

## Assessment of surgical site contamination and aseptic practices in student small animal surgeries at the Department of Veterinary Surgery and Radiology, University of Maiduguri

Dauda Laku<sup>1</sup>, Mohammed Auwal Idris<sup>2\*</sup>, Bashir Muazu Mohammed<sup>1</sup>, Musa Kalim Adam<sup>1</sup>, Abubakar Mshelia Saidu<sup>1</sup>, Zainab Bukola Yusuf<sup>1</sup>, Adamu Alkali Habib<sup>1</sup> and Mohammed Sani<sup>3</sup>

<sup>1</sup>Department of Veterinary Surgery and Radiology, Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria

<sup>2</sup>Veterinary Teaching Hospital, Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria

<sup>3</sup>Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria

\*Correspondence: \*Correspondence: [maiauwal@unimaid.edu.ng](mailto:maiauwal@unimaid.edu.ng)

Submission: 30<sup>th</sup> January, 2026; Accepted: 19<sup>th</sup> February, 2026; Published: 20<sup>th</sup> February, 2026

### Abstract

Postoperative Surgical Site Infection (SSI) is very much associated with surgical site contamination in small animal veterinary practice, especially within veterinary teaching theatres where students frequently perform surgeries. However, there is limited quantitative data evaluating the extent of surgical site contamination in veterinary teaching hospitals, particularly regarding how intraoperative factors, theatre traffic, and adherence to aseptic protocols influence contamination levels and subsequent systemic responses in small animal patients. The study evaluated the level of surgical site contamination and the effectiveness of preventive aseptic measures employed during student-performed small animal surgeries at the Department of Veterinary Surgery and Radiology, University of Maiduguri. A prospective observational study design wherein five dogs were subjected to various surgical procedures, including gastrotomy, splenectomy, and ovariohysterectomy, was used. Swab samples were collected from the kennels, surgical packs, pre-surgical sites, intraoperative fields, immediate postoperative sites, and 3 days post-surgery for bacteriological analysis. Standard culture techniques were employed for the isolation and identification of bacterial organisms, and contamination levels were expressed as colony-forming units. Observations of aseptic practices, surgical duration, and operating theatre dynamics were also recorded, besides pre- and post-operative haematological appraisals. Results revealed an overall bacterial culture positivity rate of 78.5%, with the highest contamination observed in kennel samples and postoperative surgical sites. *Staphylococcus* spp. (39.28%) were the most frequently isolated organisms, followed by *Escherichia coli* (35.71%), *Shigella* spp. (35.71%), *Pseudomonas* spp. (21.42%), and *Bacillus* spp. (21.42%). The presence of postoperative haematological changes such as leukocytosis, neutrophilia, and monocytosis provided evidence that there was a systemic response to surgical contamination. This study confirms that, surgical site contamination in student surgical procedures in part occurs as a result of both intraoperative and postoperative parameters. There is a need for heightened awareness in aseptic practice, reduced theatre traffic, and upgraded environmental or postoperative wound care.

**Keywords:** Aseptic technique; Small animal surgery; Student-performed surgeries; Surgical site contamination; Surgical site infection

### 1.0 Introduction

Surgical procedures, which offer therapeutic and diagnostic alternatives for a variety of clinical conditions, are an essential part of small animal practice [1]. However, if proper aseptic protocols are not followed, surgical intervention always affects the skin's natural protective barrier,

increasing the risk of surgical site contamination and subsequent Surgical Site Infection (SSI) [2]. "Surgical site contamination" is defined as the presence of germs at the surgical site [3]. Depending on microbial load, host immunity, and prevention care measures, this could turn into an infection [4].

In both Veterinary and Human medicine, surgical SSI is acknowledged as one of the most frequent postoperative consequences [5]. SSIs have been linked to higher patient morbidity, delayed wound healing, longer hospital stays, greater use of antibiotics, and additional financial costs in small animal practice [6]. Accordingly, the prevention of contamination of surgical sites is a very important aspect of perioperative care, which mainly relies on strict adherence to aseptic concepts in both the pre-, peri-, or post-operative period [2].

Aseptic technique in veterinary surgery is a collection of standard methods intended to minimize microbiological contamination [7]. These include preoperative patient preparation, good surgical cleaning, use of sterile gowns and gloves, good sanitation of surgical instruments, and maintaining an operative room environment under strict control [8]. Antiseptics like povidone-iodine and gluconate of chlorhexidine are widely used for surgical site disinfection based on their antibacterial spectrum and effectiveness in reducing bacterial populations [9].

Aseptic techniques continue to present challenges despite established protocols, particularly in educational settings where compliance may be inconsistent [10]. In such environments, students frequently perform minor soft tissue surgeries, including orchietomy, ovariohysterectomy, and wound care procedures [11]. Although these procedures are common, they demand strict adherence to infection control guidelines to minimize the risk of surgical site contamination. Microbial contamination can arise from multiple sources, including the animal's skin, surgical instruments, operating room surfaces, and even surgical personnel, underscoring the multifactorial and complex nature of contamination risk within teaching hospitals [12]. The Veterinary Surgery and Radiology department is indispensable in rendering clinical services and imparting to the undergraduate students. One of the important veterinary education aspects of clinical training is student-performed procedures with close ability and confidence supervision where students acquire technical experience, shown that the risk of contamination is higher [11]. Nevertheless, studies have in operations performed by trainees due to factors such as lack of experience and occasional lapse in antisepsis protocol and longer surgical time [13]. deviate from aseptic Another observational study demonstrated that resident's technique during cleaning, gowning, gloving and

instrument handling which could be of concerns for potential wound infections. which may raise the risk of surgical site contamination [14].

Procedures on performed by students under clinical education. Despite small animals were on the effectiveness of preventive this, there is limited published data asepsis in this setting and surgical site infections. An investigation of these optimise patient outcomes, surgical fellow training aspects is necessary to efficiency and infection control policies. The objective of this review is to compare between surgical site contamination, the aseptic measures performed Veterinary preventive care during surgeries conducted on small animals by students in Teaching Hospital of the University of Maiduguri.

## 2.0 Materials and Methods

### 2.1 Study location

The Department of Veterinary Surgery and Radiology Surgery Theatre University of Maiduguri, a basic training facility for clinical students, is where the study was conducted. Small animal procedures performed by clinical students under the guidance of teaching professionals were the main focus of this work. The University of Maiduguri is located at approximately latitude 11.85°N and longitude 13.15°E[15]. Estimates suggest that Maiduguri has a population in the range of approximately 1 million to over 1.2 million people. [16]

### 2.2 Research design

A prospective, observational design was employed. The study focused on educational surgeries that were performed by students on canine species, this research was conducted between the months of March to June 2025. Swab samples were collected at different stages of each surgery for bacteriological examination, and observations were made on the preventive measures practiced during those procedures.

### 2.3 Study Subjects

The study population consisted of small animals (dogs) procured by the Department of Veterinary Surgery and Radiology for the purpose of student training, and samples were collected during invasive surgical procedures including ovariohysterectomy (spaying), gastrotomy, and splenectomy. Only cases handled directly by clinical students were considered.

## 2.4 Sampling approach

Samples from the surgeries involving five (5) dogs that underwent the 3 different procedures, conducted by the students were collected using a purposive sampling technique. Before each procedure, blood samples were taken to assess the animals' surgical fitness. Three days after the procedure, blood samples were still taken to assess the systemic reaction.

Within each operation, swabs were taken at predefined stages to monitor changes in contamination.

## 2.5 Data collection

### 2.5.1 Swabbing procedure

Sterile swabs moistened with normal saline were used to obtain samples at defined perioperative time points [17]. After final skin preparation but before incision, approximately 3cm of the prepared surgical site was swabbed to assess the effectiveness of preoperative antisepsis. Immediately after opening, the surface of the sterile surgical pack was swabbed to evaluate sterility integrity prior to use. During surgery (approximately midway through the procedure), a 3cm area adjacent to the incision line was sampled to determine intraoperative contamination arising from environmental exposure, surgical manipulation, or theatre traffic. Immediately after wound closure, the entire incision length was gently swabbed to assess contamination present at the completion of the procedure and the potential risk for early surgical site infection. Three days post-surgery, the full incision site and approximately 1 cm of surrounding skin margins were swabbed to evaluate postoperative microbial colonization and detect early infection development.

### 2.5.2 Observational records

An observation sheet was used to document preventive practices (asepsis), including the technique of surgical scrubbing and gowning, use and frequency of glove changes, draping methods applied, duration of the operation, number of personnel present inside the theatre, and any noticeable breaches in aseptic technique such as accidental contact with non-sterile surfaces.

## 2.5.3 Laboratory procedures

The collected swabs were cultured on Nutrient agar for general bacterial growth, Mannitol Salt agar for *Staphylococcus* spp, and MacConkey agar for Gram negative enteric bacteria. They were incubated at 37°C for 24–48 hours in an aerobic condition [17]. The bacterial colonies were examined and identified based on colony morphology and gram staining. The level of contamination was reported as colony forming units (CFUs) streaking method were used for counting at per swab and sample area, and the isolated organisms were identified as far as possible.

## 2.6 Ethical Clearance

The Department sort and got an Animal Utilization Protocol Clearance from the Animal Use and Ethics Committee, Faculty of Veterinary Medicine, University of Maiduguri

## 2.7 Data Analysis

Data obtained were presented as mean values in tables. Descriptive analysis and independent Student's *t*-test were used to determine the mean difference using GraphPad prism version 8.2.1. *P* value  $\leq 0.05$  was considered significant.

## 3.0 Results



Figure 1: Culture Media showing Growth of Bacteria

## 3.1 Characteristics of the study population

The distribution of the study population according to gender is shown in Table 1. There were three male (60%) and two female (40%) dogs of the study population that comprise five canines used

in this study. This reveals that male canines were slightly higher in number than female canines among the surgical operations surveyed. The distribution of gender is not by deliberate selection but by availability of animals used for training students. To make this study unbiased by confining its findings on surveys of surgical site contamination and asepsis to one gender, both sexes were used. These include males and females that were used to examine different types of surgeries such as ovariohysterectomy (Female animals only), splenectomy, and gastrotomy.

**Table 1: Distribution of study population by sex**

Sex	Frequency	Percentage (%)
Male	3	60
Female	2	40
Total	5	100

**3.2 Swab Sampling Results**

The result of bacterial growth from swab samples collected from different sampling points throughout the surgical procedures is shown in Table 2. Of the 28 swab samples taken, 22 swab samples (78.5%) yielded positive bacterial cultures. This indicates that the incidence of microbial contamination within the surgical environment was high.

The environment in the kennels was very contaminated. This is a potential source of germs that may result in surgical site contamination as determined by the 100% bacterial growth present in all swab samples collected from the kennels. This also establishes the importance of biosecurity and environmental precautions preceding surgery.

Of 5 swabs collected from surgical packs, 2 (40%) yielded bacterial growth, and it could be seen that although there was success in sterilization methods, there may have been some intermittent failures in sterilization and handling after sterilization in terms of instruments being sterilized and taken into the surgical field.

Surgical scrubbing resulted in a reduction of bacterial burden but failed to completely eliminate microorganisms from the skin, as seen in the swabs taken at the end of the skin preparation,

which had a positive rate of 60%. This finding agrees with the fact that the skin flora in a resident state is decreased but not eradicated by antiseptic skin preparation.

The samples taken during the procedure showed the presence of 80% contaminants, which indicated that the surgical region was exposed to higher potential contaminants. This may be due to the longer surgical procedure or the increased movement of staff, as well as the non-usage of aseptic techniques throughout the surgery.

Bacterial growth was always found in the swab samples of the post-surgical sites both immediately after the surgery and three days post-operatively (100%). The continuous accumulation of contamination resulting from surgical exposure and interaction in ambient conditions is indicated by the high levels of contamination throughout the post-operative period. Failure to adhere to good post-operative practices may indicate a susceptibility to surgical site infections in view of the continuous bacterial growth seen three days post-operative.

The results revealed that surgical packs were relatively sterilized, kennels were highly polluted, and washing marginally reduced rather than completely eliminated bacterial counts. The highest levels of contamination occurred in postoperative cultures, especially after three days.

**Table 2: Bacterial growth from different sampling points**

Sampling point	Swabs collected	Positive cultures (%)
Kennels	3	3 (100%)
Surgical packs	5	2 (40%)
Pre-surgical site	5	3 (60%)
During-surgery	5	4 (80%)
Post-surgicalsite (immediate)	5	5 (100%)
Post-surgical site (3 days)	5	5 (100%)
Total	28	22 (78.5%)

**3.3 Types of bacterial isolates**

Table 3 are present the incidence and distribution of bacterial isolates obtained from different sites of sample collection during minor animal procedures done by students. Viable bacterial species were identified in 28 samples which reflect the diverse microbe population contributing to surgical site contamination.

*Staphylococcus* spp. were the commonly isolated organisms, contributing 39.28% to the total isolates. These isolates were found in all sampling sites, with the highest being from the dog kennel (100%) and postoperative samples collected three days post-operatively (60%). Isolates from the three stages: pre-surgical, intraoperative, and postoperative, indicate that *Staphylococcus* spp., which are skin flora, may still be contributing to SSI even if skin preparation is done properly due to their skin flora nature.

*Escherichia coli* was also found to be isolated regularly (35.71%) and was found in all kennel samples and in all samples taken three days post-surgery. This indicates that contamination may not have come from their normal skin habitats, but rather post-surgery wound or abdominal exploratory contamination, or possibly even from their environmental encounters prior to and during their surgical procedures.

*Pseudomonas* species comprised 21.42% of the isolates and were mostly isolated in surgeries, as well as in postoperative samples. Their isolation from kennel samples as well as surgical sites indicate that they are environmental isolates that thrive in moist environments, hence opportunistic

causing wound infections in postoperative patients.

*Bacillus* spp. isolations were not found from kennel, surgical pack, or pre-surgical specimens but were present during the time of surgery and gradually increased in the postoperative specimens. This indicates that environmental pollution by airborne contaminants, dust, or operating room surfaces during the time of surgery might have caused an increase in *Bacillus* spp., which are predominantly known to contaminate an environment.

*Shigella* spp. was 35.71% of total isolates and were mostly found in kennel samples and post-operative samples, most being three days post-operative (80%). Their absence during surgery but presence postoperatively indicates a strong association with environmental and faecal contamination, possibly due to inadequate hygiene or postoperative exposure. The findings suggested that environmental contamination (kennels) and postoperative colonization (three-day samples) contributed most highly to bacterial load.

**Table 3: Frequency of bacterial isolates from different sampling points**

Bacterial species	Kennels (3)	Packs (5)	Before-surgical (5)	During-Surgery (5)	Immediate post-surgery (5)	3 Days Post-surgery (5)	Total (28)
<i>Staphylococcus</i> spp.	3(100%)	1(20%)	1(20%)	1(20%)	2(40%)	3(60%)	11(39.28%)
<i>Escherichia coli</i>	3(100%)	0(0%)	0(0%)	1(20%)	1(20%)	5(100%)	10(35.71%)
<i>Pseudomonas</i> spp.	2(66.7%)	0(0%)	0(0%)	1(20%)	2(40%)	1(20%)	6(21.42%)
<i>Bacillus</i> spp.	0(0%)	0(0%)	0(0%)	1(20%)	2(40%)	3(60%)	6(21.42%)
<i>Shigella</i> spp.	3(100%)	1(0%)	1(0%)	0(0%)	1(20%)	4(80%)	10(35.71%)

**3.4 Influence of Group Dynamics in student performed small animal surgery**

The relationship of group dynamics, surgical methods, aseptic practice, and contamination outcome in student-performed small animal surgery is illustrated in Table 4. It also highlights aspects of microbiologic contamination and hematologic responses influenced by variables such as the number of student participants in the

operating room, surgical duration, and number of aseptic breaches.

Groups G1, G2, G4, and G5 received complicated abdominal cases such as splenectomy and gastrotomy, which took about 120±10 minutes. All groups had bacterial growth at multiple points, & there were moderately large numbers of students in the operating room (16-20). Group G3, on the other hand, demonstrated relatively fewer

cases of bacterial growth following ovariohysterectomy, which took less time ( $80 \pm 10$  minutes) and involved fewer complications. This implies that smaller and lesser invasive procedures reduce the chances of bacterial growth.

### 3.5 Aseptic breaches and Contamination findings

The groups G1, G4, and G5 experienced aseptic breaches where contamination by a variety of bacterial species such as *Staphylococcus*, *Escherichia coli*, *Pseudomonas*, *Bacillus*, and *Shigella* was found. The G2 group showed contamination during the surgery pack and post-operative stage even when there were no recorded aseptic breaches.

The results for contamination seemed to be directly proportional to the number of students present in the operation room. The highest number of students (20) from Group G5 exhibited contamination ranging from immediate post-operative to three days post-operatively. Samples taken post-operatively, three days post-surgery, proved to have bacterial growth for all groups regardless of whether there was a breach of asepsis.

### 3.6 Effect of number of students and Surgery duration on contamination

The bacteriological findings were backed by haematological changes. A reactive condition, either as a result of infection or inflammation, was evident in the presence of postoperative leukocytosis, neutrophilia, monocytosis, and basophilia in some individuals (G1, G2, G4, and G5), who underwent more prolonged surgeries, high levels of contamination, and lack of asepsis. Animals in prolonged surgeries showed evidence

of anaemia. Meanwhile, G3 showed relatively mild haematological changes, as expected in their lower levels of contamination and shorter surgeries.

### 3.7 Hemolytic responses in student performed small animal surgery

The mean standard deviation ( $M \pm SD$ ) of a few haematological parameters tested pre- and post-surgery in dogs used in small animal surgery done by students is given in Table 5 below. These values give an insight into the inflammatory and systemic physiologic response associated with surgical stress and contamination around surgical sites seen in this study. Table 5

Different superscripts ( $p < 0.05$ ) show that the total white blood cell (WBC) count increased significantly after surgery ( $19.46 \pm 4.7$ ) compared to pre-surgery levels ( $10.21 \pm 1.2$ ). In contrast to pre-surgical readings, postoperative leukocytosis was observed. Red blood cell (RBC) counts showed a slight, non-significant increase following surgery ( $5.0 \pm 1.87$ ) compared to pre-surgical values ( $4.79 \pm 0.41$ ).

Neutrophil percentages decreased from  $66.58 \pm 9.47$  to  $60.92 \pm 14.23$  post-surgery (ns), but remained the dominant leukocyte type. A marked and statistically significant reduction in eosinophil counts was recorded post-surgery ( $1.6 \pm 1.14$ ) compared to pre-surgical values ( $25.62 \pm 17.25$ ) ( $p < 0.05$ ). Lymphocyte percentages showed no significant difference between pre-surgical ( $27.02 \pm 8.01$ ) and post-surgical ( $26.18 \pm 12.84$ ) values. Monocyte counts demonstrated a significant decrease after surgery ( $10.6 \pm 3.21$ ) compared to pre-surgical values ( $37.84 \pm 23.17$ ) ( $p < 0.05$ ). Basophil percentages showed a slight, non-significant reduction following surge.

The analysis of group dynamics in relation to surgical site contamination revealed several important patterns

Table 4: Relationship between group dynamics, surgical procedures, and contamination outcomes

Group ID	Sex	Surgical procedure	No. of students in theater	Duration of operation (Minutes)	Aseptic breach (Yes/No)	Sampling point with growth	Microorganism isolated	Hemogram (Post-op Vs. Pre-op)	Leukogram (Post-op Vs. Pre-op)
G1	Male	Gastrotomy, splenectomy	16	120±10	Yes	During surgery	<i>Bacillus Spp., E. Coli</i>	Normal	↑ WBC, ↑Neutrophil, ↑monocytes
						Immediately after surgery	<i>Pseudomonas Spp. Staph. Spp., shigella spp.,</i>		
						3-days post-surgery	<i>E. Coli, Pseudomonas Spp., Staph. Spp., Staph. Spp., Shigella Spp.</i>		
G2	Male	Gastrotomy, Splenectomy	18	120±10	No	Surgical pack, During surgery	<i>Pseudomonas Spp., Staph. Spp.</i>	Anemic	↑WBC, ↑Monocytes, ↑ Basophil
						3-days post-surgery	<i>Bacillus Spp., E. Coli, Shigella Spp.,</i>		
						Before Surgery	<i>Staph Spp., Shigella</i>		
G3	Female	Ovariohisterectomy	16	80±10	No	3-days post-surgery	<i>Bacillus Spp., E. Coli, Shigella Spp.</i>	Normal	↑Monocytes
						Immediately after surgery	<i>Bacillus Spp., Pseudomonas Spp., Staph. spp.</i>		
G4	Male	Gastrotomy, Splenectomy	17	120±10	Yes	3-days post-surgery	<i>Bacillus Spp., E. Coli, Shigella Spp.</i>	Anemic	↑WBC, ↑Neutrophil, ↑Monocytes, ↑Basophil
						Immediately after surgery	<i>Bacillus Spp. &amp; E. Coli</i>		
G5	Female	Gastrotomy, Splenectomy, Ovariohisterectomy	20	120±10	Yes	3-days post-surgery	<i>Bacillus Spp., E. Coli, Staph. Spp., Shigella Spp.</i>	Anemic	↑WBC, ↑Lymphocytes, ↑Monocytes
						Immediately after surgery	<i>Bacillus Spp. &amp; E. Coli</i>		

**Table 5: M±SD WBC, RBC, N, E, L, M, and B (Before and After procedure) for Group Dynamics, Surgical Procedures, and Contamination Outcomes.**

Parameters	Pre-Surgery	Post-Surgery
White blood cells(WBC) ( $10^3 \mu\text{l}$ )	10.21±1.2 <sup>a</sup>	19.46±4.7 <sup>b</sup>
Red blood cells (RBC) ( $10^6 \mu\text{l}$ )	4.79±0.41	5.0±1.87
Neutrophils (N) (%)	66.58±9.47	60.92±14.23
Eosinophils (E) (%)	25.62±17.25 <sup>a</sup>	1.6±1.14 <sup>b</sup>
Lymphocytes (L) (%)	27.02±8.01	26.18±12.84
Monocytes (M) (%)	37.84±23.17 <sup>a</sup>	10.6±3.21 <sup>b</sup>
Basophils (B) (%)	1.66±3.71	0.6±0.89

M±SD values with different superscript <sup>(a, b)</sup> between columns differ significantly ( $p < 0.05$ )

#### 4.0 Discussion

This study assessed the efficacy of preventative aseptic measures and surgical site contamination during student-performed small animal surgeries at the University of Maiduguri's Department of Veterinary Surgery and Radiology. The results show that bacterial contamination happened at several stages of the surgical procedure, with the highest contamination seen during the postoperative phase, even after normal aseptic procedures were followed.

The hospital environment is a major reservoir of pathogens, as evidenced by the 100% bacterial growth found in kennel swabs. Similar results have been documented in Veterinary hospitals, where animal housing areas have been found to be significant sources of environmental contamination that, if proper biosecurity measures are not implemented, may put surgical patients at risk for postoperative infections [12,18]. Positive cultures in 60% of pre-incision swabs showed that pre-surgical skin preparation greatly decreased but did not completely eradicate bacterial presence at the surgical site. This finding is in line with earlier research showing that antiseptic skin preparation lowers microbial burden but seldom results in total sterility [4,9]. Because they are natural skin commensals and can live in deeper skin layers that topical antiseptics cannot reach, organisms like *Staphylococcus spp.* may survive after washing [19].

Contamination was shown to have significantly increased during operation (80%) and right after (100%). This pattern emphasizes that the perioperative phase is a crucial time for contamination, especially in educational settings. Longer surgery time, more personnel, and reported aseptic technique violations were all significantly linked to greater contamination rates. These

findings are in line with findings by [10] and [13], who reported trainee inexperience and extended operating times to be the key risk factors for surgical site contamination in Veterinary Teaching Institutions.

Some of the organisms isolated include *Staphylococcus spp.*, *Escherichia coli*, *Pseudomonas spp.*, *Bacillus spp.*, and *Shigella spp.* These are some of the organisms commonly associated with surgical site infection [5,18]. While the presence of enteric organisms like *E. coli* and *Shigella spp.* indicates contamination from environmental sources, gastrointestinal handling during abdominal surgeries, or poor hand hygiene, the predominance of *Staphylococcus spp.* supports their established role as primary opportunistic pathogens in surgical wounds [6]. Among all the groups, the highest number of contaminations was found in the samples taken three days post-surgery. The findings support the view that environment and postoperative care contribute significantly to the colonization of bacteria. Similar research has highlighted that cumulative contamination rather than acute intraoperative failure alone is the reason why many surgical site infections manifest several days after surgery [2,5].

The increase in white blood cell count showing significant values post-surgery was a sign of systemic inflammatory or infectious processes related to surgical trauma and contamination. Stress leukogram patterns and cellular migration to inflammatory areas are compatible with postoperative eosinopenia and monocytopenia counts [4]. These results show that the animals undergoing surgery experienced quantifiable systemic effects from surgical site contamination.

## 5.0 Conclusion

This study thus indicates that during the performance of minor animal surgeries by students at the Department of Veterinary Surgery and Radiology, University of Maiduguri, surgical site contamination presents a potential grave risk. While preoperative skin preparation and sterilization of instruments reduced the microbial load, contamination persisted through the intraoperative and postoperative periods. Longer duration of surgery, numbers of students in the operating theatre, and failure to observe asepsis were strongly associated with higher rates of contamination. The risk of postoperative surgical site infection is further underscored by the isolation of clinically significant bacterial pathogens and attendant haematological changes. These results highlight the necessity of more stringent adherence to aseptic procedures, better oversight, and improved infection control measures in operating rooms.

## 6.0 Recommendations

On the basis of findings derived from this study, the following recommendations are made:

- Aseptic protocol guidelines must be strictly followed in all surgeries carried out by students, focusing on scrubbing, gowning, gloving, and managing the sterile field.
- The number of students allowed during surgical exposures should be regulated to limit contamination of the environment and prevent violations of asepsis.
- Scale-up research studies involving antimicrobial susceptibility testing and follow-up monitoring for longer periods to understand the trends of infection at the surgical site.

## Acknowledgement

We acknowledged the efforts and assistance of the Lecturers and technologists of the Department of Veterinary Surgery and Radiology, University of Maiduguri.

## Conflict of Interest

The authors declared no conflict of interest in this study.

## References

- [1]. Bojrab MJ, Waldron DR, Toombs JP. Current techniques in small animal surgery. CRC Press 2014;
- [2]. Rezaei AR, Zienkiewicz D, Rezaei AR. Surgical site infections: a comprehensive review. *Journal of Trauma and Injury*. 2025;
- [3]. ShakirAhmed A. Surgical sites infections: prevalence, associated factors, bacterial etiologies, and antimicrobial susceptibility pattern among post operated patients admitting public hospitals in Harari region, eastern ethiopia (Doctoral dissertation, Haramaya University). 2020;
- [4]. Fossum TW. *Small Animal Surgery Textbook-E-Book*. Elsevier Health Sciences; 2012; Aug 15.
- [5]. Verwilghen D, Singh A. Fighting surgical site infections in small animals: are we getting anywhere? *Veterinary Clinics: Small Animal Practice*. 2015; 45(2), 243-276.
- [6]. Macharia, E. W. Effectiveness of Aseptic Protocols in Prevention of Surgical Site Infection Post-surgery in Selected Veterinary Practices in Kenya (Doctoral dissertation, University of Nairobi). 2024;
- [7]. Pratschke K. Infection prevention and control in theatre. In *Infection Control in Small Animal Clinical Practice*. 2023; (pp. 131-147). GB: CABI
- [8]. Nye AK, Mankin KMT. Small animal patient preoperative preparation: A review of common antiseptics, comparison studies, and resistance. *Frontiers in Veterinary Science*. 2024; 11, 1374826. <https://doi.org/10.3389/fvets.2024.1374826>
- [9]. Akers MJ. Good aseptic practices: Education and training of personnel involved in aseptic processing. In *Aseptic Pharmaceutical Manufacturing II*. CRC Press. 2020; (pp. 181-221)
- [10]. Gopinath D, McGreevy PD, Zuber RM, Klupiec C, Baguley J, Barrs VR. Developments in undergraduate teaching of small-animal soft-tissue surgical skills at the University of Sydney. *Journal of veterinary medical education*. 2012; 39(1), 21-29.

- [11]. Quinn PJ, Markey BK, Leonard FC, FitzPatrick ES, Fanning S, Hartigan PJ. *Veterinary microbiology and microbial disease* (2nd ed.). Wiley-Blackwell.2015;
- [12]. HawkerC, Gould D, Courtenay M, Edwards D. Undergraduate nursing students' education and training in aseptic technique: A mixed methods systematic review. *Journal of Advanced Nursing*. 2022; 78(1), 63-77.
- [13]. Mamman PH, Muhammad ST, Abdurrahman M, Bada AA, Awasum C. Contamination of Gloved Hands by Multidrug Resistant Bacteria during Small Animal Surgery Wet-labs and its Potential Implication for Occurrence of Surgical Site Infections. *Sahel Journal of Veterinary Sciences*. 2020; 17(4), 46-51.
- [14]. Kaka SM, Mayomi I. Geospatial assessment of the impact of topography on flood vulnerability in Maiduguri, Nigeria. *Jalingo Journal of Social and Management Sciences*. 2019; 1(4), 129-145.
- [15]. Bell M, Card K. *Maiduguri: city scoping study*. Manchester: African Cities Research Consortium.2021;
- [16]. Moore G, Griffith C. Problems associated with traditional hygiene swabbing: the need for in-house standardization. *Journal of Applied Microbiology*. 2007; 103(4), 1090-1103.
- [17]. Subhi SA, Risan MH, Al-Wattar WM. Collection, isolation and identification of pathogenic bacteria from Blood Clinical Specimens in Baghdad. *European Journal of Biomedical and Pharmaceutical Sciences*. 2017; 4(12), 1-8.
- [18]. Kaur K, Oberoi L, Devi P. Bacteriological profile of surgical site infections. *IAIM*. 2017; 4(12), 77-83.
- [19]. Dumville JC, McFarlane E, Edwards P, Lipp A, Holmes A. Preoperative skin antiseptics for preventing surgical wound infections after clean surgery. *Cochrane Database of Systematic Reviews*.2013; (3).

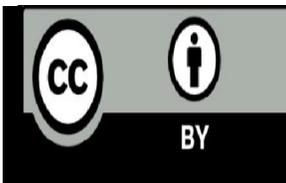
### Appendices



Figure 2: Sterile swabstick



Figure 3: Culture Media



Copyright © 2025 by the authors. This article is an open access article under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>), which permits use, distribution and reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice.