

## Diagnostic Errors and Patient Safety in Surgery at the Gabriel Toure University Hospital

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DOI: <https://doi.org/10.36347/sasjm.2026.v12i10.001>

| Received: 05.07.2026 | Accepted: 26.09.2026 | Published: 01.10.2026

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### Abstract

### Original Research Article

**Introduction:** Medical error is a major current concern for healthcare professionals and health authorities. **Objective:** To study diagnostic errors in our general surgery department. **Patients and Methods:** We conducted a prospective cross-sectional study with a total duration of 12 months in the general surgery department. **Results:** The mean age of the patients was  $43.02 \pm 18.91$  years, with a range of 15 to 80 years. There was a male predominance (58.7%), with a male-to-female ratio of 1.4. Laparotomy was planned in 93.3% of cases. The checklist was correctly completed in 43.3% of cases. General anesthesia was used and administered under medical supervision in 97.1% of cases. Patients were awakened in the operating room in 77.9% of cases. The identified situational factors were an incorrect checklist (56.7%), long shifts for staff (25%), and high patient volume (4.8%). Diagnostic errors accounted for 17.3% of adverse events. The main complication was wound suppuration (41%). Death occurred in 56.4% of patients who experienced a complication. The average length of stay was 6.1 days without complications versus 14.3 days with complications, ranging from 11 to 36 days. **Conclusion:** The checklist constitutes a security barrier, but its effectiveness remains limited by organizational constraints and its use.

**Keywords:** Diagnostic errors, patient safety, general surgery, checklist.

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## INTRODUCTION

Patient safety is now a global priority for healthcare systems. Since the publication of the *To Err report According to the Institute of Medicine's Human Health Report*, adverse events associated with healthcare have been recognized as a major cause of preventable morbidity and mortality [1]. Among these events, diagnostic errors represent a particularly concerning problem due to their frequency, potential severity, and impact on the quality of care [2]. According to the National Academies of Sciences, Engineering, and Medicine, a diagnostic error is defined as the failure to establish a timely and accurate explanation for a patient's health problem or the inability to communicate that explanation to the patient [1]. These errors can be related to missed, delayed, or incorrect diagnoses and occur at all stages of the diagnostic process [3]. In surgery, diagnostic accuracy is of paramount importance. Diagnosis forms the basis of all therapeutic decisions and directly influences the choice of intervention, its timing, and its prognosis [1]. A diagnostic error can lead to unnecessary interventions, delays in treatment,

worsening of the underlying disease, increased postoperative complications, or even the patient's death [4]. Urgent surgical conditions such as peritonitis, bowel obstruction, complicated appendicitis, or certain tumors are particularly vulnerable to the consequences of an inaccurate or delayed diagnosis. Modern surgery therefore demands a rigorous diagnostic approach based on the patient's history, clinical examination, medical imaging, and appropriate laboratory tests.

Furthermore, studies have shown that these errors contribute significantly to preventable mortality and are implicated in 6 to 17% of adverse hospital events [6]. A recent meta-analysis revealed that approximately one in fourteen hospitalized patients experiences a potentially harmful diagnostic error, highlighting the scale of the phenomenon in healthcare facilities [7]. The World Health Organization now considers diagnostic errors to be one of the leading causes of preventable harm related to healthcare and has designated it as the theme for World Patient Safety Day in 2024 [5].

**Citation:** Konaté, M. *et al* (2026). Diagnostic Errors and Patient Safety in Surgery at the Gabriel Toure University Hospital. *SAS J Med*, 12(10), 1013-1019. <https://doi.org/10.36347/sasjm.2026.v12i10.001>

The systematic analysis of diagnostic errors not only improves the quality of care but also reduces morbidity, mortality, and the costs associated with preventable adverse events. Therefore, the study of diagnostic errors in surgery is an essential step in promoting a culture of safety, continuous quality improvement, and excellence in surgical care.

## PATIENTS AND METHODS

This study was conducted in the general surgery department of the Gabriel Touré University Hospital Center (CHU) in Bamako. It was a prospective cross-sectional study conducted from September 1, <sup>2024</sup>, to August 31, 2025. The study population consisted of patients who consulted the department, were diagnosed, and underwent surgery during the study period, meeting the inclusion criteria. We included all patients who underwent emergency or scheduled surgery in the general surgery department of the CHU GT and in whom a diagnostic error was identified during the data collection period. Patients without surgical conditions and those who declined to participate in the study were excluded.

The variables studied were demographic, clinico -paraclinical variables, diagnostic data and therapeutic data as well as the follow-up to care.

In preparation for the implementation of the checklist, several training sessions involving the various stakeholders in the operating room were organized.

Patient data were collected from medical records and through preoperative interviews to supplement information, the use of the checklist and observation of the procedure during surgery, and also patient follow-up up to 30 days postoperatively.

For data collection, we developed a survey form with 3 parts, providing information on the preoperative period (socio-demographic data, risk factors, associated pathologies, length of preoperative hospitalization, hospitalization category, quality of caregivers, type of anesthesia planned); the intraoperative period (implementation of the checklist, recording of intraoperative complications if applicable, type of surgery, duration of the intervention, risk of infection, awakening) and the postoperative period: (occurrence of postoperative complications, their diagnostic and therapeutic aspects, additional cost related to cases of postoperative complications)

Patients were examined daily during the visit for possible complications, and further tests were requested depending on the type of complication.

The self-administered questionnaire sent to staff allowed us to determine the socio-professional characteristics of the respondents, their knowledge learned about the checklist, their adherence to and

perception of the effects of the checklist on daily practices within the block, and finally they expressed some suggestions for improvement to solve the difficulties we encountered.

The data were entered using Excel 2019 and analyzed using SPSS version 28. Patients obtained their free and informed verbal consent before being included in the study. The information provided by each patient will be kept confidential and will not be disclosed. It is used solely for research purposes.

## RESULTS

During the study period, 104 out of 2687 patients who underwent surgery experienced one or more adverse events, representing 3.9%. Among these events, 17.3% (18/104) were diagnostic errors.

These events occurred in emergency situations in 13.4% and in non-emergency situations in 3.8%.

The mean age of the patients was 43.02 years  $\pm$ 18.91 years, with a range of 15 to 80 years. Males predominated at 58.7%, with a male-to-female ratio of 1.4 (Figure 1).

Patients were mainly admitted as emergencies, accounting for 74% (77/104) of cases (Figure 2). The main comorbidities were a history of surgery, hypertension, and HIV, with 9.6%, 7.7%, and 4.8% of cases, respectively.

The diagnosis was primarily acute peritonitis in 31.7% (33/104) of cases; digestive tumors in 21.1% (22/104) of cases, and acute intestinal obstruction in 19.2% (20/104) of cases.

Peritonitis was of gastric origin in 45.5% (15/33); appendicular in 27.3% (9/33) and ileal in 21.2% (7/33) of all peritonitis cases.

The tumors were colonic in 22.7% (5/22); ovarian in 18.2% (4/22); and gastric in 13.6% (3/22) of all tumors. Volvulus was the most frequent obstruction, accounting for 60% (12/20) of all obstructions.

Laparotomy was planned in 93.3% of patients (Table I). The operators were primarily specialist physicians with more than 10 years of experience in 71.2% (74/104) of cases, followed by physicians in residency in 28.8% of cases. The checklist was correct in 43.3% (45/104) of cases of diagnostic error (Figure 3).

Patients were classified as Altemeier II in 52.9% of cases and Altemeier I in 24% of cases (Table II). The mean surgery time was 125.28 minutes; the range was 45 and 180 minutes.

Patients were awakened in the operating room in 96.1% of emergency cases. In elective surgery,

awakening occurred in the post-anesthesia care unit in 66.7% of cases. Anesthesia was assisted by nurse anesthetists in 50% of cases and by registered nurse anesthetists in 41.1% of cases (Table III).

Situational factors included incorrect checklist in 56.7% (59/104), long working hours of agents in 25% (29/104), and busy context in 4.8% (5/104).

The diagnosis was delayed in 27.9% of patients (29/104) and incorrect in 90.4% (94/104) of patients. The diagnosis was poorly communicated in 84.6% (88/104) of patients. Adverse events occurred in 14.4% of cases (Figure 4).

The outcome was favorable in 62.5% of cases. Complications occurred in 37.5% of cases (39/104). The

main complication was wound suppuration, occurring in 41% of cases. Surgical revision was performed in 41% of cases of complications (16 patients). Dressing and antibiotic therapy were administered in 58.9% of complications (23 patients).

Complications resolved favorably in 43.6% of cases, while 56.4% resulted in death. The average length of stay without complications was 6.1 days, and the average length of stay in cases of complications was 14.3 days, with a range of 11 to 36 days.

Of the 16 cases requiring surgical revision, the outcome was favorable in 4 patients (25%). Death occurred in 75% of cases in the intensive care unit.

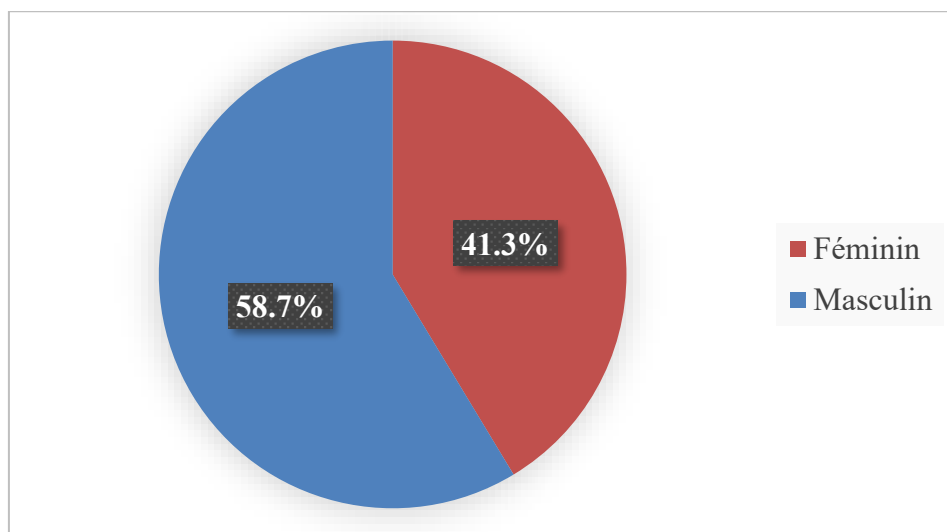


Figure 1: Distribution of patients by sex

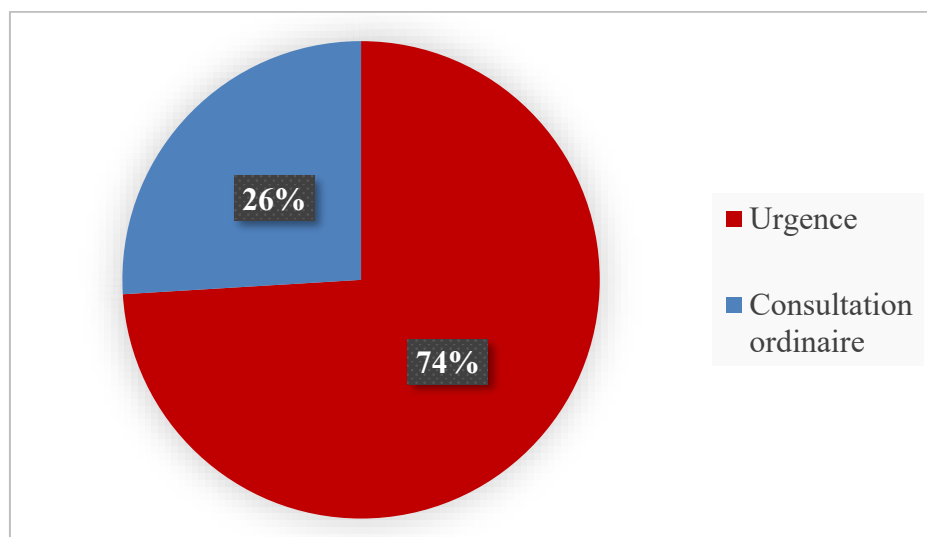


Figure 2: Distribution of patients according to recruitment method

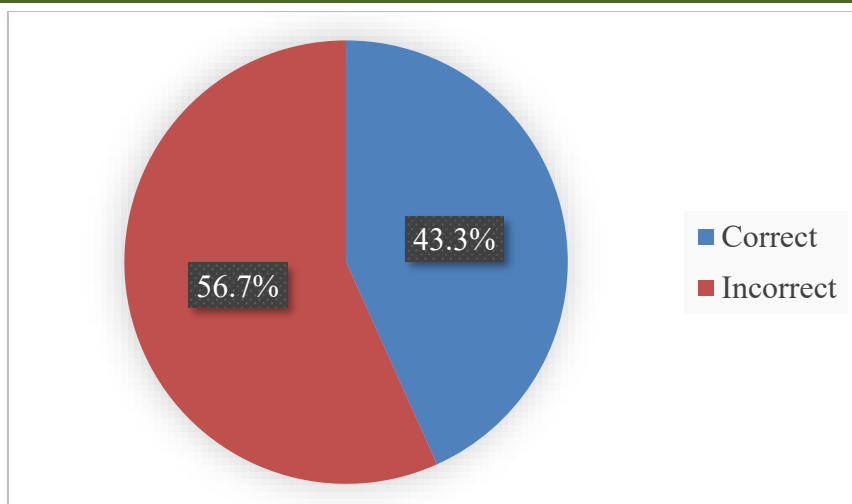


Figure 3: Distribution of patients according to the checklist

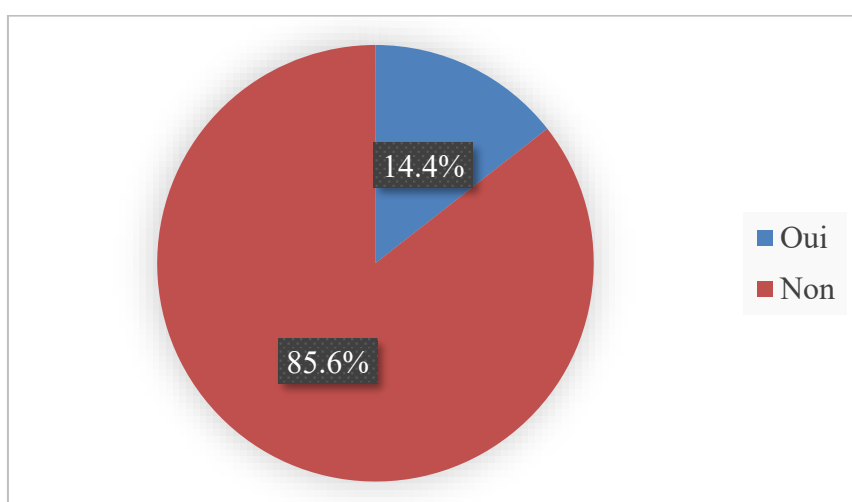


Figure 4: Distribution of patients according to the occurrence of adverse events

Table I: Distribution of patients according to surgical technique

| Type of surgery       | Effective | Percentage |
|-----------------------|-----------|------------|
| Laparotomy            | 97        | 93.3       |
| Inguinotomy           | 2         | 1.9        |
| Laparoscopic surgery  | 3         | 2.9        |
| Proctological surgery | 2         | 1.9        |
| Total                 | 104       | 2.1        |

Table II: Distribution of patients according to the Altemeier score

| Altemeier Score | Effective | Percentage |
|-----------------|-----------|------------|
| I               | 25        | 24         |
| II              | 55        | 52.9       |
| III             | 18        | 17.3       |
| IV              | 6         | 5.8        |
| Total           | 104       | 100        |

Table III: Distribution of patients according to their state of awakening

| Context                        |               | Effective | Percentage |
|--------------------------------|---------------|-----------|------------|
| Emergency wake-up call<br>n=77 | Op Block      | 73        | 96.1       |
|                                | SSPI          | 0         | 0          |
|                                | Resuscitation | 4         | 5.9        |
| Wake-up from surgery scheduled | Op Block      | 8         | 29.6       |
|                                | SSPI          | 18        | 66.7       |

|                    |               |    |      |
|--------------------|---------------|----|------|
| n=27               | Resuscitation | 1  | 3.7  |
|                    | MAR           | 9  | 8.6  |
| Wake-up assistance | OF THE        | 43 | 41.4 |
| n=104              | IADE          | 52 | 50   |

## DISCUSSION

In our study, diagnostic errors accounted for 17.3% of cases (18/104). We identified a frequency of 13.4% of errors in elective surgery and 3.8% in the emergency department, with 74% of patients being recruited through the emergency department. This frequency highlights the significant role of diagnostic errors in the occurrence of adverse events in surgery. Although this proportion is lower than those reported in some international studies, it confirms that diagnostic error remains a major patient safety issue. According to the 2015 National Academies of Sciences report by Balogh EP *et al.*, diagnostic errors affect nearly 5% of patients treated annually in healthcare facilities and constitute a significant cause of preventable harm [8]. Similarly, Singh H in 2015 [9] emphasized that diagnostic errors are among the leading causes of serious adverse events in healthcare settings.

In sub-Saharan Africa, studies on patient safety remain scarce. However, some surveys conducted in Senegal, Burkina Faso and Benin by the World Health Organization in 2024 also report a likely underestimation of adverse events due to shortcomings in hospital surveillance systems [5].

Diagnostic errors occurred primarily in emergency surgery settings (13.4%) compared to 3.8% in elective surgery. Indeed, surgical emergencies provide a particularly favorable environment for diagnostic errors due to time constraints, the severity of clinical presentations, the need for rapid decision-making, and sometimes the limited availability of additional tests. Graber ML *et al.*, in Berlin in 2022 [4] showed that diagnostic errors are more frequent in contexts where decision-making pressure is high and clinicians have limited time to analyze available clinical data. Similarly, Newman-Toker DE *et al.*, in 2021 reported that the most serious diagnostic errors frequently involve acute conditions requiring urgent management [10].

The mean age of the patients was  $43.02 \pm 18.91$  years, with a range of 15 to 80 years. This relatively young mean age reflects the demographic profile of the sub-Saharan African population, characterized by a high proportion of young and working-age individuals. Comparable results were observed in the 2013 study by Kante L *et al.*, on surgical emergencies in Mopti, which reported a mean age of 47.6 years among patients treated for acute intestinal obstruction. Conversely, according to De Vries EN, in Western countries, adverse events and diagnostic errors often affect older populations, generally over 60 years of age, due to the high frequency of comorbidities and chronic diseases [11].

The male predominance observed in our series (58.7%; sex ratio = 1.4) is also consistent with the African literature. Kanté L, in 2013 in Bamako, reported a sex ratio of 1.4 among patients operated on for generalized acute peritonitis [12]. This male predominance is regularly observed in abdominal surgical pathologies in sub-Saharan Africa. It could be linked to men's greater exposure to digestive, infectious, and traumatic risk factors, as well as a higher representation of men among patients admitted for surgical emergencies. Some authors also mention sociocultural differences in healthcare utilization and access to specialized hospital facilities.

The main pathologies involved were acute peritonitis (31.7%), digestive tumors (21.1%), and acute intestinal obstruction (19.2%). These results are consistent with the data from ZZ Sanogo *et al.*, in 2012, who identified these pathologies as the main abdominal emergencies [13]. Peritonitis remains particularly difficult to diagnose due to its clinical polymorphism. In our series, gastric perforations accounted for nearly half of the peritonitis cases. This finding aligns with the observations of ZZ Sanogo *et al.*, in 2012, who highlighted the high frequency of gastroduodenal perforations in general surgery departments [13].

Intestinal obstructions were dominated by volvulus (60%). This high frequency is consistent with studies conducted in Mali by D Traoré *et al.*, in 2014 [14] and in Niger by Harouna T *et al.*, in 2016 [15], where sigmoid volvulus is one of the main causes of acute intestinal obstruction. These conditions often require prompt management, and any diagnostic delay can lead to intestinal ischemia, perforation, or severe sepsis. Digestive tumors accounted for more than one-fifth of diagnoses. The diversity of observed locations reflects the diagnostic difficulties encountered in digestive and gynecological cancers in Africa. According to Lombé DC in 2023, the diagnosis is often made at an advanced stage due to delayed consultation, a lack of imaging resources, and inadequate screening programs [16]. These factors contribute to diagnostic errors and therapeutic delays.

Laparotomy was planned for over 93% of patients. This result reflects the predominance of abdominal pathologies in our series. Open surgery remains the most commonly used technique in many African countries due to the limited availability of minimally invasive surgical equipment.

The procedures were performed predominantly by specialist surgeons with more than ten years of experience (71.2%). This result suggests that diagnostic

error is not solely dependent on the individual experience of the practitioner. The work of Graber ML *et al.*, in 2022 showed that even experienced clinicians are susceptible to cognitive biases and systemic failures that can lead to diagnostic error [4] .

One of the major findings of our study concerns the quality of the surgical checklist. It was incorrectly completed in 56.7% of cases. However, the World Health Organization (WHO) considers the surgical checklist an essential tool for preventing adverse events by 2024 [5] . Haynes AB *et al.*, demonstrated in 2009 that its rigorous use significantly reduced mortality and postoperative complications [17] . Our result suggests that its application remains insufficient in our setting.

Other situational factors identified included excessive working hours for professionals (25%) and peak periods (4.8%). These results confirm the influence of organizational factors on the occurrence of diagnostic errors and This highlights a failure in the medical-technical chain (additional tests not available or misinterpreted). Long shifts lead to physical and cognitive fatigue that can impair clinical reasoning and decision-making abilities. According to Graber ML *et al.*, in 2022, high-volume situations also increase the cognitive load on teams, promoting diagnostic biases and communication errors.

The diagnosis was incorrect in 90.4% of cases and delayed in 27.9% of cases. In 2019, Newman-Toker DE *et al.*, in an analysis of the three major categories of diseases associated with serious diagnostic harm – vascular events, infections, and cancers – estimated that these three categories were responsible for approximately 75% of serious harm related to diagnostic errors [10] .

In terms of patient outcomes, complications occurred in 37.5% of patients. In 2024, Ndong A *et al.*, in a meta-analysis of abdominal emergencies in sub-Saharan Africa, found a surgical site infection rate of 14.4% [18] . Reoperation was required in 41% of patients with complications. This high rate reflects the clinical impact of diagnostic errors and the need for often complex corrective procedures. Despite these reoperations, the outcome remained unfavorable in many cases.

The increased average length of hospital stay observed in patients with complicated conditions (14.3 days versus 6.1 days) confirms the economic and organizational impact of diagnostic errors. Similar results were reported by Gunderson CG *et al.*, in 2020, who showed that diagnostic errors significantly increase hospital costs and length of stay [7] .

Finally, among patients who underwent further surgery, only a quarter had a favorable outcome, while three-quarters died, primarily in intensive care. This

result highlights the severity of complications secondary to diagnostic errors and underscores the need to strengthen prevention strategies.

## CONCLUSION

Patient safety at Gabriel Touré University Hospital is primarily compromised by communication breakdowns and diagnostic errors that severely impact postoperative outcomes. Despite its proven effectiveness in international literature, the safety checklist faces organizational resistance that limits its role as a safety barrier. Improving the quality of care now relies on establishing a shared safety culture and rigorously supervising surgical practices.

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