



Surgical Site Infections and Aspirative Drain Use: Bridging Evidence and Clinical Practice

Ervin Nepravishta¹

Dariel Thereska²

Eris Nepravishta³

Ervin Toçi⁴

Artan Distafa¹

Tahir Çela¹

¹Department of Orthopedics and Traumatology,
Trauma University Hospital, Tirana, Albania

²Department of General Surgery, Faculty of Medicine,
University of Medicine, Tirana, Albania

³Department of Medical Sciences,
Aleksandër Moisiu University, Durrës, Albania

⁴Department of Public Health, Faculty of Medicine,
University of Medicine, Tirana, Albania

Received: 17 January 2026 / Revised: 24 February 2026 / Accepted: 7 March 2026 / Published: 25 March 2026
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Doi: 10.56345/ijrdv13n122

Abstract

Background: The role of aspirative drains in preventing surgical site infections (SSIs) remains controversial. Although widely used in multiple surgical specialties, evidence regarding their impact on infection risk is inconsistent. This study aimed to assess healthcare professionals' perceptions of aspirative drains as potential SSI risk factors and to examine how these beliefs influence attitudes toward the prolongation of antibiotic prophylaxis. **Methods:** A descriptive cross-sectional survey was conducted in October 2023 at the Trauma University Hospital in Tirana, Albania. Eighty-six healthcare professionals (67 attending surgeons, 6 residents, and 13 operating room nurses) across four surgical specialties participated. The structured questionnaire evaluated perceptions regarding drain-related SSI risk and support for prolonging postoperative antibiotic prophylaxis after drain application. Descriptive statistics and chi-square tests were performed using SPSS v20.0. **Results:** Overall, 43.0% ($n = 37$) of respondents believed that aspirative drains increase SSI risk. Although this perception was not significantly associated with professional role or years of experience ($p > 0.05$), less experienced clinicians (<10 years) showed a higher tendency to perceive drains as risky (56.5%). Among those who believed drains increase infection risk, 67.6% supported prolonging postoperative antibiotic prophylaxis. A statistically significant association was observed between years of experience and support for prolonged prophylaxis ($\chi^2 = 14.81$, $p = 0.0006$), with less experienced professionals more likely to favor extended antibiotic use. **Conclusion:** A substantial proportion of healthcare professionals perceive aspirative drains as contributing to SSI risk, and this perception significantly influences attitudes toward prolonged antibiotic prophylaxis. Targeted educational initiatives and standardized institutional protocols are needed to align clinical practice with current evidence and antimicrobial stewardship principles.

Keywords: antibiotic prophylaxis, aspirative drains, risk factors, surgical site infections, Trauma University Hospital

1. Introduction

Surgical site infections (SSIs) are among the most common, hardly and costly manageable postoperative complications, representing a major burden on patients, surgical teams, and healthcare systems globally. These infections account for up to 20% of all healthcare-associated infections and are responsible for increased hospital stays, morbidity, mortality, and healthcare expenditures (World Health Organization [WHO], 2018). Despite the advances in perioperative care and infection control that have led to significant improvements, SSIs continue to pose a threat—particularly in high-risk surgeries, developing countries where resources are limited, and in especially vulnerable patient populations. (WHO, 2018)

Among the many strategies employed to prevent SSIs, despite having a many-decade-long history the role of surgical drains remains controversial. Surgical drains are often inserted postoperatively to prevent the accumulation of blood, pus, or other body fluids in the surgical cavity, thereby theoretically reducing the risk of fluid collections that could facilitate bacterial growth (Chen et al., 2020). Drains are categorized into passive and active systems, with aspirative (or suction) drains—such as the Jackson-Pratt or Redon drains—classified as active due to their use of negative pressure to evacuate fluids (Schalamon et al., 2017). These drains are widely used in abdominal, orthopedic, plastic, and breast surgery, among others.

However, their clinical effectiveness in preventing SSIs is far from universally accepted. Opponents argue that drains may act as foreign body pathways for external pathogens to access the wound, especially when improperly maintained or when drain sites are not adequately covered (de Oliveira et al., 2021). Furthermore, there are studies since decades ago that associate prolonged drain placement with an increased infection risk, particularly when combined other risk factors like patient comorbidities, long operative times, or poor wound care practices (Kirkland et al., 1999).

Several studies and meta-analyses have attempted to clarify the role of aspirative drains in infection control, but results remain contradictory. For instance, a meta-analysis by Chen et al. (2020) found that closed-suction drainage may reduce SSI risk in certain surgical contexts, but the evidence was inconsistent across different specialties. Conversely, de Oliveira et al. (2021) highlighted that drains may offer no benefit—or even pose increased risk—depending on how and when they are used. As a result, current guidelines from major authorities such as the WHO and the Centers for Disease Control and Prevention (CDC) do not provide strong, specific recommendations regarding routine drain use. Instead, they stress individualized assessment, proper drain management, and early removal when indicated (Berríos-Torres et al., 2017; CDC, 2017; WHO, 2018).

In real-world everyday practice, however, decisions regarding drain placement are mostly driven by institutional culture, personal preference, and surgical good practice habits, rather than by robust clinical evidence. This gap between evidence and practice reflects both the limitations and inconsistency of the existing literature and the clinical uncertainty surrounding the benefits and risks of drain use. To better understand divergences regarding SSI's preventive measures, our study was assembled as a local survey conducted among healthcare professionals (surgeons, residents, and perioperative nurses) aimed at assessing their practices and beliefs about the role of aspirative drains among other measures of SSI prevention.

1.1 Rationale for Aspirative Drain Use

Aspirative drains, also known as closed-suction drains, are designed to actively remove fluids from the surgical site using negative pressure. Unlike passive drains, which depend on gravity or capillary action, the aspirative systems use compressible reservoirs to create a vacuum that draws fluid from the wound space through flexible tubing. This sealed system theoretically reduces the chance of retrograde contamination when compared to open drainage systems (O'Leary et al., 2019).

The rationale for placing an aspirative drain during surgery is primarily prophylactic: to prevent the accumulation of exudates, blood (hematoma), or serous fluid (seroma) in the dead space created by tissue dissection. These fluid collections, may potentially act as a culture medium for bacteria, leading to infection or delayed wound healing (Guo et al., 2010). Drains are also believed to reduce tissue tension, minimize edema, and improve tissue apposition—factors thought to promote better wound healing outcomes (Durai et al., 2009).

In addition, closed-suction drains may serve as a monitoring tool, allowing early detection of postoperative bleeding or leakage of lymphatic or enteric contents, depending on the type of surgery performed. This can be especially important in abdominal and oncological surgeries, where early intervention may prevent serious complications (Devi et al., 2016).

However, despite the theoretical benefits, drains are not without risks. The presence of a drain introduces a foreign

body that can serve as a potential route for infection, especially if the integrity of the closed system is compromised or if the drain remains in situ longer than necessary (de Oliveira et al., 2021). The tubing can also cause local tissue irritation, contribute to discomfort, and—when improperly positioned—lead to local tissue necrosis or drain site complications (Chen et al., 2020).

The actual impact of drains on infection prevention remains procedure-specific and context-dependent. While some procedures, such as mastectomies or extensive soft tissue dissections, have historically favored the use of drains, others, including clean orthopedic operations, have increasingly moved away from routine drainage due to a lack of proven benefit (WHO, 2018). In fact, several modern Enhanced Recovery After Surgery (ERAS) protocols now discourage the use of prophylactic drains unless clearly indicated (Ljungqvist et al., 2017).

In short, the mechanism of action of aspirative drains supports their theoretical utility, but this must be balanced against the risks of infection, patient discomfort, and prolonged hospitalization. Their efficacy should be evaluated based on evidence, surgical context, and appropriate drain application protocols (Zhang et al., 2020; Parker et al., 2007).

1.2 *Current Evidence on Aspirative Drains and SSI Prevention*

Despite their widespread use across surgical disciplines, the efficacy of aspirative drains in reducing surgical site infections (SSIs) remains a subject of debate. Studies on this topic have produced mixed results, often varying by surgical specialty, procedure type, and postoperative protocols. A critical review of the literature suggests that while aspirative drains may offer benefits in certain contexts, their unconditional use is not universally supported by adequate evidence.

1.3 *Surgical Context Matters*

The effectiveness of aspirative drains appears to be highly procedure-specific. In breast surgery, for instance, drains have traditionally been used to reduce seroma formation following mastectomy or axillary dissection. However, recent studies challenge the assumption that drains reduce infectious complications. A meta-analysis by O'Leary et al. (2019) found that prophylactic closed-suction drainage in breast surgery did not significantly reduce SSI rates, although it did modestly lower seroma incidence.

In contrast, orthopedic procedures, particularly clean surgeries such as total joint arthroplasty, have increasingly moved away from routine drainage. A large retrospective review by Zhang et al. (2020) found no significant difference in infection rates between patients who received closed-suction drainage and those who did not after total knee replacement. Moreover, enhanced recovery after surgery (ERAS) protocols in orthopedic and spinal surgeries now typically advise against routine drain use, citing the absence of clear benefit and the potential for harm (Ljungqvist, Scott, & Fearon, 2017; Zhang et al., 2020)

In abdominal and colorectal surgery, the evidence is more nuanced. Some studies suggest drains may help in detecting early anastomotic leakage or intra-abdominal abscesses, but they have not consistently been shown to prevent SSIs (Fujii et al., 2017).

In fact, the World Health Organization (2018) specifically states that prophylactic drain placement is not routinely recommended after colorectal procedures due to the lack of demonstrated benefit (WHO, 2018).

1.4 *Risks Associated with Prolonged Drain Use*

The key concern associated with aspirative drains is their potential to increase infection risk when left in place for extended periods. Drains can act as a conduit for bacteria from the skin to the surgical site, particularly when the sterile seal is compromised. According to de Oliveira et al. (2021), prolonged drain duration beyond 72 hours was associated with a statistically significant increase in SSI risk across multiple surgical specialties.

Moreover, site infections at the drain port, although not classified as deep SSIs, can lead to patient discomfort, extended antibiotic use, and delays in wound healing. Proper management, including sterile handling, daily assessment, and early removal, is essential to mitigate these risks (Chen et al., 2020).

2. **Guideline Recommendations**

Leading health authorities have not endorsed the routine use of drains for SSI prevention. The World Health Organization's Global Guidelines for the Prevention of Surgical Site Infection (2018) recommend that drains, if used, be

removed as soon as clinically feasible. Similarly, the Centers for Disease Control and Prevention (CDC, 2017) emphasize minimizing the use of devices that could serve as portals for microbial entry, including drains (Berríos-Torres et al., 2017; WHO, 2018).

The lack of strong, consistent evidence has led many clinical bodies to conclude that drain use should be individualized based on patient risk factors, the nature of the surgery, and taking into account the surgeon’s experience, and the institutional protocols.

3. Methodology

This descriptive analytical cross-sectional study was conducted at the Trauma University Hospital in Tirana, Albania, from October 1 to October 31, 2023, involving 86 healthcare professionals from General Surgery, Orthopedics, Neurosurgery and Otorhinolaryngology Departments. No exclusion criteria were applied, regarding all professionals actively engaged in all phases of preoperative, operative and postoperative care. Participants included attending surgeons, surgical residents, and perioperative nursing staff, recruited voluntarily and anonymously through a questionnaire distributed over a four-week period. Among respondents, 67 were attending surgeons, 6 surgical residents, and 13 operating room nurses, representing four surgical specialties: General Surgery (n = 30), Orthopedics (n = 37), Neurosurgery (n = 9), and Otorhinolaryngology (ORL) (n = 10).

The structured, self-administered survey consisted primarily of closed-ended questions addressing demographics, years of professional experience, surgical specialty, and among others opinions regarding whether the use of aspirative (suction) drains increases the risk of surgical site infections (SSI) with closed answers “Yes” and “No”, and opinions regarding whether the participant supports or not the grounds favoring the prolongation of antibiotic prophylaxis succeeding drain application.

Descriptive statistics were used to summarize respondent characteristics and response distributions, while inferential analyses such as chi-square tests were planned to evaluate differences between professional groups according to departments, roles, and years of experience of the participants. All statistical analyses were conducted using Stata Statistical Package for Social Sciences (SPSS) v.20.0.

Ethical approval was obtained from the institutional ethics committee, and informed consent was implied by voluntary completion of the anonymous survey. Participant confidentiality and data security were strictly preserved throughout the study.

4. Results

A total of 86 healthcare professionals completed the survey at the Trauma University Hospital in Tirana. The respondents included 67 attending surgeons, 6 surgical residents, and 13 operating room nurses, representing four specialties: General Surgery (n = 30), Orthopedics (n = 37), Neurosurgery (n = 9), and ENT (n = 10). Regarding professional experience, 23 respondents had less than 10 years, 33 had 10 to 20 years, and 30 had over 20 years of clinical experience. This distribution is shown in Table 1.

Table 1. The Distribution of Survey Participants (n = 86)

Category	n	%
Professional Role		
Attending Surgeons	67	77.9%
Surgical Residents	6	7.0%
Operating Room Nurses	13	15.1%
Specialty		
General Surgery	30	34.9%
Orthopedics	37	43.0%
Neurosurgery	9	10.5%
ENT	10	11.6%
Years of Clinical Experience		
< 10 years	23	26.7%
10–20 years	33	38.4%
> 20 years	30	34.9%
Total	86	100%

4.1 Results Regarding the Belief That Aspirative Drains Increase SSI Risk

Out of the 86 respondents, 37 participants (43.0%) believed that the use of aspirative (suction) drains increases the risk of surgical site infection (SSI). This perception varied notably with years of professional experience. Among those with <10 years of experience, 13 out of 23 (56.5%) held this belief, while the proportion was 15 of 33 (45.5%) among those with 10–20 years, and 9 of 30 (30.0%) among those with more than 20 years of experience. This distribution is shown in Table 2 and visualized in Figure 1.

Table 2. Distribution of the Perception of Drain-Related Infection Risk vs. Years of Experience

Years of Experience	Yes (SSI Risk)	No/Unsure	Total	% “Yes”
<10 years	13	10	23	56.5%
10–20 years	15	18	33	45.5%
>20 years	9	21	30	30.0%

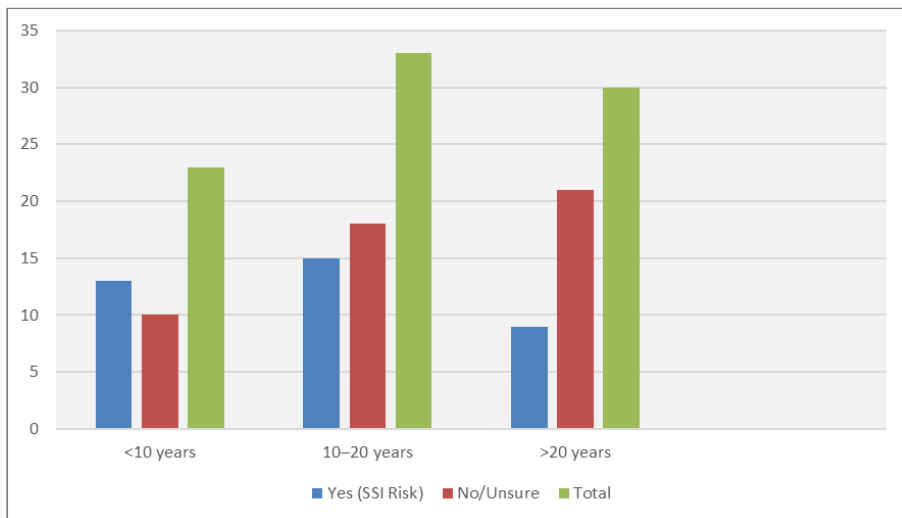


Figure 1. Chart Showing the Distribution of the Level of the Belief that *Aspirative Drains Increase SSI Risk*

4.2 According to Years of Experience

A chi-square test revealed that this association was not statistically significant ($\chi^2 = 3.86$, $p = 0.1448$), suggesting a trend but not a strong dependency between experience and drain perception as a risk factor.

When analyzed by professional role, 28 surgeons, 4 residents, and 5 nurses believed drains increase infection risk. However, the differences across roles were not statistically significant ($\chi^2 = 1.41$, $p = 0.4952$). (Table 3)

Table 3. Distribution of the Perception of Drain-Related Infection Risk vs. Professional Role

Professional Role	Believe Drains Increase Infection Risk (n)	Believe Drains Increase Infection Risk (%)	Total number (%)
Attending Surgeons	28	32.6%	67 (77.9%)
Surgical Residents	4	4.7%	6 (7.0%)
Operating Room Nurses	5	5.8%	13 (15.1%)
Total	37	43.0%	86 (100%)

4.3 Results Regarding the Prolongation of Antibiotic Prophylaxis

Among those who perceived drains to increase infection risk, 25 respondents (67.6%) expressed support for the prolongation of postoperative antibiotic prophylaxis. Among these 25 participants:

13 had less than 10 years of experience, 3 had 10–20 years, and 9 had over 20 years of experience. Results shown in Table 4.

Table 4. Support for Prolonged Antibiotic Prophylaxis by Years of Experience

Experience	Support	Do Not Support	% Support
<10 years	13	10	52%
10–20 years	3	30	12%
>20 years	9	21	36%

A chi-square test showed a highly significant relationship between years of experience and support for prolonged antibiotic prophylaxis ($\chi^2 = 14.81$, $p = 0.0006$). Respondents with less experience were significantly more likely to advocate for extended antibiotic coverage.

This trend is illustrated in Figure 2, where professionals with less than 10 years of experience were the majority of those favoring prolonged prophylaxis.

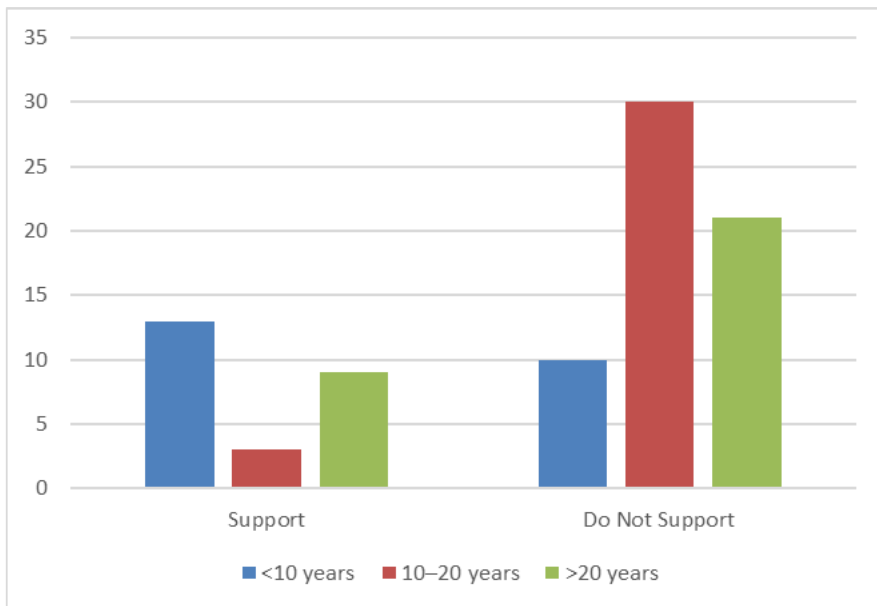


Figure 2. Chart Showing the Support for Prolonged Antibiotic Prophylaxis by Years of Experience

4.4 Differences by Professional Role and Specialty Regarding the Prolongation of Prophylaxis

Among those who supported prolonged antibiotic use, 18 were surgeons, 4 were surgical residents, and 3 were nurses (Table 5). The association between professional role and support was not statistically significant ($\chi^2 = 4.50$, $p = 0.1055$), though the trend suggested greater support among younger and less experienced professionals.

Table 5. Support for Prolonged Antibiotic Prophylaxis by Professional Role

Role	Support	No Support	% Support
Surgeon	18	49	72
Resident	4	2	16
Nurse	3	10	12

By specialty, General Surgeons (30%) and ENT Surgeons (60%) accounted for the largest portion of supporters, among respective departments. Table 6 and the chart in Figure 3 show the distribution by surgical discipline. This association did not reach statistical significance ($\chi^2 = 5.85, p = 0.1190$).

The summary of the statistical analysis for all the investigated variables including the perceptions regarding aspirative drains as potential SSI risk factors, and the observed level of support for subsequent antibiotics prophylaxis prolongation is shown in Table 7.

Table 6. Support for Prolonged Antibiotic Prophylaxis by Surgical Specialty

Specialty	Support	No Support	% Support
General Surgery	9	21	36
Orthopedics	8	29	32
Neurosurgery	2	7	8
ENT	6	4	24

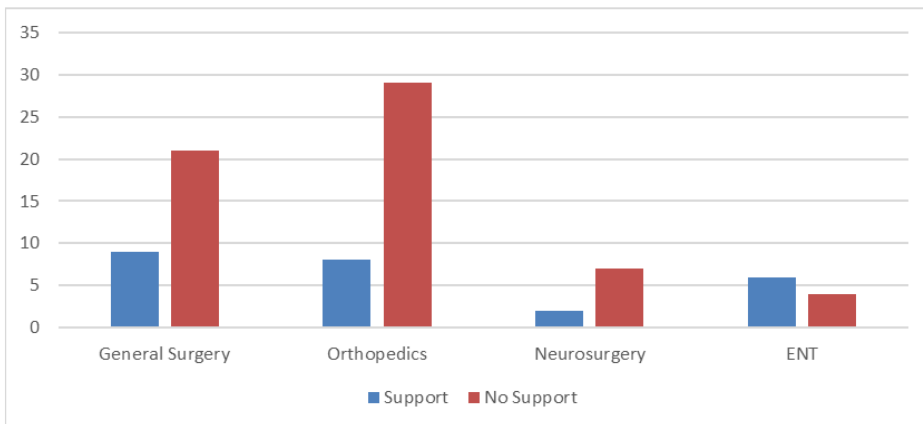


Figure 3. Chart Showing the Support for Prolonged Antibiotic Prophylaxis by Surgical Specialty

Table 7. The Summary of Statistical Analysis

Comparison	Chi ²	P-value	df	Interpretation
Experience vs Belief Drains ↑ SI	3.86	0.1448	2	Not statistically significant
Role vs Belief Drains ↑ SSI	1.41	0.4952	2	No significant association
Experience vs AB Prophylaxis Support	14.81	0.0006	2	Significant: Less experienced professionals favor prolonged prophylaxis
Role vs AB Prophylaxis Support	4.50	0.1055	2	Trend toward significance
Specialty vs AB Prophylaxis Support	5.85	0.1190	3	Not statistically significant

5. Discussion

This study investigated perceptions among health care professionals regarding the potential contribution of aspirative (suction) drains to the risk of surgical site infections (SSIs), and how these perceptions may relate to attitudes toward prolonged antibiotic prophylaxis.

Although the current trends do not favor the routine application of the former as a preventive measure (Lu et al., 2025; Ramesh et al., 2025), our findings reflect a diverse range of opinions across professional roles, departments, and years of clinical experience, underscoring the ongoing uncertainty regarding the investigated clinical practice.

5.1 Perceptions on Drain-Related SSI Risk

Of the 86 respondents, 37 (43.0%) indicated that aspirative drains increase the risk of SSI. This perception, while not statistically associated with professional role ($p = 0.4952$), years of practice or specialty, demonstrated a significant trend related to clinical experience. Among those with less than 10 years of experience, 13 out of 23 (56.5%) believed drains increase infection risk, compared to 15 out of 33 (45.5%) in the 10–20 year group and 9 out of 30 (30.0%) among those with more than 20 years of experience ($p = 0.1448$, $\chi^2 = 3.84$). Although the result did not reach statistical significance, it suggests that younger clinicians may be more sensitive to potential iatrogenic risks, possibly due to recent exposure to updated guidelines or infection control education. (Berríos-Torres et al., 2017; WHO, 2018)

These results align with published data indicating a lack of consensus regarding the efficacy and safety of surgical drains. Several studies have demonstrated no significant reduction in infection rates with routine drain use, and in some cases, increased infection risks have been reported due to retrograde contamination or prolonged indwelling time (Parker et al., 2007; Gonzalez et al., 2002). Additionally, guidelines such as those from the CDC (Berríos-Torres et al., 2017) do not offer clear recommendations on drain use, further reflecting the ambiguity in practice (WHO, 2018).

5.2 Association with Antibiotic Prophylaxis Practices

A key finding of the study is the strong association between beliefs about drains and preferences for antibiotic prophylaxis prolongation. Among the 37 respondents who believed that drains increase infection risk, 25 (67.6%) also supported prolongation of postoperative antibiotic prophylaxis—compared to a much lower proportion among those who did not perceive drains as risky ($p = 0.0006$, $\chi^2 = 14.81$). This suggests that concern over drain-related infections may influence broader surgical infection prevention behaviors, including the decision to extend antibiotic coverage beyond recommended durations.

This association is clinically significant, as prolonged antibiotic use—though potentially seen as a protective measure—does indeed increase the risk for antimicrobial resistance, leading to superbug (high antibiotic resistance microorganisms) infections, and unmanageable healthcare costs (Bratzler et al., 2013; Yazir R., 2024; Marino et al., 2022; Rink et al., 2025). Therefore, it is critical to address the underlying fears or misperceptions that drive non-evidence-based antibiotic prescribing habits. (Kirkland et al., 1999; Kasse et al., 2024)

5.3 Influence of Experience and Professional Role

When stratified by years of experience, 13 out of 25 (52%) of those favoring prolonged antibiotics had less than 10 years of clinical practice, while only 12% fell within the 10–20 years range. This distribution was statistically significant ($p = 0.0005$, $\chi^2 = 14.80$), indicating a possible inverse relationship between clinical tenure and aggressive prophylactic behavior. This may reflect a lack of confidence among less experienced practitioners or a tendency to overcompensate in uncertain scenarios.

Profession-wise, 18 out of 25 (72%) respondents who favored extended antibiotics were surgeons, and only a small minority were nurses (3) or residents (4). While not statistically significant ($p = 0.0995$), this suggests that decision-making around prophylaxis may remain largely in the hands of senior surgical staff, even if influenced by broader team perceptions. Specialty analysis revealed no significant differences, although general surgeons and orthopedists made up the majority of those supporting extended antibiotic use.

6. Clinical and Educational Implications

Our results indicate a perceptual and behavioral gap among surgical teams regarding best practices for infection prevention. The belief that drains contribute to SSI risk is strongly associated with support for extended antibiotic use, a practice contrary to current SSI prevention guidelines. As a result, two main implications arise:

1. **Need for protocol standardization:** Institutions should develop and enforce clear, evidence-based protocols regarding both drain usage and antibiotic duration. These should be harmonized with international guidelines such as those from the WHO and CDC to reduce practice variability. (Berrios-Torres et al., 2017; WHO, 2018)
2. **Targeted education:** Training should specifically address misconceptions among less experienced staff and reinforce the risks of antibiotic overuse. Case-based learning and audit-feedback mechanisms can help align clinical behavior with best practices.

7. Limitations

The study has several limitations. It was conducted in a single tertiary institution, which may limit the generalizability of findings.

The self-reported data introduces the potential for response bias, and the study did not correlate perceptions with actual patient outcomes or SSI rates.

Additionally, although statistical tests were applied, some subgroups had small sample sizes, limiting the impact of certain analyses.

8. Conclusion

This study highlights notable perceptions among surgical healthcare professionals regarding the role of aspirative drains in surgical site infection (SSI) risk and the implications of these beliefs on antibiotic prophylaxis practices.

Despite a lack of robust evidence, a significant proportion of respondents expressed concerns on increased SSI rates over the use of aspirative drains, and these concerns were strongly associated with support for prolonging postoperative antibiotic prophylaxis.

Our findings emphasize the need for targeted educational interventions aimed at aligning the usage of the aspirative drains not as a routine application, but only when deemed necessary according to local clinical practices and surgical experiences, and moreover to avoid any prolongation on the established protocols of postoperative antibiotic prophylaxis.

Younger and less experienced professionals, in particular, may benefit from enhanced training on SSI prevention strategies, and the judicious use of surgical drains. Moreover, institutional protocols should be reviewed to address inconsistencies in practice and promote adherence to established recommendations. (Berrios-Torres et al., 2017; WHO, 2018; Seideman et al., 2023)

In conclusion, while aspirative drains remain a valuable tool in specific clinical contexts, their routine use should be discouraged and carefully evaluated domestically.

Institutions must ensure that practice is guided by evidence rather than perception, to optimize patient outcomes and to minimize the unnecessary antibiotic exposure.

9. Disclaimer

This study does not provide direct clinical evidence regarding the actual impact of aspirative drains on surgical site infection (SSI) rates but rather explores perceived associations. Recommendations drawn from this research should be interpreted in the context of broader clinical evidence and in alignment with institutional protocols and international guidelines.

The authors declare no conflict of interest.

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