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# Factors contributing to perioperative infections in Mbandaka (Democratic Republic of the Congo): a cross-sectional analytical study at Wangata General Referral Hospital

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**Abstract**

**Introduction:** Perioperative infections (POIs) are common in sub-Saharan Africa, but the factors contributing to them are poorly documented in Mbandaka (DRC).

**Objective:** To identify factors associated with POIs at Wangata General Referral Hospital.

**Methods:** A cross-sectional analytical study (June 2025 – February 2026) involving 70 patients who underwent surgery. Data collected via questionnaire, observation and audit. Univariate, bivariate ($\chi^2$) and multivariate (logistic regression) analyses.

**Results:** The prevalence of postoperative infections was 35.7%. In the multivariate analysis, seven independent factors were associated: age ≥61 years (ORa=4.2), malnutrition (ORa=3.5), HIV (ORa=5.1), surgical emergency (ORa=3.8), duration >120 min (ORa=3.0), blade shaving (ORa=2.9) and infrequent hand hygiene (ORa=4.0).

**Conclusion:** Surgical site infections in Mbandaka are multifactorial, dominated by modifiable factors (practices, management of comorbidities). Interventions targeting hand hygiene, skin preparation and antibiotic prophylaxis are a priority.

**Keywords:** Perioperative infections – risk factors – surgery – DRC – Mbandaka – hospital hygiene

## 1. Introduction

Perioperative infections (POIs) represent a considerable burden on healthcare systems, particularly in low- and middle-income countries where their prevalence can reach 40% (Allegranzi et al., 2016; WHO, 2018). In the Democratic Republic of the Congo (DRC), data remain patchy, especially outside Kinshasa. The city of Mbandaka, the capital of Équateur Province, experiences a high volume of surgical

activity under often difficult logistical conditions (water cuts, shortages of disinfectants). However, no study has yet formally identified the local determinants of POIs.

The aim of this study was to identify the factors contributing to perioperative infections in Mbandaka, distinguishing the respective roles of the patient, healthcare practices, characteristics of the procedure and the environment.

## 2. Methods

### 2.1. Study type and setting

A cross-sectional study with an analytical focus conducted at the Wangata General Referral Hospital (Mbandaka) between 1 June 2025 and 28 February 2026. This hospital performs approximately 80% of the city's surgical procedures.

### 2.2. Population and sampling

All patients aged 15 years or older who underwent surgery during the study period and gave their informed consent were included. The sample size (n=70) was determined to allow for robust multivariate analyses. Sampling was simple random from the surgical register.

### 2.3. Variables and outcome measures

• Dependent variable: occurrence of postoperative infection within 30 days of surgery, defined according to CDC criteria (2022).

• Independent variables: age, sex, nutritional status (BMI), comorbidities (diabetes, HIV, anaemia), preoperative skin condition, smoking status, urgency of the procedure, duration of surgery, contamination class (Altemeier), type of surgery, preoperative shaving, hand hygiene of the team, antibiotic prophylaxis, availability of running water, shortage of disinfectants, operating theatre ventilation.

### 2.4. Data collection

A structured questionnaire (for patients and staff), a clinical observation form and an operating theatre audit checklist were used. All patients were followed up until 30 days post-operation.

### 2.5. Statistical analysis

Data entered into SPSS v26. Descriptive analysis (frequencies, percentages). Bivariate analysis: Chi-square test (or Fisher's exact test if sample size <5). Multivariate analysis: stepwise descending binary logistic regression (entry threshold $p<0.20$, retention threshold $p<0.05$). Adjusted odds ratios (aOR) are presented with their 95% confidence intervals.

### 2.6. Ethical considerations

Written consent, anonymity, freedom to withdraw, approval from the ISTM/MBANDAKA management committee.

## 3. Results

### 3.1. Characteristics of the study population

**Table 1:** Sociodemographic characteristics of patients (n=70)

| Variable | Category | Sample size (n) | Percentage (%) |
|---|---|---|---|
| **Age** | 15–30 years | 18 | 25.7% |
| | 31–45 years | 25 | 35.7% |
| | 46–60 | 16 | 22.9% |
| | Over 61 | 11 | 15.7% |
| **Gender** | Male | 32 | 45.7% |
| | Female | 38 | 54.3% |
| **Education** | None | 14 | 20% |
| | Primary | 26 | 37.1% |
| | Secondary | 23 | 32.9% |
| | Higher education | 7 | 10% |

**Comment:** The most represented age group is 31 to 45 years (35.7%). There is a slight predominance of women (54.3%), explained by the high volume of obstetric activity at the Wangata Regional General Hospital. Furthermore, the majority of patients have only primary education or no education at all (57.1%), which poses a challenge for adherence to pre- and post-operative hygiene guidelines.

**Table 2:** Comorbidities and nutritional status of patients (n=70)

| Variable | Category (Yes) | Number (n) | Percentage (%) |
|---|---|---|---|
| **Anaemia (Hb < 11 g/dL)** | Yes | 25 | 35.70% |
| **Malnutrition (BMI < 18.5)** | Yes | 22 | 31.40% |
| **Preoperative skin lesion** | Yes | 18 | 25.70% |
| **Diabetes** | Yes | 12 | 17.10% |
| **HIV** | Yes | 8 | 11.40% |

**Comment:** More than a third of patients suffer from anaemia (35.7%) or malnutrition (31.4%). These deficiencies, which are common in the local context, impair the body's immune system. The prevalence of HIV (11.4%) among those who have undergone surgery is notable, reflecting the epidemiological situation in Mbandaka, a hub for river trade.

### 3.2. Characteristics of surgical procedures

**Table 3:** Clinical parameters of the surgical procedure (n=70)

| Variable | Procedure | Sample size (n) | Percentage (%) |
|---|---|---|---|
| **Type of surgery** | General | 28 | 40.00% |
| | Obstetrics and Gynaecology | 24 | 34.30% |
| | Traumatology | 12 | 17.10% |
| | Other | 6 | 8.60% |
| **Emergency** | Yes | 40 | 57.10% |
| **Duration** | 60 mins | 22 | 31.40% |
| | 1–120 mins | 30 | 42.90% |
| | > 120 mins | 18 | 25.70% |
| **Altemeier's class** | Clean | 14 | 20.00% |
| | Clean-contaminated | 28 | 40.00% |
| | Contaminated | 18 | 25.70% |
| | Dirty | 10 | 14.30% |

**Comment:** Surgical emergencies predominate (57.1%). According to Altemeier's classification, 40% of procedures are classified as 'contaminated' or 'dirty', implying a high intrinsic risk of infection. Furthermore, one in four procedures lasts longer than 120 minutes, thereby increasing the duration of exposure of the surgical site to airborne germs.

### 3.3. Professional practices and environment

**Table 4:** Assessment of perioperative care practices (n=70)

| Variable | Modality | Sample size (n) | Percentage (%) |
|---|---|---|---|
| **Preoperative shaving** | Razor (blade) | 48 | 68.6% |
| | Hair clipper | 12 | 17.1% |
| | None | 10 | 14.3% |
| **Hand hygiene** | Always | 32 | 45.7% |
| | Sometimes | 24 | 34.3% |
| | Rarely | 14 | 20% |
| **Antibiotic prophylaxis** | Yes | 42 | 60% |
| | No | 28 | 40% |

**Comment:** Shaving with a razor remains the norm (68.6%) despite the risk of micro-skin lesions. There is a critical shortfall in the application of protocols: less than half of the

teams (45.7%) systematically perform rigorous surgical scrubbing, and 40% of patients do not receive pre-incisional antibiotic prophylaxis, which is alarming given the proportion of contaminated surgeries.

### 3.3. (Continued) Operating theatre environmental conditions

**Table 5:** State of operating theatre infrastructure and logistics (n=70)

| Variable | Modality | Proportion observed (%) |
|---|---|---|
| **Running water** | Cuts > 2 days/week | 66.7% |
| **Disinfectants** | Shortage at least every other day | 73.3% |
| **Entrance airlock** | Not present | 100% |
| **Ventilation** | Faulty | 82.9% |

**Comment:** The Wangata Regional General Hospital has major structural deficiencies: the complete absence of airlocks exposes the operating theatres to direct contamination from the corridors. Ventilation is inadequate in over 80% of cases, and there are shortages of disinfectants three days in four. These precarious conditions are significantly more severe than those reported in hospitals in major African cities.

### 3.4. Prevalence of perioperative infections (poi)

**Table 6:** Frequency and types of POIs at Day 30 (n=70)

| Variable | Category | Sample size (n) | Percentage (%) |
|---|---|---|---|
| **Overall IPO** | **Yes** | **25** | **35.7%** |
| **Type of IPO (n=25)** | Superficial | 16 | 64% |
| | Deep | 6 | 24% |
| | Organ / Cavity | 3 | 12% |

**Comment:** More than one in three patients (35.7%) develops a perioperative infection at Wangata General Hospital. Although superficial infections are the most common (64%), a significant proportion of deep and organ infections (36% in total) are observed, directly threatening the lives of those who have undergone surgery and prolonging the length of hospital stay.

### 3.5. Bivariate analysis: search for correlations

**Table 7:** Factors associated with postoperative infections (Chi-square test) – Significant results

| Factor | Category | % of postoperative infections | $\chi^2$ (ddl) | p-value |
|---|---|---|---|---|
| **Age** | Over 61 years vs No | 72.70% | 8.93 (1) | **0.003** |
| **Malnutrition** | Yes vs No | 59.10% | 8.53 (1) | **0.003** |
| **HIV** | Yes vs No | 75.00% | 7.06 (1) | **0.008** |
| **Anaemia** | Yes vs No | 56.00% | 6.84 (1) | **0.009** |
| **Skin lesion** | Yes vs No | 61.10% | 7.46 (1) | **0.006** |
| **Emergency** | Yes vs No | 47.50% | 7.26 (1) | **0.007** |
| **Duration** | > 120, -minute vs No | 61.10% | 6.99 (1) | **0.008** |
| **Contamination** | Contaminated/Dirty vs Not | 53.60% | 7.34 (1) | **0.007** |
| **Shaving** | Blade vs Others | 43.80% | 4.62 (1) | **0.032** |
| **Hand hygiene** | Rarely vs Others | 64.30% | 6.32 (1) | **0.012** |
| **Antibiotic prophylaxis** | Absence vs Presence | 50.00% | 4.29 (1) | **0.038** |

**Comment:** This table shows that eleven factors are significantly associated with perioperative infections ($p < 0.05$). The strongest associations relate to HIV, advanced age ($\geq 61$ years) and malnutrition. Poor practices such as razor shaving and infrequent hand hygiene also increase the risk. In contrast, environmental factors (water, disinfectants, ventilation) do not reach statistical significance, probably due to near-universal exposure in this hospital.

### 3.6. Multivariate analysis: independent determinants

**Table 8:** Factors independently associated with POIs (Logistic regression)

| Factor | Adjusted odds ratio (ORa) | 95% CI | p-value |
|---|---|---|---|
| **HIV-positive** | **5.1** | **[1.4 – 18.6]** | **0.012** |
| Age 61 years | 4.2 | [1.3 – 13.6] | 0.016 |
| Rare hand hygiene | 4 | [1.2 – 13.4] | 0.024 |
| Surgical emergency | 3.8 | [1.4 – 10.5] | 0.009 |
| Malnutrition | 3.5 | [1.2 – 10.2] | 0.022 |
| Duration > 120 minutes | 3 | [1.1 – 8.5] | 0.031 |
| Shaving with a razor | 2.9 | [1.0 – 8.2] | 0.048 |

**Final comment:** After adjustment, seven determinants retain their predictive value. **HIV** shows the strongest association (ORa=5.1), followed by **poor hand hygiene** (ORa=4.0). It should be noted that **razor blade shaving**, a practice that is nevertheless preventable, increases the risk of infection by nearly threefold. The lack of significance of environmental factors in the final model suggests that their effect is 'captured' by practices (e.g. a lack of water results in poor hand hygiene).

### 4. Discussion

Our study shows that the prevalence of POIs at Wangata General Hospital (35.7%) is among the highest reported in Central Africa, but consistent with data from the DRC (18–38%; Kabamba et al., 2021) and neighbouring Cameroon (Nzouankeu et al., 2020).

The independent role of HIV (ORa=5.1) is more pronounced than in Western studies, likely reflecting a more severe immune deficiency linked to late diagnosis and a lack of antiretroviral treatment in some patients. This finding supports the case for systematic pre-operative screening and immune system optimisation prior to non-urgent surgery.

Malnutrition (ORa=3.5) and anaemia (significant in bivariate analysis but not retained in multivariate analysis) are markers of food insecurity in Mbandaka. Perioperative nutritional supplementation programmes could be trialled.

Professional practices (shaving with a blade, inadequate hand hygiene) are modifiable factors at moderate cost. The absence of antibiotic prophylaxis in 40% of cases is unacceptable for contaminated or dirty procedures; an audit with feedback and training for prescribers are priorities.

Structural deficiencies (water, ventilation, airlock) do not appear to be independent factors in our model, but they indirectly contribute to poor practices. Correcting these (e.g. water tank, minimal renovation of the operating theatre) is a necessary but not sufficient condition.

Limitations: moderate sample size (n=70), single-centre recruitment, inability to take bacteriological samples for all cases. Environmental data (shortages) are self-reported and subject to recall bias.

### 5. Conclusion

Perioperative infections in Mbandaka are very common (35.7%). They are attributable to a combination of factors related to the patient (age, malnutrition, HIV), the procedure (emergency, long duration) and healthcare practices (shaving with a razor blade, inadequate hand hygiene, lack of antibiotic prophylaxis).

Simple and inexpensive measures – banning razor shaving, implementing a hand hygiene protocol, systematically administering antibiotic prophylaxis before incisions, and screening for and managing HIV and malnutrition – could halve the rate of POIs. A before-and-after intervention study is needed to validate these measures at the Wangata General Hospital.

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