشفى الملك عبدالعزيز التخصصي بالجوف; مستشفى محافظة دومة الجندل العام; مستشفى النساء والاطفال والولاده بالجوف; مستشفى محافظة طبرجل العام; مستشفى صوير العام; Gurayat General Hospital-Gurayat- مستشفى القريات العام
نسخة: Mohammed Fahad Mohammed Alsharaan
الموضوع: تسهيل عمل الباحث / محمد فهد الشرعان ٢٠٢٥

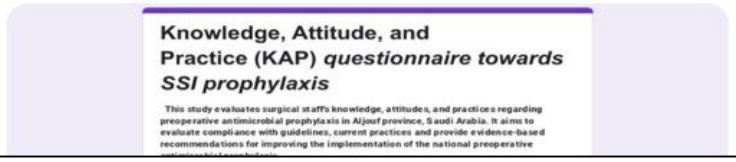
سعادة مدراء المستشفيات المحترمين

السلام عليكم ورحمة الله وبركاته

تحية طيبة """

مرفق لسعادتكم رابط الاستبيان المقدم من الباحث /
محمد فهد الشرعان

نامل من سعادتكم تسهيل عمل الباحث بتعميمه على منسوبيكم بالاقسام الطبية بالمستشفى وحثهم بالمشاركة بالاستبيان وذلك لدعم البحوث العلمية لمنسوبي التجمع


Knowledge, Attitude, and Practice (KAP) *questionnaire towards SSI prophylaxis*

This study evaluates surgical staffs knowledge, attitudes, and practices regarding preoperative antimicrobial prophylaxis in Aljouf province, Saudi Arabia. It aims to evaluate compliance with guidelines, current practices and provide evidence-based recommendations for improving the implementation of the national preoperative

Appendix 3: Ethical approval from the Middle East University

MEU
جامعة الشرق الأوسط
MIDDLE EAST UNIVERSITY
عمادة الدراسات العليا والبحث العلمي
Deanship of Graduate Studies
and Scientific Research

الرقم: ع د ع/د/1977
التاريخ: 2025/06/5

الأستاذة الدكتورة سلام خالد المحادين المحترمة
رئيسة الجامعة

تحيـة طيبة وبعد،،

اتخذت لجنة أخلاقيات العمل في البحث العلمي في الجلسة رقم (05- 2025/2024) المنعقدة بتاريخ 2025/06/04 القرار الآتي:

قرار (2025-2024/05/05)
صادر عن لجنة أخلاقيات العمل في البحث العلمي

قررت لجنة أخلاقيات العمل في البحث العلمي الموافقة على طلب مشروع بحث على الإنسان (استبانات/مقابلات) للباحث الرئيس الطالب **محمد فهد الشرعان** /ماجستير العلوم الصيدلانية، والباحث المشارك الدكتورة **مي تيم**/كلية الصيدلة، المعنون بـ: "**المعرفة والمواقف والممارسات بين الكادر الجراحي تجاه الوقاية بمضادات الميكروبات قبل الجراحة في وحدات الرعاية الثانوية في الجوف، المملكة العربية السعودية**"، على أن يتم تطبيق سياسة أخلاقيات البحث العلمي دون تحمّل الجامعة أية أعباء أو تكلفة مادية أو مسؤولية قانونية.

وتفضلوا بقبول فائق الاحترام والتقدير...

رئيس لجنة أخلاقيات العمل في البحث العلمي

أ.د أحمد عبدالحي موسى