# Profiles of microorganisms isolated from neonates' blood cultures, incubators, cradles, ventilators, washbasins, and health-workers of Libreville University Hospital Neonatal Service: focus on infection prevention and control measures

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## Abstract

*Background:* Nosocomial infection outbreaks in neonatal services are a serious healthcare concern in both developed and developing countries, but few studies have been conducted in sub-Saharan Africa.

*Objective:* This study explored the etiology of septicemia in neonates and associated patterns of antimicrobial susceptibility in Gabon.

*Methods:* We analyzed cultures from neonates' blood and swabs from medical personnel and equipment located in the neonatology service.

*Results:* Sixty-eight microorganisms were isolated from the medical personnel and equipment; 46 microorganisms were isolated from neonates' blood culture. *Klebsiella pneumoniae* spp *pneumoniae* was the most common bacteria found in both (30.6% and 26.9%, respectively). All *Klebsiella pneumoniae* spp *pneumonia* isolates were resistant to amoxicillin with clavulanic acid, gentamycin resistance ranged from 93% to 100%, and cephalosporin resistance ranged from 33.3% to 47%.

*Conclusions:* Awareness of the etiology, prevalence, and outcome of nosocomial infection is the first and most important step to appropriate interventions.

## Introduction

Neonatology services medical are focus on the care of newborns who most often require intensive care due to preterm birth, intrauterine growth restriction, birth defects, sepsis, birth asphyxia etc. Because of the fragility of its patients, neonatal services demand the highest hygiene standards not only for clinicians and parents, but also to the equipment and the accessories for the treatment newborns.

Nosocomial infection outbreaks in neonatal services are a serious healthcare concern in both developed and developing countries.[1-5] Indeed, Healthcare-Associated Infections (HAIs) are an important cause of morbidity and mortality in neonatal services.[5,6]

In Brazil, 45% of HAIs occurred in a pediatric or Neonatal Intensive-Care Unit (NICU) with a crude mortality rate of 21.6%.[7] In Egypt, the Mansoura University Children's Hospital NICU showed an incidence of 21.4% for HAIs.[5] Also, the increasing rate of antimicrobial resistance among pathogens causing healthcare-associated infections is an additional problem.[8-10] With no available local data on species distribution and the resistance patterns of pathogens causing HAIs it is difficult for physicians to choose the most appropriate course of antimicrobial treatment for their patients.

In terms of prevention, studies have shown that hygiene healthcare provider's compliance is the key to minimized HAIs.[11] Although publications on HAIs in sub-Saharan Africa exist,[12] a limited number of studies on neonates HAIs exist in sub-Saharan Africa.[13,14] The present study presents the results of the investigation conducted by the Gabonese National laboratory of Public Health to elucidate the etiology of neonatal sepsis occurring in neonates at Libreville University Hospital Neonatal Service. Also, the study assessed the bacterial profile and antimicrobial susceptibility pattern of isolated germs.

## Materials and Methods

### Ethical considerations

All participants gave their consents to use their tests results data for epidemiological surveillance purposes. For the use of secondary data, no ethical approval was necessary. The National Laboratory of Public Health review board approved this study protocol (approval n°23022010-1).

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Availability of data and materials: All data generated or analyzed during this study are included in this published article.

Ethics approval and consent to participate: All participants gave their consents to use their tests results data for epidemiological surveillance purposes. For the use of secondary data, no ethical approval was necessary. The National Laboratory of Public Health review board approved this study protocol (approval n°23022010-1).

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### Study design

In March 2010, in the setting of Libreville University Hospital Neonatal Service, we sampled the neonatology service environment [medical personnel hands and nasal swabs, incubators, cradles, respirators, vents and washbasins located in the Intensive Care Unit (ICU), Resuscitation Room (RR) and the Sterilization Room (SR)]. Samples were analyzed at the National Laboratory of Public Health. The phenotypes of isolated microorganisms were compared with the phenotypes of microorganisms isolated from septicemic neonates' bloodstream during the year 2010.

### Microorganisms' identification and susceptibility testing

Microorganisms identification was done using BioMerieux API bacterial identification test strips (BioMerieux, France). Briefly, all tests were done following the manufacturer's instructions and protocols. BioMerieux Api 20E or Api 10S strips (BioMerieux, France) were used for the identification of Enterobacteriaceae, where-

as Staphylococci and Streptococci were identified by BioMerieux Api Kits for micrococcacea (Slidex kits were used for the confirmation of Staphylococcus aureus). Antibiotics resistance diagnosis was done following the French Society of Microbiology Guideline. Sensitivity testing was done using both bioMerieux ATB™ test strips (BioMerieux, France) and BioRad (BioRad, Marnes-la-Coquette, France) agar disk diffusion method.

## Results

### Microorganisms isolated from neonates' blood culture

Forty-six (46) microorganisms were isolated from neonates' blood culture (Figure 1). The top 5 isolates were *Klebsiella pneumoniae spp pneumonia* (30.6%), *Stenotrophomonas maltophilia* (16.3%), *Enterobacter cloacae* (12.2%) *Citrobacter freundii* (8.2%) *and Candida spp* (6.2%), (Figure 1).

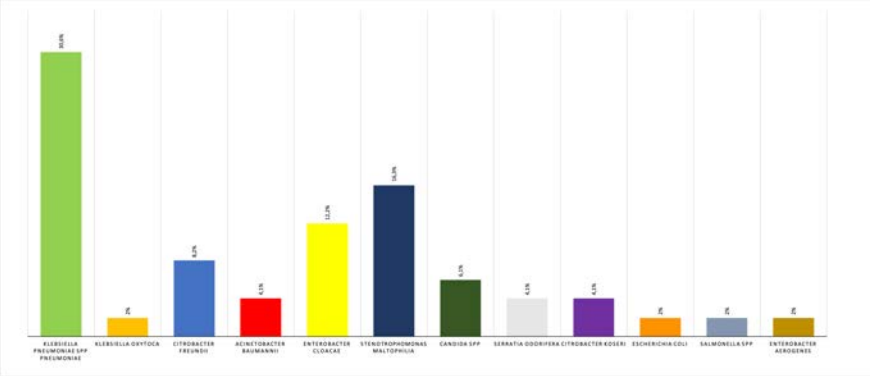

**Figure 1. Frequencies of microorganisms isolated from neonates' blood cultures, Libreville University Neonatal Hospital, Gabon, March 2010.**

### Microorganisms isolated from health-workers and neonatology service environment

Sixty-seven (67) microorganisms were isolated from the medical personnel in service (3 medical doctors and 4 nurses) and equipment (Figure 2 and Table 1). *Klebsiella pneumoniae spp pneumoniae*

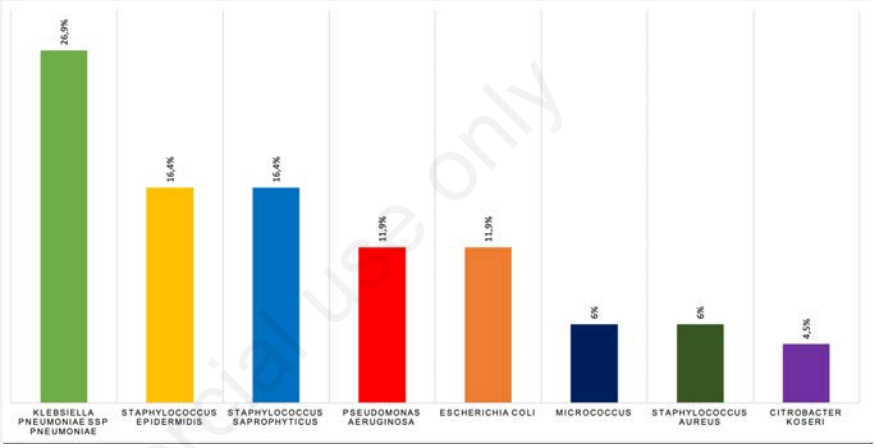


**Figure 2. Frequencies of microorganisms isolated from medical personnel and equipment, Libreville University Neonatal Hospital, Gabon, 2010.**



**Table 1. Microorganisms isolated from health-workers, incubators, cradles, ventilators, washbasins, Libreville University Neonatal Hospital, Gabon, 2010.**

| Sites | Microorganisms isolated |
|---|---|
| Medical Doctors (3) and nurses (4) | *Escherichia coli (hands)*<br>*Klebsiella pneumoniae ssp pneumoniae (hands)*<br>*Micrococcus (hands)**<br>*Pseudomonas aeruginosa (hands)*<br>*Staphylococcus epidermidis (hands)**<br>*Staphylococcus aureus (hands and nose)*<br>*Staphylococcus saprophyticus (hands)* |
| Baby scales | *Klebsiella pneumoniae ssp pneumoniae*<br>*Staphylococcus epidermidis**<br>*Staphylococcus saprophyticus* |
| Cradles | *Klebsiella pneumoniae ssp pneumoniae*<br>*Staphylococcus saprophyticus*<br>*Staphylococcus saprophyticus*<br>*Candida spp*<br>*Staphylococcus saprophyticus*<br>*Pseudomonas aeruginosa*<br>*Escherichia coli*<br>*Staphylococcus epidermidis** |
| Incubators | *Klebsiella pneumoniae ssp pneumoniae*<br>*Escherichia coli* |
| *Ventilators* | *Klebsiella pneumoniae ssp pneumoniae*<br>*Staphylococcus epidermidis** |
| *Washbasins* | *Klebsiella pneumoniae ssp pneumoniae*<br>*Staphylococcus epidermidis** |

*Human commensal bacteria, typical of the skin flora.

**Table 2. Key antibiotics susceptibility profiles Klebsiella pneumoniae spp pneumoniae isolated from neonates' blood cultures and the neonatology service environment, Libreville University Neonatal Hospital, Gabon, March 2010.**

| | *Klebsiella pneumoniae spp pneumoniae* | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Strain given number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Amoxicilline+acide clavulanic | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Cefotaxime | I | I | I | I | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Ceftazidime | I | I | I | S | I | I | I | R | R | R | R | R | R | R | R | R | R | S |
| Imipenem | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Gentamicin | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R | R |
| Amikacin | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| Ciprofloxacin | S | S | S | S | S | S | S | R | R | R | R | R | R | R | R | S | S | I |
| Strain source | NBC | NBC | NBC | NBC | NBC | NBC | NBC | NBC | NBC | NBC | NBC | NBC | ICR | ICR | ICR | NBC | NBC | NBC |

R= resistant; S= sensitive; I= intermediary; NBC = Neonates blood culture; ICR = incubators, cradles, respirators.

was the most common bacteria found in the neonatology service environment (26.9%), followed by *Staphylococcus epidermidis* (16.4%), *Staphylococcus saprophyticus* (16.4%), *Pseudomonas aeruginosa* (11.9%), *Escherichia coli* (11.9%), *Staphylococcus aureus* (6%), *Micrococcus* (6%) and *Citrobacter koseri* (4.5%).

### Antibiotics susceptibility profiles of Klebsiella pneumoniae from neonates' blood culture

All isolates of *Klebsiella pneumoniae spp pneumonia* were resistant to amoxicillin with clavulanic acid and gentamycin. The rate of cefotaxime, ceftazidime, ciprofloxacin resistance was 47%, 33.3%, and 33.3% respectively. We observed a very high rate of gentamycin resistance (93%). No resistance to imipenem and amikacin was observed.

### Antibiotics susceptibility profiles of Klebsiella pneumoniae isolated from health-workers and ICU equipment

Focussing on *Klebsiella pneumoniae,* isolated strains were all resistant to Amoxicillin, Amoxicillin with Clavulanic Acid, Oxacillin, Ticarcillin, Ticarcillin-clavulanic acid, Piperacillin/Tazobactam, Cefoxitin, Ceftazidime, Cefotaxime, Cefepime, Gentamicin, Tobramycin, Netilmicin, Ofloxacin, Ciprofloxacin, Sulfamethoxazole with Trimethoprim. Only Imipenem, Fosfomycin, and Amikacin were actives against isolated *Klebsiella pneumoniae,* strains. The same phenotypic sensitivity profile was observed in *Klebsiella pneumoniae,* strains isolated from 5 neonates in the blood cultures (Table 2).

## Discussion

In Africa, there are very few studies covering HIAs in neonates. In our setting, *Klebsiella pneumoniae spp pneumonia* was the most common bacteria found in both neonates' bloodstream and in the neonatology service environment (30.6% and 26.9% respectively). Our data showed that like in Botswana[13] *Klebsiella pneumoniae spp pneumonia* and *Candida spp* were among the most frequent pathogens responsible for bloodstream infection. Moreover, *Klebsiella pneumoniae spp* represented about one-third (1/3) of isolated microorganisms and was one of the frequent pathogens isolated from neonates like in Poland.[15]

The detection of bacteria such as *Klebsiella pneumoniae spp pneumoniae*, *Pseudomonas aeruginosa*, and *Escherichia coli* on the medical personnel and equipment from the neonatology services raised the issue of hospital hygiene. The fact that selected strains of *Klebsiella pneumoniae* isolated from neonates and the neonatology service environment had the same antibiotics susceptibility profiles suggested a link between poor hygiene and neonates' infections.

Because hygiene is a pillar for HAIs control,[16,17] Healthcare providers should understand the devastating consequences of not complying with or implementing hospital hygiene recommendations.[18] It is our view that although the repressive method may not be seen for some as a solution, in sub-Saharan Africa, the lack of accountability for what can be classified, by others, as medical negligence is not helping the fight against HAIs.[19]

Now with more reports on community-acquired infections recognized as important nosocomial infections and because developing countries are poorly equipped to deal with outbreaks, the developing world must prioritize infection control practices, infection control policies, and professionals training.[18,20,21]

### Limitations

The principal limitation of this study is the absence of molecular investigation on Klebsiella pneumoniae strains isolated from neonates and the neonatology service environment to confirm the suggested a link between poor hygiene and neonates' infections. Also the assessment of healthcare personnel knowledge and IPC practice would have given us more insight on how to approach and best resolve the issue of hygiene in our setting.

## Conclusions

Awareness of HAIs characteristics (etiology, prevalence, and outcome) is the first and most important to design appropriate interventions. Also prevention (including hand-hygiene, environment cleaning, and limited usage of large spectrum antibiotics) to avoid the dissemination of these multidrug-resistant bacteria is mandatory.

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