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Identification and Distribution of Pathogenic Bacteria Isolated from Suppurative Infections at Kindia Regional Hospital in Guinea

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Abstract

Background: Healthcare-associated infections, particularly suppurative wounds, represent a major cause of patient morbidity. This study aimed to identify the pathogenic bacteria isolated from suppurative infections and determine their distribution across units at Kindia Regional Hospital. **Methods:** We conducted a prospective, cross-sectional descriptive study from December 2022 to December 2025 at Kindia Regional Hospital. Standard microbiological methods were used to identify bacterial species from 4293 collected pus samples. **Results:** In our study, females constituted the majority (81.7%), and the [20 - 29 years] age group was the most represented (33.7%). Analysis of the patients' occupations revealed that 49% of the participants were "housewives," followed by "retail workers" at 19%. *Staphylococcus aureus* (22%) was the most prevalent species, followed by *Escherichia coli* (10%). In our study, bacteria such as *Streptococcus agalactiae*, and *Streptococcus pyogenes* were isolated exclusively from female patients. **Conclusion:** This study will help strengthen microbiological surveillance of suppurative infections and contribute to improved care for patients suffering from pyogenic infections.

Keywords

Pyogenic Infections, Bacterial Species, Distribution, Hospital Units, Republic

of Guinea

1. Introduction

Wound infection is a common problem among hospitalized patients. Indeed, a breach in the skin barrier caused by surgery, trauma, or burns facilitates the entry of pathogens [1] [2]. To fight bacteria, the body's immune system sends defense cells to the site of the infection. When these cells accumulate, pus forms, leading to a pyogenic or suppurative infection that actually delays wound healing and can result in complications such as wound breakdown [3]. That is why one of the most easily recognizable signs of a suppurative infection is the presence of pus [4]. The microbial agents responsible for suppuration are primarily Gram-positive cocci (*Staphylococcus aureus*, *Streptococcus pyogenes*, *Enterococcus*, etc.) and Gram-negative bacilli (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus*, and *Pseudomonas*, etc.) [5]. Suppurative or pyogenic infections are common in developing countries, and their management remains a challenge despite advances in microbiological techniques and surgical treatments [6]. In Africa and the West African subregion, several studies have already identified cases of nosocomial wound infections and postoperative site infections caused by these pathogens [7]-[9]. It should be noted that the virulence of these pathogenic bacteria is defined by their ability to cause harmful effects in humans, which is facilitated by access to a suitable target tissue and the ability to evade the host's defense mechanisms [10]. The cost of bacterial culture prevents widespread access to laboratory results needed to identify the causative pathogen in developing countries in Africa [11].

In the Republic of Guinea, the lack of precise data on the various bacterial species involved in purulent infections in hospital settings hinders the effectiveness of patient care. To ensure appropriate and effective treatment, it is necessary to identify the types of bacterial species causing these purulent infections. It is within this context that the present study was conducted, with the overall objective of identifying the pathogenic bacterial species isolated from suppurative infections and their distribution across the care units of the Kindia Regional Hospital (Guinea).

2. Materials and Methods

2.1. Study Area

This study was conducted in the Kindia Prefecture, in the Republic of Guinea. The Kindia Regional Hospital served as the sampling site, and the Institute for Research in Applied Biology of Guinea (IRBAG) served as the facility for the bacteriological analysis of the various pus samples.

2.2. Study Design

This was a prospective, cross-sectional, descriptive study conducted from December 2022 to December 2025 among 4293 patients in the general surgery, maternity, and general medicine departments.

2.3. Inclusion Criteria

The study included patients admitted to the general surgery and maternity units suffering from a postoperative infection and who agreed to participate in the study; outpatient patients admitted to the general medicine unit suffering from a suppurative infection and for whom consent to participate in the study was obtained.

2.4. Exclusion Criteria

Excluded from this study were patients who did not meet the inclusion criteria and participants whose consent to participate in the study was not obtained.

2.5. Sampling

An individual interview was conducted with participants to collect sociodemographic data. This was supplemented by reviewing admission registries, patient clinical records, and the surgical report register. Anonymity and confidentiality of the obtained results were strictly maintained.

Subsequently, pus samples were collected from patients admitted to the Kindia Regional Hospital presenting with suppuration, using sterile swabs, and placed into tubes containing physiological saline. A total of 4293 pus samples were collected from patients. Sample processing was performed at the Bacteriology Laboratory of the Research Institute in Applied Biology of Guinea (IRBAG) using standard microbiological techniques.

2.6. Microbiological Analysis

Pus samples were transported to the laboratory at room temperature within 1 hour and 30 minutes, accompanied by clinical information forms. Due to the diversity of pyogenic bacteria, specific and selective culture media were used to detect them: MacConkey agar for Gram-negative bacteria, Chapman agar for Staphylococci, Cetrimide agar for *Pseudomonas*, and simple nutrient agar (BioMérieux). Once inoculated, the plates were incubated at 37˚C for 24 hours. The criteria for sterility or culture contamination were based on the absence of colonies after incubation on specific agar media or the presence of colonies on agar media. Strain identification was performed using commercial media and reagents from bioMérieux: API 20 NE, Api Staph, Api Strep, and API 20E.

Various additional biochemical tests were also used to identify the bacteria isolated from the pus. Pyocyanin (a blue pigment), characteristic of the species *Pseudomonas aeruginosa*, was detected by inoculating the slant of a King A medium tube with a central streak. The tube was incubated at 30˚C for 24 hours with the cap loosely in place but not screwed on. One milliliter of chloroform was added to the slant; the blue coloration of the chloroform indicated the presence of *Pseudomonas aeruginosa*.

2.7. Statistical Analysis of Data

Data were entered into Excel 2019 and analyzed using R software (version 4.5.1). Descriptive analyses were performed by calculating frequencies (n) and proportions (%). The 95% confidence intervals (CI) for proportions were estimated using the Clopper-Pearson exact method. Proportions across different categories were compared using the Pearson chi-squared test (χ^2). A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Distribution of Participants by Gender

Among the entire study population, females constituted the majority, accounting for 81.7% (3507/4293) of the total sample, compared with 18.3% for males (786/4293). The difference observed between the proportions by gender was statistically significant ($p < 0.001$) (Table 1).

Table 1. Breakdown of participants by gender.

Gender	Numbers	Proportion (%)	p-value
Female	3507	81.7 [80.5 - 82.9]	
Male	786	18.3 [17.1 - 19.5]	**p < 0.001**
Total	**4293**	**100**	

3.2. Proportion of Participants by Age Group

Regarding age distribution, the 20 - 29 age group was the most represented at 33.7%, followed by the 30 - 39 age group at 24.3%. Conversely, the under-10 age group was very weakly represented (0.4%) across the specific hospital departments included in this study. These observed differences were statistically significant ($p < 0.001$) (Figure 1).

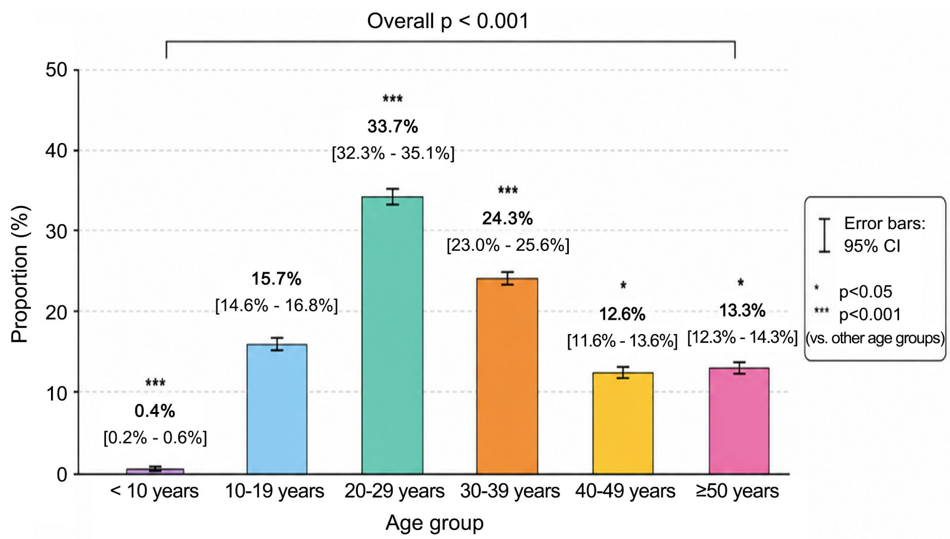

Figure 1. Breakdown of participants by age group.

3.3. Distribution of Participants by Educational Attainment

At this level, the analysis revealed a predominance of participants with a "Primary" level of education at 40%, followed by "Uneducated" participants at 35%. Participants with a higher education level were the least represented at 10%. The representation of primary-level participants was highly significant compared to the other groups ($p < 0.001$) (Figure 2).

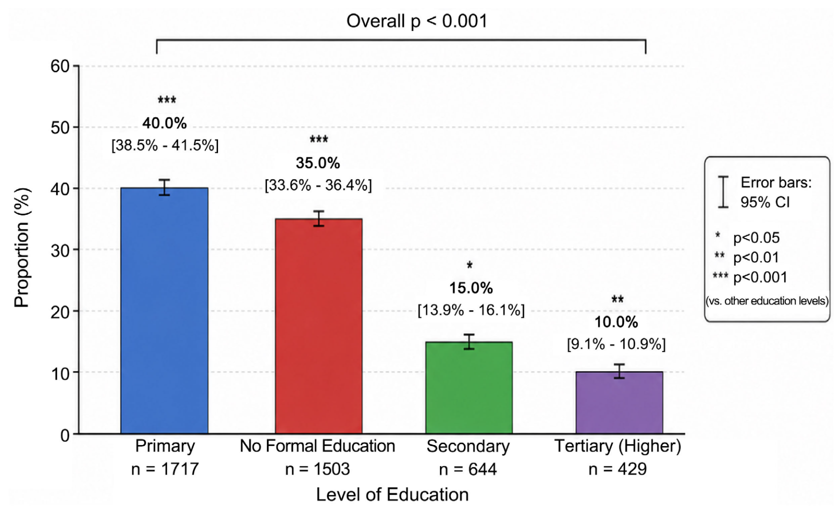

Figure 2. Proportion of participants based on educational level.

3.4. Proportions of Participants by Occupation

The results reveal varying proportions of participants based on their occupation. Thus, 49% of participants are "Housewives," followed by "Merchants" at 19%. The least represented occupation is "Farmers/Ranchers" at 3%. The "Other" category includes occupations that are less common in the sample, such as health workers, retirees, the unemployed, and law enforcement officers (Figure 3).

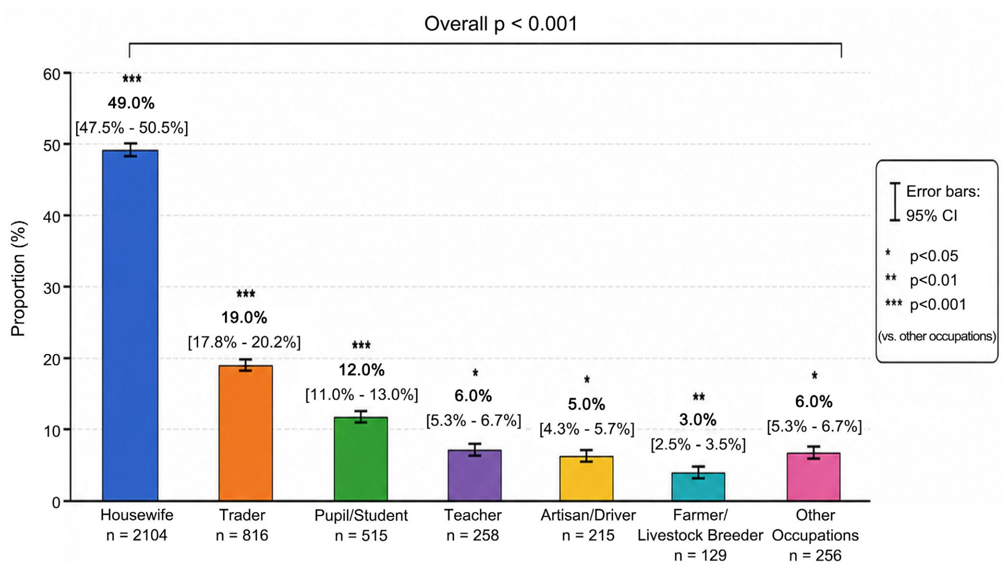

Figure 3. Proportion of participants by occupation.

3.5. Distribution of Collected Suppuration Types

In total, six distinct types of purulent samples were identified in the raw data. Surgical site suppurations (parietal suppurations) were the most predominant, accounting for 70%, followed by cutaneous suppurations at 12%. The lowest proportion (2%) was observed in purulent pleural fluids. This predominance of surgical site suppurations was highly significant across the study samples ($p < 0.001$) (**Figure 4**).

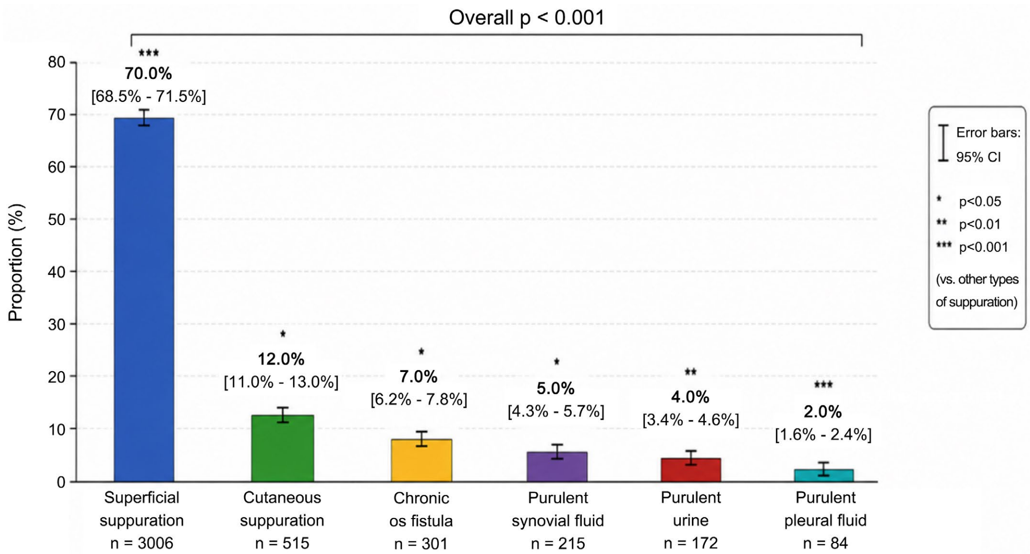

Figure 4. Proportions of the collected pus samples.

3.6. Overall Proportion and Distribution of Identified Pathogenic Germs

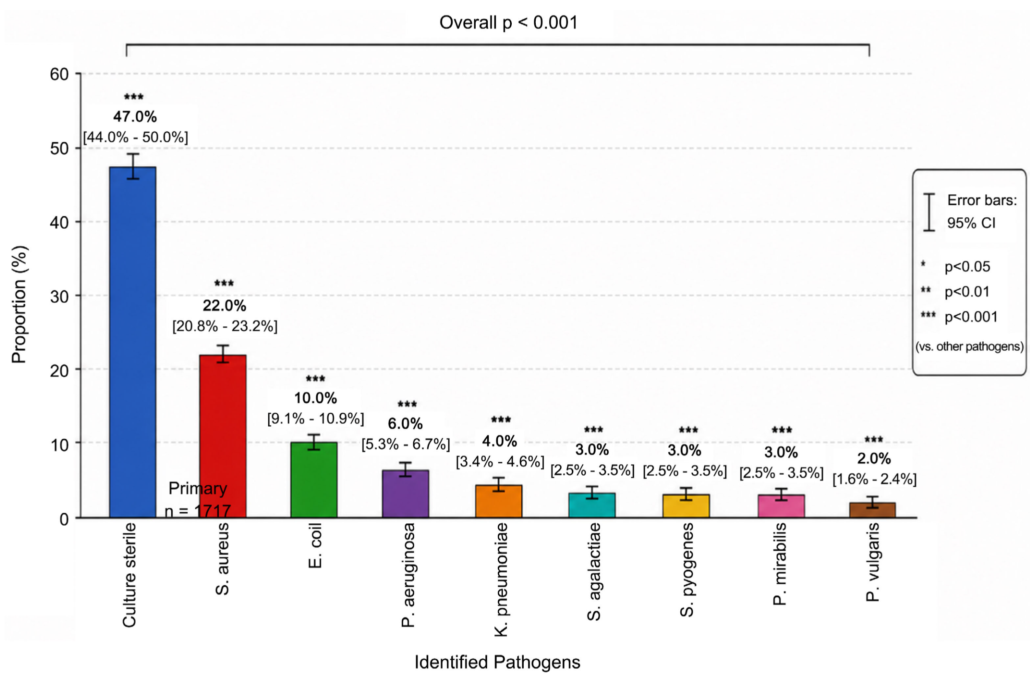

Figure 5. Distribution of identified pathogenic germs.

Microbiological analyses revealed the presence of nine identified bacterial species in the samples at varying proportions. Overall, 53% of the samples tested positive for a pathogen, while 47% were uncontaminated (sterile cultures). A predominance of *Staphylococcus aureus* strains was observed at 22% (944/4293), followed by *Escherichia coli* strains at 10% (430/4293). The least represented species was *Proteus vulgaris* strains at 2% (84/4293). The high proportion of *S. aureus* was highly significant ($p < 0.001$) (Figure 5).

3.7. Association between Identified Bacterial Species and Hospital Units

Analysis of the heatmap shows that non-contaminated samples (sterile cultures) are observed across all hospital wards. Furthermore, the maternity ward is mainly associated with bacterial species such as *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Streptococcus agalactiae*, *Streptococcus pyogenes*, *Proteus mirabilis*, and *Proteus vulgaris*. As for General Medicine and General Surgery, both wards share the presence of *Staphylococcus aureus* (Figure 6).

Figure 6. Association between the identified germs and the units.

3.8. Association between Identified Germs and Participants' Gender

The results of the association between identified germs and participants' gender reveal a highly significant correlation between the identified pathogenic strains and the participants' gender. Indeed, certain germs such as *S. aureus*, *P. aeruginosa*, and enterobacteria (*E. coli*, *K. pneumoniae*, *P. mirabilis*, and *P. vulgaris*) are ubiquitous, as these strains were isolated in both genders. Conversely, germs such as *S. agalactiae* and *S. pyogenes* are exclusively correlated with the female gender (**Figure 7**).

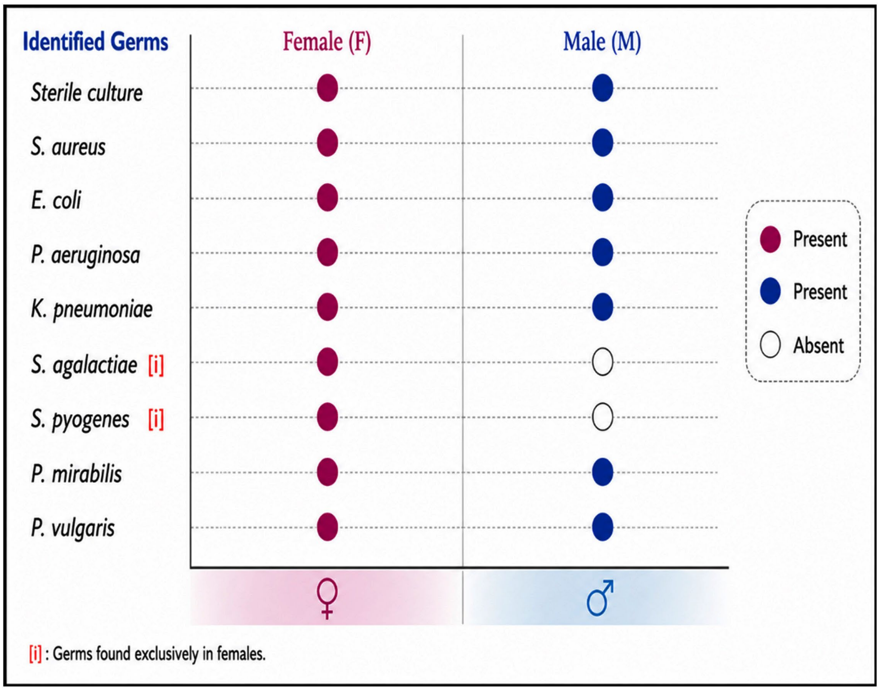

Figure 7. Association between identified germs and the participants' gender.

4. Discussion

Suppurative infections remain a public health problem, particularly in developing countries. The objective of this study is to identify the pathogenic bacterial species isolated from suppurative infections in the wards of the Kindia Regional Hospital.

This study shows a predominance of female patients (81.7%) with suppurative wounds. Our results are substantially higher than the 53.7% of women observed in a study among patients suffering from infectious otitis at the Cocody University Hospital in Ivory Coast [7], but contrast with the low representation of 24.5% for females among patients with infected wounds admitted to a hospital in northeastern Tanzania [12]. In our context, this female predominance can be explained by the fact that female patients account for the entirety of the Maternity ward and the majority of the General Medicine ward at the Kindia Regional Hospital.

In our study, the 20 - 29 and 30 - 39 age groups were the most represented, accounting for 58% of cases. This distribution is comparable to that reported in a study conducted in the eastern Democratic Republic of the Congo, where patients aged 20 to 40 constituted the most represented category among surgical site infection cases [11]. Similarly, a predominance of the 18 - 59 age group (89.11%) was observed among surgical patients presenting with surgical site infections in the DRC [13]. In contrast, Suragul *et al.* [14] reported a mean age of 59.98 ± 10.79 years in Thailand, reflecting a predominance of older subjects. The high representation of young adults in our study could be explained by the fact that this age group constitutes the most professionally, economically, and reproductively active population, making them more exposed to trauma, surgical emergencies, and procedures [15].

Regarding the educational level of the patients, the results showed a predominance of participants with a primary education level (40%), followed by those who were uneducated (35%). Furthermore, the analysis of occupation revealed a predominance of housewives (49%) and traders (19%). This distribution could be explained by the socioeconomic characteristics of the studied population, particularly the prominent role of domestic activities and the informal sector in low-resource communities. These observations are comparable to those reported in the same study in Tanzania, which showed that individuals with no formal education or who had not completed primary school presented with more comorbidities [12]. These authors suggest that a low level of education could constitute a major social determinant of health.

In our study, parietal suppurations represented the main localization of suppurative infections, accounting for 70%, followed by cutaneous suppurations. Similar observations have been reported in several studies devoted to wound infections and surgical site infections, where superficial and parietal infections rank among the most frequently encountered clinical forms, particularly in resource-limited settings [16] [17]. This predominance could be explained by environmental factors and care practices that strongly influence the occurrence and progression of skin and wound infections [15] [18].

Microbiological analysis revealed that 53% of the samples were positive for at least one pathogen. Among the microorganisms isolated, *Staphylococcus aureus* was the predominant species (22%), followed by *Escherichia coli* (10%). Several authors consider *S. aureus* to be the bacterial species most frequently associated with wound infections, and this predominance has been reported in India, South Africa, and Ethiopia [19]-[21]. Indeed, its strong ability to colonize the skin, its capacity to produce numerous virulence factors, and its aptitude for forming biofilms all contribute to the persistence of infection [22]. Our results differ from those reported in Pakistan, where *E. coli* and *P. aeruginosa* were the most frequently isolated bacteria from pus samples [23] [24]. These differences could be explained by geographic variations in bacterial ecology, differences in the population studied, the type of wounds included, and the hygiene conditions.

The correlation between the isolated bacterial species and the different hospital wards highlighted a specific distribution of pathogens depending on the care units. The maternity ward was mainly associated with *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Streptococcus agalactiae*, *Streptococcus pyogenes*, *Proteus mirabilis*, and *Proteus vulgaris*. This predominance is consistent with the characteristics of obstetrical and neonatal infections, where enterobacteria, particularly *E. coli* and *K. pneumoniae*, constitute the primary causes of urinary tract infections, postpartum endometritis, neonatal sepsis, and obstetrical wound infections [25] [26]. Furthermore, *S. agalactiae* is widely recognized as one of the main agents responsible for early-onset neonatal infections and maternal-fetal infections, while *P. aeruginosa* and *Proteus* species are frequently involved in nosocomial infections among hospitalized patients or those with medical devices [27]. Our observations are in line with those of Allegranzi *et al.* [16], who showed that maternity services in low- and middle-income countries have a high prevalence of Enterobacteriaceae and Gram-positive cocci, mainly due to invasive procedures, complicated deliveries, and care practices. Similarly, Magill *et al.* [28] reported that *E. coli*, *K. pneumoniae*, and *P. aeruginosa* are among the pathogens most frequently involved in healthcare-associated infections in hospital settings.

The General Medicine and General Surgery departments mainly shared the presence of *Staphylococcus aureus*. This observation is consistent with the literature, which identifies *S. aureus* as one of the main agents responsible for surgical site infections, skin infections, and healthcare-associated bloodstream infections. Its ability to colonize the skin and nasal passages of healthcare personnel and patients facilitates its transmission across multiple hospital departments [22] [27].

In this study, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and Enterobacteriaceae (*Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Proteus vulgaris*) were isolated from patients of both sexes, reflecting their ubiquitous nature and their involvement in a wide range of community-acquired and nosocomial infections [28] [29]. In contrast, *Streptococcus agalactiae* and *Streptococcus pyogenes* were isolated exclusively from female patients. This observation could be explained by the predominance of these species in gynaecological and obstetrical infections. In particular, *S. agalactiae* (Group B *Streptococcus*) is a common colonizer of the female genital tract and represents a major agent of maternal, neonatal, and urinary tract infections in women [30]. Likewise, although *S. pyogenes* is mainly associated with respiratory tract and soft tissue infections, it is also involved in certain invasive postpartum infections, notably endometritis and puerperal sepsis, which could explain its exclusive detection in women in our series [31]. However, this distribution could also be influenced by the nature of the analysed specimens as well as the distribution of clinical presentations between both sexes, and warrants cautious interpretation.

All these findings highlight the crucial role of local microbiological surveillance and should serve to optimize strategies for managing wound infections.

5. Conclusions

At the conclusion of this study, we highlighted the key sociodemographic factors as well as the bacterial species associated with suppurative (pyogenic) infections among patients managed at the Kindia Regional Hospital. The bacteriological profile revealed a diversity of pathogens involved in these infections, with a predominance of *Staphylococcus aureus* and *Escherichia coli*, confirming their major roles in suppurative infections. The distribution of isolates across hospital departments showed that Enterobacteriaceae were mainly isolated in the Maternity department, whereas *S. aureus* predominated in the General Medicine and General Surgery units.

These insights are essential to strengthening the microbiological surveillance of suppurative infections and contribute to improved management of patients suffering from pyogenic infections.

6. Study Limitations

In this study, some patients had previously received antibiotics or other antiseptic treatments, which could partially explain the proportion of sterile cultures.

Ethical Considerations

Prior to the start of this study, formal approval was obtained from the relevant authorities at the Kindia Regional Hospital, thereby ensuring institutional authorization. In addition, a rigorous informed consent process was established for each participant. Individuals requested to provide samples were fully informed about the study objectives, collection procedures, sample usage, and data confidentiality. Their free and informed consent was collected verbally on a survey form and marked accordingly for non-literate participants. It was explicitly specified that individual analysis results would be communicated to the participants in accordance with medical confidentiality, enabling them to receive relevant information regarding their health status.

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Author Contributions

Ouo-ouo Balamou: Conceptualization, Formal analysis, Data curation, Funding acquisition, Methodology, Writing original draft.

Gbago Onivogui: Validation, Writing-review & editing.

Akim Socohou and **Jerome Anani Houngue**: Conceptualization, Methodology, Data analysis, Validation, Writing-review & editing.

Sinata Dounamou and **Aïssatou Boiro**: Data collection and investigation, funding acquisition, and review.

Ramatoulaye Balde and **Mamadou Ciré Diallo**: Formal analysis, Writing-original draft.

Roger Kolamou, Nyankoye Youssouf Loua, and **Nathalie Kolie**: Investigation, review of the first draft, and editing.

Mamadou Yero Boiro and **Mohamed Sahar Traore**: Supervision.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviation

IRBAG: Institute for Applied Biology Research in Guinea.

CHU: University Hospital Centre.