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# Perioperative Surgical Practices Amongst Kenyan Veterinarians And Their Association To Surgical Site Infections

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***Abstract:***
***Background:*** *Surgical site infections (SSIs) are a significant postoperative complication in veterinary practice, leading to delayed recovery, increased morbidity, and higher treatment costs. Understanding the factors that predispose veterinary patients to SSIs is essential for enhancing surgical standards, optimizing postoperative care, and promoting judicious antimicrobial use.*
***Objective:*** *To evaluate perioperative surgical practices and their association to SSIs in veterinary patients in Kenya.*
***Methods:*** *A cross-sectional study was conducted among 83 veterinarians across Kenya using a structured questionnaire. Data on surgical practices, perioperative care, occurrence of SSIs, and antibiotic usage were collected. Statistical analysis, including univariate and multivariate logistic regression, was performed to identify factors associated with SSIs.*
***Results:*** *Eighty-three veterinarians responded, with a near-equal gender distribution. Amongst the respondents, 79.5% held only undergraduate degree. Mixed animal practice was the most common (50.6%), followed by small animal (41%) and large animal practice (8.4%). The mean number of surgeries performed per month was 8.70 ± 12.67, with elective and reconstruction procedures being the most frequent. Majority of the respondents (86.7%, n = 72) scrubbed hands prior to a surgical procedure. Majority of the surgeons always adorned head cover, face mask and sterile surgical gloves during surgery. Overall, 95.2% (n = 79) of the respondents always scrubbed the patient's surgical site mainly by using scrub solutions and thereafter disinfecting the field using 70% ethyl alcohol. Further, 77.1% (n = 64) and 97.6% (n = 81) of the respondents were draping the surgical site and used sterilized surgical instruments, respectively. The most popular method of sterilizing surgical instruments was immersion in chemicals (49.4%) followed by autoclaving (37.4%). Surgical theatres were mainly disinfected after every surgery. Factors significantly associated with SSIs included the surgeon's gender, years of experience, consistent hand scrubbing, use of alpha-2 agonists, preoperative administration of analgesics, administration of penicillin in orthopaedic surgeries, and the frequency of elective surgeries. A unit increase in years of surgical experience increased the odds of SSI by 28%, while consistent hand scrubbing, use of alpha-2 agonists, and preoperative analgesic administration reduced SSI risk by 8%, 5%, and 14%, respectively. Frequent performance of elective surgeries increased the odds of SSI by 32-fold.*
***Conclusion:*** *This study highlights modifiable factors influencing the occurrence of SSIs in veterinary practice in Kenya. The findings of the study underscore the need for targeted interventions to improve surgical standards and reduce postoperative infections.*
***Keywords:*** *Perioperative; practices; Veterinarian; Surgical site infection; Veterinary patients.*

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## I. Introduction

Surgical site infections (SSIs) represent one of the most common and consequential complications following veterinary surgical procedures and leads to increased patient morbidity, mortality, treatment costs, and over/misuse of antimicrobial (1). An SSI is defined as an infection occurring within 30 days of a surgical procedure or within one year after an implant is placed, and it can involve the incision site or deeper tissues at the surgical site (2).

The reported prevalence of SSIs in veterinary medicine varies widely, ranging from 2% to 10% for clean procedures, and can exceed 20% for contaminated or dirty procedures or specific high-risk surgeries such as orthopedic and reconstructive operations (3). This variability is influenced by the type of practice, surgical procedure, patient factors, and the intensity of surveillance.

The development of an SSI is a multifactorial process, arising from a complex interplay of patient-related, procedure-related, and management-related risk factors. Key patient factors include underlying comorbidities like endocrinopathies, poor nutritional status, and remote site infections (4). The procedure-related factors include the duration of surgery, the degree of intraoperative tissue trauma, the classification of the surgical wound (clean vs. contaminated), and the efficacy of aseptic technique (3).

Further, perioperative management, including the presurgical hand antisepsis, surgical gloving, appropriate patient skin preparation, strict aseptic technique, maintenance of a sterile surgical environment, judicious use of antimicrobial prophylaxis, optimal pain management, careful tissue handling, minimization of operative time where feasible and sterile instrument processing, are all modifiable factors that significantly reduce the risk of SSI (5).

The treatment of established SSIs typically involves a combination of surgical intervention, such as debridement and lavage, and systemic antimicrobial therapy. The choice of antimicrobial is ideally based on culture and susceptibility testing to ensure efficacy and promote antimicrobial stewardship (6). However, empirical use of antibiotics for treating SSIs is a common practice especially in low resource clinical setups and can contribute to antimicrobial resistance, a growing global One Health concern (7).

The link between SSI management and AMS is inextricable. The prophylactic use of antibiotics to prevent SSIs is a common and sometimes necessary practice; however, its misuse through incorrect drug selection, timing, or duration—offers no clinical benefit and unnecessarily contributes to AMR (6). Therefore, optimizing antimicrobial prophylaxis protocols and reserving therapeutic antibiotics for confirmed infections are cornerstone principles of veterinary AMS. Current guidelines emphasize the use of narrow-spectrum, perioperative antibiotics for specific indications rather than prolonged postoperative courses (6).

Given the significant impact of SSIs on animal health and the critical role of prudent antimicrobial use in mitigating AMR, ongoing surveillance and research into SSI prevalence, risk factors, and treatment practices are essential. The aim of this study was to determine the perioperative surgical practices amongst Kenya veterinarian and their association to surgical site infection. This overall goal was to provide evidence-based strategies to improve surgical outcomes and support antimicrobial stewardship efforts.

## II. Materials And Methods

***Ethical approval***

The ethical approval was acquired from the Faculty Biosafety, Animal use and Ethics Committee, University of Nairobi, Nairobi, Kenya (FVM BAUEC/2023/630).

***Study design***

The present study was a cross-sectional study designed to determine the surgical practices amongst Kenyan veterinarians and their association to surgical site infections. The study was carried out between January 1, 2023 to June 30, 2023.The sample size was calculated using a formula described by Dohoo et al (8) for estimating a single proportion in a cross section study. Assuming a 95% confidence level, a margin error of 5% and expected proportion of 50%, the calculation yielded a sample size of 384 veterinary clinics. Since the total number of veterinary clinics registered by the Kenya veterinary board are less than 100, then they were all considered eligible to participate in the study.

***Selection of veterinary clinics and surgeons***

In this study, the sampling unit was a veterinary practice involved in small animal practice. This was informed by the fact that perioperative surgical practices are often influenced by clinic-specific protocols, resource availability and institutional norms and traditions. In addition, the limited number of registered veterinary clinics in Kenya made clinic-level sampling more practical and allowed border geographic representation and thus improve representativeness. Where more than one veterinarian was working in a clinic, the one directly involved in developing surgical SOPs and overseeing surgeries was selected to participate in the study so as to avoid clustering effects and overrepresentation of individual clinics.

To achieve targeted sampling, a list of all registered and active veterinary practices in Kenya was obtained from the Kenya Veterinary Board. Formal invitations to participate in the study were sent out to the head veterinarian in each of the practices. The aim was to purposively interview at least one veterinarian in each of the practices in Kenya. Questionnaires were distributed via Google forms through the official practice email address to veterinarians who consented and expressed their willingness to participate in this study. The google forms were left active for a period of 6 months with bi-weekly reminders to all the veterinarians who had not filled and sent back the questionnaires.

***Data collection***

Data on perioperative practices and surgical site infections were collected using a standard questionnaire. The questionnaire was administered to one consenting veterinarian working in registered veterinary clinics in Kenya. The questionnaire was fragmented into three sections and consisted of closed-ended and a few open-ended questions. Section 1 contained questions that sought to gather information regarding the respondents' demographics such as sex, level of qualification, years in practice and number of surgeries performed per month. Section 2 acquired information on surgical practices perioperatively such as scrubbing techniques, sterilization of surgical instruments and other aseptic preparation processes. Section 3 focused on knowledge of surgical site infections postoperatively including scoring the level of occurrence and treatment of surgical site infection. The questionnaire was pre-tested and questions refined before being sent out to veterinarians. Questionnaire were also serialized as a means of identifying the respondents especially those that preferred to remain anonymous.

***Data management and analysis***

Data were initially entered into Microsoft Excel 2010 where they were sorted coded and, imported to Stata 15.1 software for statistical analyses. For categorical variables, proportions were generated and for continuous variables, range, standard deviation, mean, mode and median were calculated.

To identify factors associated with surgical site infection a multilevel mixed-effects logistic regression analysis was done. Veterinarians were asked to give a score for occurrence of surgical site infection (SSI) on a scale of 1-5. Score 1 was never encountered, score 2 was low occurrence, score 3 was moderate occurrence, score 4 was frequent occurrence and score 5 was occurrence of SSI after every surgery. To facilitate analysis, score 1 and 2 were treated as absence of surgical site infection postoperatively while score 3, 4, and 5 were treated as presence of surgical site infection after surgery.

Univariable regression analysis was initially performed to determine association between all the predictor variables and antibiotic use. All variable with $p \leq 0.3$ were then included in the multivariable logistic regression. Initially, correlations between predictor variables were evaluated using pair-wise correlation. The final model was then fitted manually through backward stepwise elimination, retaining predictor variables with $p \leq 0.05$. Plausible biological interactions between significant explanatory variables in the final model were also tested (8). The overall performance of the model was tested using area under the curve (AUC) of the receiver operating characteristic.

Final multivariate logistic regression model checking was done to examine if the regression model fits the data. The goodness of fit test was done using Pearson chi-square ($P \geq 0.05$) and was considered acceptable, and if the fit was not acceptable, the covariate patterns were restricted to 10, and the Hosmer-Lemeshow chi-square was done. Overall predictive ability to test for sensitivity and specificity of the model and receiver operating characteristics curve generated. Multicollinearity was also checked with the variance inflation factor of ≤ 10 considered acceptable.

## III. Results

***The demographic of the respondents***

A total of 83 veterinarians in veterinary practices consented and completed the questionnaire. Out of the 83 respondents, 48 (57.8%) were male while the remaining 35 (42.2%) were female. In reference to the level of education, 80.7% (67/83) of the respondents had only acquired Bachelor of Veterinary Medicine degree while the remaining 16/83 had attained postgraduate training either at the Master or Doctorate level. Majority of the respondents had engaged in clinical practice for a period of 2-5 years. Additionally, 50.6% (42/83) of the veterinarians were involved in mixed animal practice while 41% (34/83) and 8.4% (7/83) were exclusively in small animal and large animal practices, respectively. The data on the demographics of respondents is shown in Table 1.

**Table 1:** The demographics of eighty three respondents who participated in the study

| | **Category** | **Number of respondents (n = 83)** | **Percentage of the respondents (%)** |
|---|---|---|---|
| Gender | Male | 48 | 57.8 |
| | Female | 35 | 42.2 |
| Level of study | Undergraduate | 67 | 80.7 |
| | Postgraduate | 16 | 19.3 |
| Country of training | Kenya | 81 | 97.6 |
| | Outside Kenya | 2 | 2.4 |
| Duration in practice | < one year | 18 | 21.7 |
| | 2 – 5 years | 41 | 49.4 |
| | 6 – 9 years | 16 | 19.3 |
| | >10 years | 8 | 9.6 |
| Type of practice | Mixed practice | 42 | 50.6 |
| | Small animal practice | 34 | 41.0 |
| | Large animal practice | 7 | 8.4 |

***The surgical practices among the respondents***

***Type and frequency of surgical procedures***

The median number of surgeries carried out per practice in a month was 5 surgeries (Range 1-100; IQR: 7). When the respondents were asked to indicate the type of surgeries, they had performed frequently in the last 6 months, elective surgeries (Spay and castrations) were overwhelmingly mentioned by 43 out of the 83 respondents. This was followed by reconstructive surgeries (42/83), orthopedic surgeries (5/83), abdominal and emergency surgeries (2/83) while ocular and neurological surgeries were each mentioned by one respondent (Figure 1).

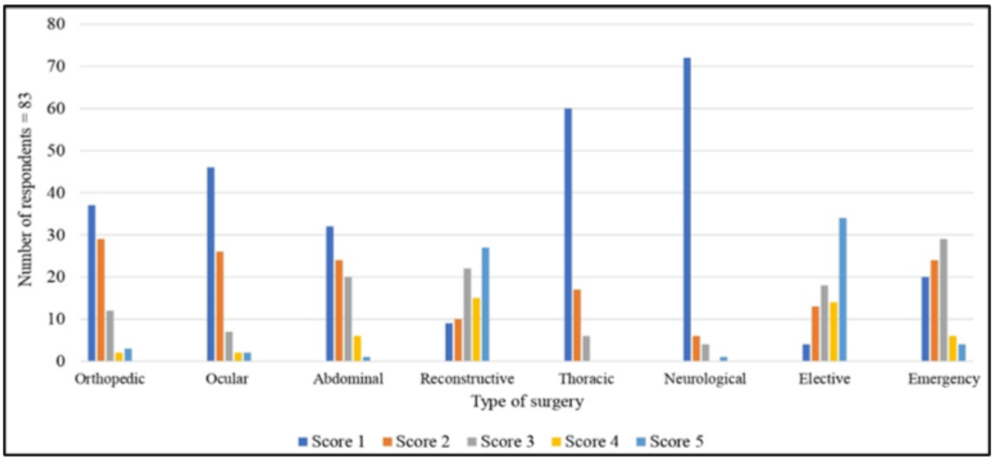


**Figure 1**. The figure shows percentage at which various surgical procedures were carried out in small animal practices in Kenya between January and July 2023. **Key**: Score 1: Very low; Score 2: Low; Score 3: Moderate; Score 4: High; Score 5: Very high

***Anaesthesia and analgesia practices***

When asked to select the type of anesthetic agents that were commonly used to anesthetize patients during surgery, majority of the respondents selected alpha-2 adrenoceptor agonists (90.4% n = 75) and cyclohexamines (67.5% n = 56). Benzodiazepines and opioids were the least used anesthetics at 10.8% (n = 9) and 7.2% (n = 6), respectively. Regarding pain management, 55.4% (46/83) of the respondents always administered analgesics to surgical patients, 37.3% (31/83) administered analgesics depending on the type of surgery, and 7.2% (6/83) were not giving analgesic perioperatively. The most popular group of analgesics was NSAIDs (65.1%) followed by corticosteroids (19.3%), drug combinations (7.2%), opioids (6.0%), and lastly local analgesics (2.4%). In reference to the preferred time of analgesic administration, 51.8% preferred giving analgesics before and after surgery, 34.9% postoperatively, and 13.3% preoperatively only.

***Preparation for aseptic surgery***

Majority of the respondents (86.7%, n = 72) scrubbed hands prior to a surgical procedure with 41.0% of them scrubbing thoroughly using scrub solution and thereafter disinfecting the hands using 70% ethyl alcohol. Additionally, 48% of the respondents always adorned head cover, a similar percentage used a face mask and 71% wore sterile surgical gloves during surgery. The other common preoperative surgical practices are summarized in Table 2.

Overall, 95.2% (n = 79) of the respondents always scrubbed the patient's surgical site in preparation for an aseptic surgery. Majority of them, scrubbed the operative field thoroughly using a scrub solution and thereafter disinfected the site using 70% ethyl alcohol. Further, 77.1% (n = 64) and 97.6% (n = 81) of the respondents were draping the surgical site and used sterilized surgical instruments, respectively. The most popular method of sterilizing surgical instruments was immersion in chemicals (49.4%) followed by autoclaving (37.4%) and boiling (13.3%) as shown in Table 2. With regard to surgical infrastructure, 96.4% (80/83) of the practices had a room dedicated to patient preparation only while only 65% had a room dedicated to surgery only. Surgical theatres were mainly disinfected after every surgery as stated by 39.8% of the respondents (Table 2).

**Table 2**. The perioperative practices amongst eighty three veterinary clinicians in Kenya

| Perioperative practice | Category of the perioperative practice | Number of respondents (n = 83) | Percentage of the respondents (%) |
|---|---|---|---|
| Hand scrubbing | Do not scrub hands | 11 | 13.3 |
| | Always scrubs hands | 72 | 86.7 |
| Hand scrubbing technique | Disinfect my hands with alcohol | 2 | 2.4 |

| | | | |
|---|---|---|---|
| | Always scrub thoroughly using a scrub solution like chlorhexidine | 18 | 21.7 |
| | Scrub thoroughly using the scrub solution and disinfect the hand with alcohol | 35 | 42.2 |
| | Wash my hands using soap/hand wash solutions and disinfect my hands with alcohol | 28 | 33.7 |
| Use of head cover | Do not adorn a head cover | 48 | 57.8 |
| | Always adorn a head cover | 35 | 42.2 |
| Use of face mask | Do not wear face mask | 35 | 42.2 |
| | Always wear face mask | 48 | 57.8 |
| Use of sterile gloves | Do not wear sterile gloves | 12 | 14.5 |
| | Always wear sterile gloves | 71 | 85.5 |
| Scrubbing of surgical site | Do not scrub surgical site<br>Always scrubs surgical site | 4<br>79 | 4.8<br>95.2 |
| Draping of surgical Site | Do not drape surgical site<br>Always drape surgical site | 19<br>64 | 22.9<br>77.1 |
| Use of sterile surgical equipment | Do not use sterilize instruments<br>Always use sterilize instruments | 2<br>81 | 2.4<br>97.6 |
| Sterilization method | Autoclave | 31 | 37.4 |
| | Boiling | 11 | 13.2 |
| | Chemical sterilization | 41 | 49.4 |
| Clinic have a dedicated surgical theatre | Yes<br>No | 54<br>29 | 65.1<br>34.9 |
| Disinfecting surgical theatres | Never<br>Twice per year<br>Every 3 months<br>Monthly<br>Weekly<br>Daily<br>After every surgery | 10<br>3<br>4<br>7<br>11<br>15<br>33 | 12<br>3.6<br>4.8<br>7<br>13.3<br>18.1<br>39.8 |

***Surgical site infection***

***Occurrence of surgical site infections***

Overall, when the respondents were asked to rate, on a scale of 1-5, how often they encountered surgical site infection postoperatively, 85.5% (71/83) gave a low score of below 2, 10.8% gave a median score of 3 while only 4% (3/83) gave a score of 4. When the same question was asked in reference to specific surgical procedures, surgical site infections had the lowest occurrence rate (Score 1-2) in ocular and elective surgeries and was highest (score 4-5) in reconstructive and orthopedic surgeries (Figure 2).

When asked to choose the class of antibiotics that they used to treat surgical site infection, 42.2% (35/83) of the respondents selected penicillin, 22.9% combined two or more antibiotics while 15.7% (13/83) chose cephalosporin. The choice of the antibiotics used to treat surgical site infections is detailed in Figure 3. Further, 68% of the respondents either agreed or strongly agreed that prophylactic antibiotics can significantly reduce surgical site infection (Figure 4).

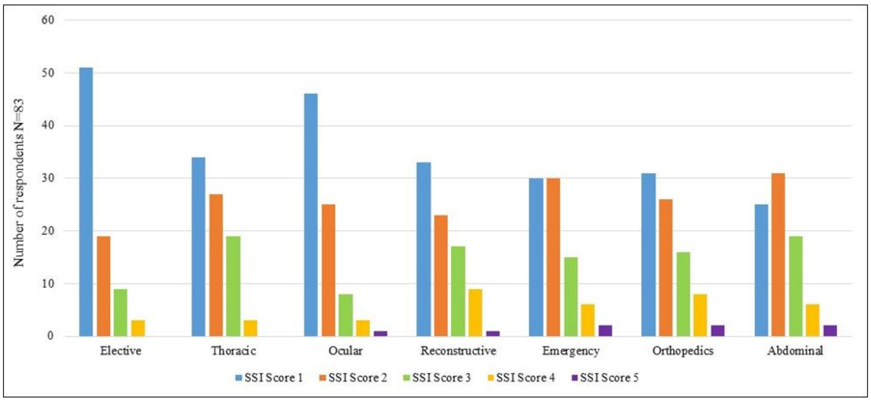


**Figure 2.** The figure illustrates the rate of at which surgical site infections occur in various small animal procedures in Kenya. Scores for SSI were lowest in elective and ocular surgeries but higher score were seen in reconstructive, orthopaedics and abdominal surgeries. **Key:** SSI score 1: Very low occurrence; SSI score 2: Low occurrence; SSI score 3: Moderate occurrence; SSI score 4: High occurrence; SSI score 5: Very high occurrence

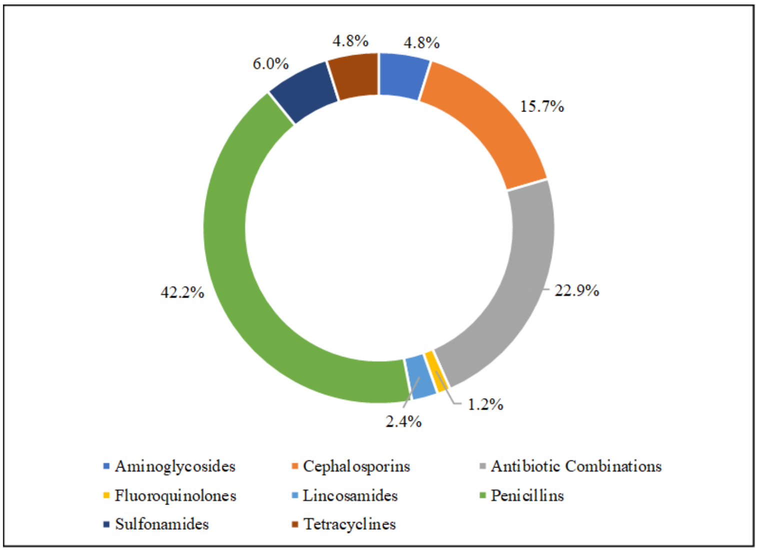


**Figure 3.** The preferred choice of antibiotics that are used to treat surgical site infection when they occur in small animal surgeries in Kenya. Penicillin, antibiotics combinations and cephalosporin were the most popular group of antibiotics.

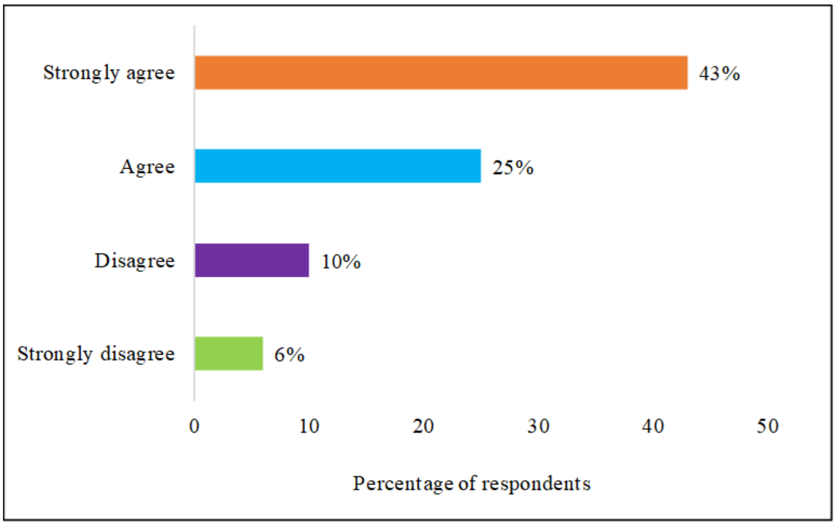


**Figure 4.** The perception of eighty-three veterinarians who took part in this survey with regard to the role of prophylactic antibiotics in minimizing surgical site infection in small animal surgeries in Kenya.

***Factors associated with surgical site infections in veterinary surgical patients***

The factors listed in table 3 were shown to have a univariate association with surgical site infection in veterinary patients. In the final surgical site infection model, seven variables namely the sex of the veterinary surgeon, surgeon's years in practice; anesthesia where alpha-2 agonists are used, surgeons always scrubbing hands, administration of penicillin in orthopedic surgeries, administering analgesics preoperative and oftnely performing elective surgeries were found to be significantly associated ($p \leq 0.05$) with surgical site infections in veterinary patients (Table 4). A unit increase in the number of years a veterinary surgeon had been in practice increased the odds of a patient getting surgical site infections by 28%. The odds of patients getting surgical site infections were reduced by 4% when the surgeon was a female, and by 5% where alpha-2 agonists were used for anesthesia, by 8% where surgeons always scrub hands before surgery, by 14% where analgesics were administered preoperatively and by 10% where penicillin antibiotics were administered in orthopedic surgeries. On the other hand, the odds of a patient getting surgical site infections were 32 times higher in practices where elective surgeries were performed oftnely.

**Table 3**: Univariable associations of predictor variables with occurrence of surgical site infections in veterinary patient.

| **Predictor variable** | **Type** | **P-value** |
|---|---|---|
| Sex of the veterinary surgeon | Categorical | 0.041 |

| | | |
|---|---|---|
| Surgeons' years in practice | Continuous | 0.008 |
| Performing elective surgeries often | Categorical | 0.1745 |
| Anesthesia where alpha-2 agonists are used | Categorical | 0.012 |
| Anaesthesia where ketamine is used | Categorical | 0.121 |
| Anesthesia where inhalants are used | Categorical | 0.186 |
| Administering analgesics preoperative | Categorical | 0.200 |
| Always scrubbing hands | Categorical | 0.013 |
| Always wearing a surgical cap | Categorical | 0.291 |
| Always wearing mask | Categorical | 0.296 |
| Method of sterilizing surgical instruments | Categorical | 0.2618 |
| Autoclave surgical instruments | Categorical | 0.103 |
| Chemical sterilization of surgical instruments | Categorical | 0.176 |
| Use of dedicated surgical theatre | Categorical | 0.200 |
| Frequency of theatre disinfection | Categorical | 0.179 |
| Frequency of disinfecting surgical table | Categorical | 0.1998 |
| The rate of antibiotics use perioperatively | Categorical | 0.1592 |
| Antibiotics use rate | Categorical | 0.104 |
| Choosing antibiotics based on culture and sensitivity | Categorical | 0.103 |
| Choosing antibiotics based on online literature | Categorical | 0.066 |
| Wash my hands using soap/hand wash solutions and disinfect my hands with alcohol | Categorical | 0.157 |
| Frequency of antibiotic use in clean-contaminated surgery | Categorical | 0.1999 |
| Frequency of antibiotic use in contaminated surgery | Categorical | 0.2979 |
| Frequency of antibiotic use in neurological | Categorical | 0.1337 |
| Administration of penicillin in contaminated surgery | Categorical | 0.087 |
| Administration of penicillin in dirty surgery | Categorical | 0.285 |
| Administration of penicillin in orthopedic surgery | Categorical | 0.036 |

**Table 4:** Final multilevel mixed-effects logistic regression model of surgical site infections in veterinary patients

| Variable | Category | OR | 95% CI | p-value |
|---|---|---|---|---|
| Surgeons' years in practice | Continuous | 1.28 | 1.05-1.56 | 0.013 |
| Sex of the veterinary surgeon | Male | Baseline | | |
| | Female | 0.04 | 0.004-0.41 | 0.007 |
| Anaesthesia where alpha-2 agonists are used | Baseline | | | |
| | Yes | 0.05 | 0.004-0.71 | 0.026 |
| Performing elective surgeries often | Low | Baseline | | |
| | Medium | 32.47 | 1.82-578.92 | 0.018 |
| | High | 2.40 | 0.23-25.15 | 0.465 |
| Surgeons always scrub their hands | No | Baseline | | |
| | Yes | 0.08 | 0.008-0.72 | 0.025 |
| Administering analgesics preoperatively | No | Baseline | | |
| | Yes | 0.14 | 0.008-0.72 | 0.025 |
| Administration of penicillin in orthopedic surgeries | No | Baseline | | |
| | Yes | 0.10 | 0.013-0.77 | 0.027 |
| | | | | |

## IV. Discussion

To the best of the author's knowledge, this is the first study that provides data on factors associated with surgical site infection in veterinary patients in Kenya. The findings reveal several key areas of strength in routine aseptic practice, identified modifiable risk factors for SSI, and identified unexpected patterns that warrant further investigation.

The high reported rates of hand scrubbing (86.7%) and patient surgical site preparation (95.2%) are commendable and align with fundamental principles of asepsis (4, 9) These practices form the first line of defense against SSIs and their widespread adoption is encouraging. However, the comparatively lower consistent use of complete sterile attire—such as head covers (48%) and face masks (48%)—presents a potential area for improvement. While the evidence on the impact of adoring surgical caps and masks on SSI rates in veterinary surgery is sometimes debated (4, 9), they are considered standard components of sterile technique which minimizes microbial shedding from the surgical team and are thus highly recommended in best practices

The reliance on chemical immersion over autoclaving is a significant deviation from the gold standard method of instrument sterilization. Autoclaving is the only method that guarantees sterility of surgical instruments as it effectively killing all microorganisms, including bacterial spores. Chemical disinfectants though can be used, are subject to operator error, can be inactivated by organic material, and may not achieve true sterility, (10) posing a substantial risk for SSI (6). This practice likely reflects resource constraints but represents a critical target for intervention through education on affordable autoclave options or the strict protocols required for effective chemical sterilization (7).

The finding that preoperative analgesia was associated with a 14% reduction in SSI is clinically significant and supported by physiological rationale. Pain is a potent stressor that activates the hypothalamicpituitary-adrenal axis and sympathetic nervous system, leading to immunosuppression (11). Pre-emptive analgesia mitigates this stress response (12), potentially preserving immune function and enhancing the patient's ability to combat intraoperative bacterial contamination. This finding strengthens the argument for pre-emptive analgesia not just as an ethical imperative for welfare, but as a key component of medical management which can improve surgical outcomes (13). Notably, the fact that 7.2% of veterinarians never administer perioperative analgesics is a serious animal welfare concern that must be addressed mainly through sensitization.

Similarly, $\alpha_2$-adrenoceptor agonists (e.g., xylazine and dexmedetomidine) exert significant anaesthetic-sparing effects through their potent sedative, analgesic, and muscle relaxant properties. Their use contributes to improved perioperative stability by reducing sympathetic responses to surgical stimulation and decreasing the doses of injectable and inhalational anaesthetic agents required for induction and maintenance of anaesthesia (14). Maintaining a stable plane of anaesthesia reduces the likelihood of intraoperative hypotension, thereby preserving tissue perfusion and oxygen delivery. Adequate tissue oxygenation supports neutrophil function, collagen synthesis, and wound healing, whereas sustained hypotension and tissue hypoperfusion increase susceptibility to surgical site infection (15, 16). Furthermore, emerging evidence suggests that $\alpha_2$-adrenoceptor agonists, particularly dexmedetomidine, exert immunomodulatory and anti-inflammatory effects by modulating innate and adaptive immune responses and attenuating the perioperative inflammatory response (17). However, the clinical significance of these immunomodulatory properties, particularly in relation to surgical outcomes and surgical site infection, requires further investigation.

The most striking finding of this study was that dogs undergoing elective surgery had 32-fold higher odds of developing surgical site infection (SSI) than those undergoing non-elective procedures. Although this represents a substantial effect size, it is unlikely to imply that elective surgical procedures are inherently associated with a greater risk of SSI. The exceptionally large odds ratio should also be interpreted with caution, as it may partly reflect the relatively small number of SSI events, imbalance between comparison groups, or the influence of residual confounding. Nevertheless, the strength of the association suggests that factors associated with elective surgical practice warrant careful consideration.

Rather than indicating that elective procedures are intrinsically high-risk procedures, this finding may reflect systemic factors associated with the high-volume nature of elective surgical practice. Elective procedures such as ovariohysterectomy and castration are frequently performed in rapid succession, particularly in teaching hospitals and high-throughput veterinary clinics, where increased surgical workload may inadvertently compromise adherence to aseptic principles.

High surgical caseloads have been associated with increased time pressure, workflow interruptions, operating room traffic, and reduced compliance with infection prevention protocols, including meticulous patient preparation, instrument handling, maintenance of the sterile field, and adherence to sterilization procedures. These factors have been recognized as important contributors to SSI risk in both human and veterinary surgery (16, 18). Similarly, veterinary literature emphasizes that strict adherence to perioperative aseptic practices remains one of the most effective strategies for preventing SSIs, irrespective of the type of surgical procedure (16).

Another possible explanation is the cumulative effect of workload-related fatigue and reduced vigilance among surgical personnel. High procedural volumes and repetitive surgical tasks have been associated with cognitive fatigue, burnout, and diminished attention to detail, factors that can adversely affect compliance with infection prevention measures and increase the likelihood of technical errors (19). Although direct evidence linking compassion fatigue to SSIs in veterinary surgery is limited, studies across healthcare settings consistently demonstrate that clinician fatigue and excessive workload negatively influence patient safety, procedural performance, and adherence to established protocols.

These findings underscore the importance of maintaining rigorous aseptic standards regardless of surgical workload. Evidence-based interventions, including standardized surgical safety checklists, structured perioperative protocols, and fostering a culture of safety in which all members of the surgical team are empowered to identify and address breaches in aseptic technique, have been shown to improve compliance with best practices and reduce preventable surgical complications (18, 19). Consequently, veterinary practices with high elective surgical caseloads should prioritize workflow management, adequate staffing, ongoing staff training, and continuous quality improvement initiatives to ensure that efficiency is not achieved at the expense of infection prevention.

The finding that increasing years in surgical practice were associated with higher odds of surgical site infection (SSI) was unexpected and contrasts with the conventional assumption that greater clinical experience leads to improved surgical outcomes. However, similar observations have been reported in both veterinary and human healthcare settings, where practitioner experience alone does not necessarily translate into better adherence to infection prevention practices or improved patient outcomes (19). This association should therefore be interpreted cautiously, as years of professional experience may act as a surrogate for other unmeasured factors rather than being an independent risk factor for SSI.

One possible explanation is that more experienced surgeons are often responsible for managing a greater number of surgical cases, including more complex procedures and referral cases that inherently carry a higher risk of postoperative complications, including SSI. Consequently, the observed association may reflect differences in case complexity and workload rather than the direct effect of professional experience. Furthermore, high clinical workloads and repetitive performance of routine procedures may contribute to cognitive fatigue, reduced vigilance, and gradual deviations from established infection prevention practices over time (19).

Another plausible explanation is variation in the adoption of evolving evidence-based recommendations. Surgical infection prevention guidelines continue to be updated as new evidence emerges, and clinicians who completed their training more recently may be more familiar with contemporary recommendations on perioperative asepsis, antimicrobial stewardship, and SSI prevention. In contrast, experienced practitioners who have not engaged in regular continuing professional development may be less likely to incorporate updated best practices into routine clinical care. This interpretation does not imply inferior clinical competence among experienced surgeons but rather highlights the importance of lifelong learning and periodic review of infection prevention protocols. Current international guidelines emphasize that consistent adherence to standardized, evidence-based perioperative practices is more important than years of clinical experience in minimizing the risk of SSI (18; 20).

Collectively, these findings reinforce the need for continuous professional education, regular audits of aseptic practice, and implementation of standardized surgical protocols for all members of the surgical team, irrespective of seniority or years of experience. Such measures help ensure that evolving evidence is translated into routine practice and reduce variability in adherence to infection prevention standards.

The modest protective effect associated with female surgeons should be interpreted with caution, as the observed association does not necessarily imply a causal relationship. Nevertheless, similar findings have been reported in human medicine. In a large population-based cohort study involving over one million patients in Canada (21), found that patients treated by female surgeons experienced a modest but statistically significant reduction in adverse postoperative outcomes, including surgical site infections, compared with those treated by male surgeons. Although the mechanisms underlying these differences remain uncertain, they are likely multifactorial. Proposed explanations include greater adherence to evidence-based clinical guidelines, meticulous surgical technique, enhanced communication with patients and other healthcare professionals, and increased compliance with perioperative care protocols (20, 21). However, these hypotheses remain speculative, and surgeon sex should be regarded as indicators of a complex interplay of behavioural, procedural, and healthcare system factors rather than an independent determinant of surgical outcomes. Further research is needed to determine whether similar associations exist in veterinary surgical practice.

The finding that penicillin was the most frequently administered antibiotic for the treatment of surgical site infections (42.2%) and appeared to have a protective association in orthopedic procedures is noteworthy, particularly in light of the widespread global prevalence of penicillin-resistant *Staphylococcus pseudintermedius*, one of the most common pathogens associated with canine SSIs (22). This apparent protective effect should therefore be interpreted cautiously, as the observed association may reflect local antimicrobial susceptibility patterns, concurrent administration of other antimicrobial agents, differences in case selection, or residual confounding rather than the intrinsic efficacy of penicillin alone. Furthermore, antimicrobial resistance patterns vary geographically, and limited surveillance data from Kenya make it difficult to determine whether local bacterial ecology differs from that reported elsewhere.

The relatively high proportion of cases managed with combination antimicrobial therapy (22.9%) may also suggest that treatment decisions were frequently empirical rather than guided by bacterial culture and antimicrobial susceptibility testing. While empirical therapy is often necessary when immediate treatment is required, current veterinary antimicrobial stewardship guidelines recommend that antimicrobial selection should, whenever feasible, be informed by culture and susceptibility results to optimize therapeutic success while minimizing the emergence of antimicrobial resistance (23).

The widespread use of prophylactic antibiotics reflects an encouraging awareness of the importance of SSI prevention among veterinary surgeons. However, prophylactic antimicrobial administration should always be integrated within a comprehensive perioperative infection prevention strategy and aligned with established antimicrobial stewardship principles. Current guidelines emphasize that prophylactic antibiotics are most effective when administered only for appropriate surgical indications, using the correct antimicrobial agent, at the optimal time before surgical incision, and for the shortest effective duration. Prolonged or unnecessary antimicrobial use provides little additional protection against SSI while increasing the risk of antimicrobial resistance and unnecessary drug exposure (18). Consequently, strengthening antimicrobial stewardship through routine culture and susceptibility testing, periodic surveillance of local resistance patterns, and evidence-based prescribing practices would likely improve both patient outcomes and the long-term preservation of antimicrobial efficacy in veterinary practice.

An important limitation of this study is the uneven distribution of the outcome variable used in the regression analysis. Most respondents (85.5%) rated the occurrence of surgical site infections as low leaving only about 15.5% in the high occurrence category. When one outcome group is much larger than the other, logistic regression models can produce unstable and unreliable results. Therefore, the findings from the regression analysis should be interpreted with caution and considered exploratory rather than definitive. In addition, the cross-sectional design of the study and the use of a self-administered questionnaire limit the ability to draw cause-and-effect conclusions. The results may also be affected by recall bias and social desirability bias, as veterinarians may have reported practices that they perceived to be appropriate rather than their actual behaviour. These factors limit the accuracy and generalizability of the study findings.

## V. Conclusion

This study highlights modifiable factors influencing the occurrence of SSIs in veterinary practice in Kenya. Adherence to aseptic techniques, appropriate anesthesia selection, and perioperative pain management were found to be protective factors, while high surgical workloads, particularly frequent elective surgeries, significantly increase the risk of SSI.

## VI. Recommendations

The study thus recommends, prioritizing the acquisition and use of autoclaves over chemical immersion for instrument sterilization; implementing strict protocols in high-volume settings**,** including surgical checklists, to maintain aseptic standards; Mandating pre-emptive analgesic protocols for all surgical procedures; Promoting antimicrobial stewardship by encouraging culture and susceptibility testing for SSIs and reviewing prophylactic antibiotic guidelines to ensure they are targeted and timely and lastly providing continuing education focused on aseptic technique and perioperative management for surgeons of all experience levels.

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