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Healthcare Associated Infections and Antimicrobial Use in the Neonatal Unit at the Dalal Jamm National Hospital, Senegal

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ABSTRACT

Introduction: Healthcare-associated infections (HAIs) represent a significant public health concern, as they have been associated with prolonged hospital stays and deteriorated patient prognoses. The objective of this study was to ascertain the prevalence of HAIs at the neonatology clinic, the microorganisms implicated, and the antibiotics employed for their treatment. Method: This prospective study was conducted at the Dalal Jamm National Hospital of Guédiawaye (CHNDJ) in Dakar, Senegal.Microorganisms were identified by culture and the automated Vitek II syst

em for bacterial and a filamentation test for yeast. Data on antimicrobial treatment were collected. Results: The prevalence of HAIs was 36.2% (17/47), and a mortality of 21.3% (10/47). The microorganisms responsible for HAIs were mainly Klebsiella pneumoniae (36.1%), Staphylococcus aureus (22.2%), Escherichia coli (11.1%), Enterococcus spp. (8.3%), Candida albicans (5.6%), Pseudomonas aeruginosa (5.6%) and Acinetobacter baumannii (2.8%). Four families were most used; Cephalosporins, Fluoroquinolones, Aminosides and Carbopenems. Conclusion: HAIs are a frequent occurrence in the neonatology clinic at CHNDJ, and are responsible for a significant mortality rate. Consequently, there is an imperative for the implementation of an active surveillance system to facilitate the development of effective control and preventive interventions.

Keywords: Healthcare, Associated, Infections, antimicrobial treatment, Neonates, Diagnosis.

INTRODUCTION

Healthcare associated infections (HAIs) have been broadened to encompass any infectious event related to a process, structure, or approach to care. HAI occurs during or after treatment (diagnostic, therapeutic, palliative, preventive or educational) of a patient; it was neither present nor incubating at the start of treatment [1].

In hospitalized newborns, it can be challenging to differentiate between a maternal-fetal infection (MFI) occurring in the first three or four days of life and an HAI. Schematically, infections of endogenous origin develop from oropharyngeal, digestive, urogenital or cutaneous flora, colonized in the days following birth; infections of exogenous origin are due to microorganisms coming from the hospital environment: material environment (surfaces, air, water), human environment (other patients, caregivers, visitors, etc.) or products administered to the patient (infused solutions, food …) and colonized by one or more pathogenic germs. All pathogens (bacteria, fungi and viruses) can be involved [2].

HAIs are common in neonatology, particularly in premature babies who combine several risk factors: immaturity of the immune system, absence or low concentration of antibodies, initially axenic organism subjected within a few days to massive contamination from the environment and staff, prolonged duration of central venous catheters (CVC) and artificial ventilation. Overall mortality is 10% to 16% Infections associated with an inflammatory syndrome increase the risk of neurological sequelae in premature babies [3].

The main locations are bacteremia/sepsis associated or not with CVC and pneumoniaassociated with artificial ventilation, invasive or not. Urinary infections, meningitis and focal infections are much rarer. The diagnosis is based on changes in clinical status associated with an inflammatory syndrome and is confirmed by blood cultures. If the bacterial epidemiology of infections associated with CVC is dominated by coagulase-negative *staphylococci* (CoNS), other causes of bacteremia are enterobacteria, other causes of bacteremia are dominated by *enterobacteria*. The rapid progression of bacterial infections and the risk of secondary localizations imply rapid initiation of broad-spectrum first-line antibiotic therapy which must be re-evaluated and adapted secondarily. HAIs constitute a worrying situation due to their high morbidity and mortality and especially the emergence of multidrug-resistant bacteria (MRB) [4]. Unlike developed countries, little data is available in Africa. A review

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reported that over a period of 20 years, only a few dozen publications dealt with HAIs in patients from intertropical Africa and that the majority were retrospective studies or prevalence surveys. As a result, the incidence, morbidity and mortality and economic impact of these infections remain underestimated in sub-Saharan Africa [5].

In Senegal, with the establishment of a National Programme for the Fight against Nosocomial Infections (PRONALIN) in 2004, a few studies have been initiated to take stock of the situation and evaluate the effectiveness of activities to combat HAIs. In Senegal, the establishment of a National Program for the Fight against Nosocomial Infections (PRONALIN) in 2004 prompted the initiation of several studies aimed at evaluating the prevalence of HAIs and assessing the efficacy of implemented infection control measures.

A survey conducted in 2007 in 15 regional hospitals found a prevalence of HAIs of 4.8% [6]. In 2006, a study reported a rate of 10.9% at the National University Hospital Centre (CHNU) in Fann [7]. However, few studies have been conducted in Senegal on HAI. This study aims to, firstly, determine the frequency of HAIs and its risk factors, and secondly, to describe the antimicrobial treatment, and their resistance in the neonatal unit of the Dalal Jamm National Hospital of Guédiawaye in Dakar, Senegal.

METHODS

This is a prospective cohort study conducted at the Dalal Jamm National Hospital of Guédiawaye (CHNDJ) in Dakar, Senegal from May to December 2023. Appropriate informed consent was obtained from the neonate's children's parents, and the research was conducted under the hospital's healthcare guidelines.

Study Design and Patients

This study was carried out from May to December 2023 at the neonatal intensive care unit (NICU) of the CHNDJ in collaboration with clinicians and the Healthcare-associated infection control committee. The study population consisted of newborns admitted to the neonatal unit with no signs of infection upon admission (both premature and full-term newborns). The exclusion criterion was the presence of infection at the time of admission. Bacteriological culture was performed for all samples. A HAI was defined as any infection occurring after 48 hours of hospitalization or caused by a microorganism other than the one previously identified during hospitalization.

Patients and Sample Collection

Newborns with symptoms of infections and admitted at the neonate clinic for more than 48 hours were included in this study. On symptom days, when the symptoms worsen, and upon discharge, oral, rectal, and/or blood samples were collected when the patient presented signs of infection (on D-follow-up). The samples collected are dependent upon the presenting symptoms which may include blood, swabs, pleural fluid, secretion, catheter tip, bronchoalveolar lavage (BAL), and cerebrospinal fluid (CSF). During the same period, samples were collected in the neonatal clinic from a variety of surfaces, including the bottle washbasin, vacuum cleaner, incubators, breast pump, tap, telephone, service stamp, door handle, and the mother's hands. In cases where neonates exhibited symptoms indicative of sepsis, blood samples were collected for culture.

Microorganisms Identification and Antimicrobial Determination

Following a macroscopic and microscopic examination (in wet mount and with a Gram stain), samples of these pathological products were inoculated onto culture media. Orientation tests (oxidase and/or catalase) were conducted on the colonies obtained. The identification of the bacteria was based on their biochemical characteristics, using an identification classic gallery consisting of Kligler-Hajna, Mannitol, Mobility, Simmons Citrate, Urea, Indole, or based on an automatic Vitek II system based on manufacturing protocol. Yeasts were identified using Sabouraud agar with chloramphenicol and incubated at 37 degrees Celsius for 24 to 48 hours. The yeast *C. albicans* was identified using the filamentation test.

RESULTS

Characteristics of Patients

During this study, a total of 97 newborns were admitted to the neonatal unit of the CHNDJ. According to the pre-established selection criteria, 51.5% (50/97) were excluded from the study due to no-compliance with the inclusion criteria (stay more than 48 hours). The remaining 48.5% (47/97) constituted the study population with a sex ratio of 0.6 (18/29) [Figure 1, Table 1]. Among this population, 76.6% (36/47) recorded the gestational age information. The bacteriological results demonstrated that 36.2% (17/47) of the cases were HAIs, while 63.8% (30/47) were non-HAIs. Of these HAIs, the overall mortality rate of the enrolled patients was 21.3% (10/47) [Figure 1].

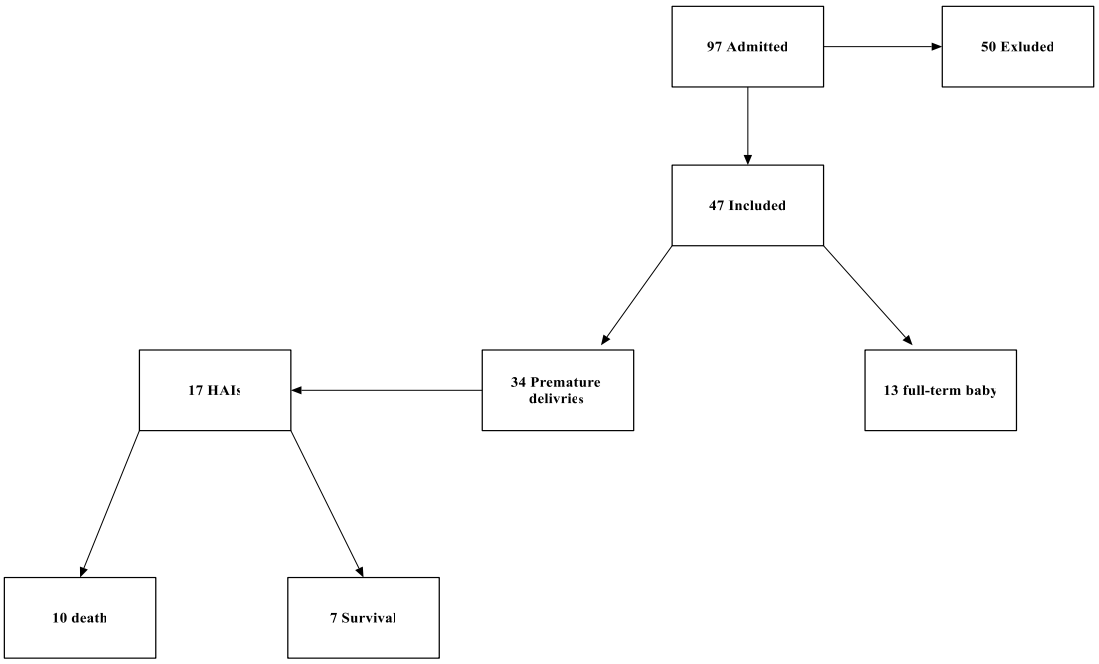

Figure 1: Patients enrollment and admission outcome flowchart

The study revealed that 51.1% (24/47) of the newborns are aged below 33 weeks of amenorrhea, and 29.8% (14/47) are aged above 33 weeks of amenorrhea while 19.1% (9/47) of the newborn's amenorrhea aged were not reported.

Newborns with less than 1500 grams constituted 38.3% (18/47), these with more than 1500 grams represented 55.3% (26/47) while 6.4% (3/47) of them did not report their weight.

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Newborns with less than 5 days constituted 6.4% (3/47), these 5 and 20 days of hospitalization represented 63.8% (30/47), and more than 20 days constituted 29.8% (14/47) [Table 1].

Table 1: Characteristics of the newborns according to their gender, gestational age, birthweight, and length of hospitalization.

Characteristics of the newborns		Number	Frequencies % (N=47)
Sex	Male	18	38.3
	Female	29	61.7
Gestational age (weeks of amenorrhea)	< 33	24	51.1
	> 33	14	29.8
	Unknown	9	19.1
Birthweight (gramme)	< 1500	18	38.3
	> 1500	26	55.3
	Unknown	3	6.4
Length of hospitalization (days)	< 5	3	6.4
	5 - 20	30	63.8
	> 20	14	29.8

Hypothesis of HAIs Diagnosis in Neonatology

A total of 27 diagnostic hypotheses were formulated based on the observed symptoms (It is possible for a newborn to have two or more diagnostic hypotheses). At Day 0 of admission at the neonatology unit, the respiratory symptoms were observed in 44.7% (21/47) of infected patients, followed by septicemia in 37% (10/27). The prevalence of pulmonary infections was 26% (7/27), with the nasogastric or tracheobronchial tube identified as the entry point or exposure factor.

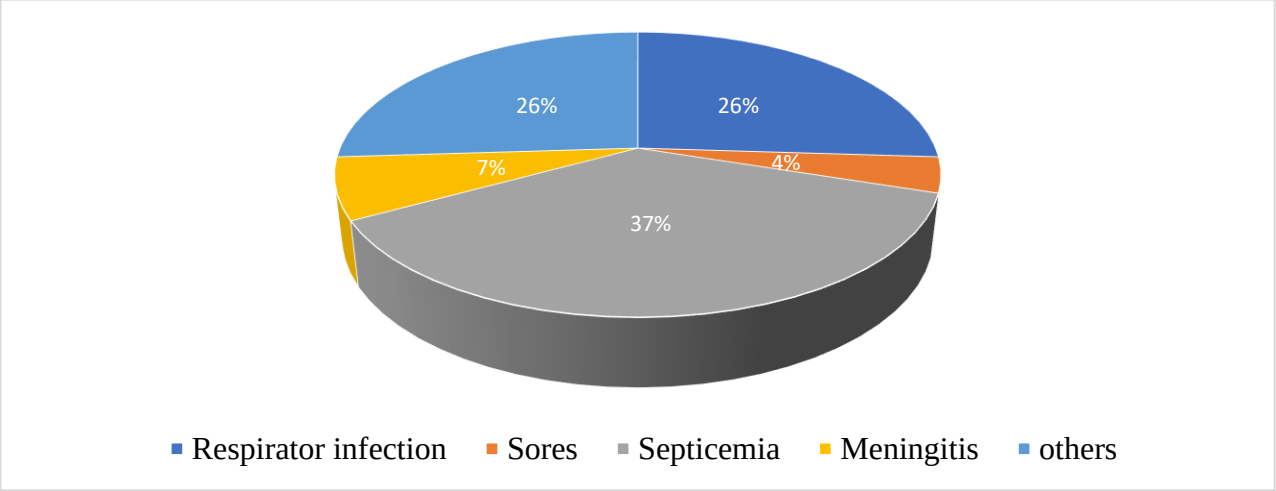

Figure 2: Proportion of HAIs in the Neonatology unit of the Dalal Jamm Hospital in Dakar

[Figure 2] In 4% (1/27) of these patients, the infection was related to sores and 7% (2/27) exhibited meningeal infections. Additionally, other localizations were identified, including pleural and cutaneous infections, which collectively represented 26% (7/27) of cases. At day of admission, respiratory distress represented 12.8% (6/47), malformations 8.5% (4/47), malnutrition problems 4.3% (2/47), neonatal jaundice 2.1% (1/47), absence of cry 4.3%

(2/47) and 72.3% (34/47) reduced maturity (premature) and meningitis 2.1% (1/47). Among newborns with infections, Septicemia were observed in 59.5% (28/47) respiratory symptoms 44.7% (21/47), sores 4.3% (2/47), meningitis 4.3% (2/47) and others 21.3% (10/47) of patients.

Frequency of Microorganisms Isolated from Patients

Bacteriological analyses were performed on all 47 patients included in the study. Based on the definition criteria of HAIs, 36.2% (17/47) were positive with a mortality rate of 58.8% (10/17) among HAIs diagnosed newborns. A total 36 isolates were identified by the bacteriological culture. Among these, *Klebsiella pneumoniae* represents the most prevalent species at 36.1% (13/36), followed by *Staphylococcus aureus* 22.2% (8/36), *Escherichia coli* 11.1% (4/36), *Enterobacter cloacae* 8.3% (3/36), *Candida albicans* 5.6% (2/36), *Pseudomonas aeruginosa* 5.6% (2/36) and *Acinetobacter* spp. 2.8% (1/36). The bacteria that infected the environment were primarily *Enterobacter* spp., and non-fermenting gram-negative bacilli [Table 2].

Table 2: The microorganisms found in the different sites of infection:

Microorganisms	Frequencies in clinical samples % (N=36)	Infection sites	Environmental sites
Klebsiella pneumoniae	36.1 (13/36)	Meningitis, Respiratory, sores, Others	None
Staphylococcus spp.	22.2 (8/36)	Respiratory, Septicemia	Box exposed to the open air
Escherichia coli	11.1 (4/36)	Septicemia, Respiratory	None
Enterobacter spp.	8.3 (3/36)	Meningitis, Septicemia	Baby bottle basin, Vacuum cleaner, Incubator 11
Pseudomonas spp.	5.6 (2/36)	Meningitis, Septicemia	Vacuum cleaner, Breast pump
Non-fermentative gram-negative bacillus	5.6 (2/36)	Septicemia	Baby bottle basin, Faucet, Breast pump, Incubator 12, Incubator 11
Candida albicans	5.6 (2/36)	Sores, Septicemia	None
Acinetobacter spp.	2.8 (1/36)	Septicemia	None
Burkholderia spp.	2.8 (1/36)	Others	None
Gram-positive bacillus	None	None	Mom's hands

Antibiotic Treatment

Nearly 80% of HAIs were under antibiotic treatment and four families were most used; Cephalosporins, Fluoroquinolones, Aminosides and Carbapenems. The treatment protocols varied depending on the infections. Amikacin was the antibiotic most frequently used alone or in combination with cefotaxime and/ or ciprofloxacin, followed by the metronidazole 47.2 % (7/17) Ciprofloxacin 35.3 % (6/17), imipenem 29.4 % (5/17) and vancomycin 17.6 (3/17). Rifamycin 5.9 % (1/17) lincomycin 5.9 % (1/17), and cefotaxime 5.9 % (1/17) were used in monotherapy [Table 3].

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Table 3: The frequency of antibiotic administered to the patients

Antibiotics	Numbers	Frequencies % (N=17)
Amikacin	4	23.5 (4)
Amikacin+cefotaxime	7	41.2 (7)
Amikacin+cefotaxime+Ciprofloxacin	3	17.6 (3)
Cefotaxime	1	5.9 (1)
Ciprofloxacin	6	35.3 (6)
Metronidazole	7	47.2 (7)
Imipenem	5	29.4 (5)
Vancomycin	3	17.6 (3)
Rifamycin	1	5.9 (1)
Lincomycin	1	5.9 (1)

DISCUSSION

HAIs are responsible for a high rate of mortality; longer hospital stays and rising healthcare costs. However, the burden of this problem is often underestimated in resource-limited countries. Despite their underestimation, HAIs pose a grave threat to public health. Neonatology is one of the clinical departments at risk, and the management of the condition requires a monitoring and reporting of the current epidemiological situation which often is lacking in hospitals of developing countries.

A high rate of HAIs was found during this study. The World Health Organization (WHO) estimates that bacterial infections cause about 25% of the 2.8 million annual neonatal deaths and long-term neurodevelopmental disabilities in survivors [8]. Among those infections, HAIs are a major cause of neonatal morbidity and mortality with prevalence ratios in low- and middle-income countries 3–20 times higher than high-income countries [9]. Sparse studies exist in Senegal to estimate the burden of HAIs and there is less attention these past years. A study conducted in 2010 in principal hospital of Dakar using a one-day survey showed a frequency of 4.05% in the neonatal unit [10]. The frequency of HAIs varies according to the care units and their recruitment [11], according to prescription habits and the use of invasive procedures, but also with the definitions used, the pathologies, and the newborns monitored. However, differentiating infection related to infection from the mother and infections acquired from the hospital could be quite difficult especially among neonates. Based on the literature infections happening less than 72 hours after birth are defined as due to vertical transmission from the mother and the one happening 72 hours after birth are late onset and due to acquired infections from the hospital. To obtain a reliable estimate of HAIs, this study exclusively included neonates who did not exhibit any indications of infection at the time of hospitalization and who remained in the neonatal unit for a minimum of 48 hours.

The main bacteria responsible for HAIs were *K. pneumoniae*, followed by *S. aureus*, *E. coli*, *E. cloacae*, *C. albicans*, *P. aeruginosa* and *Acinetobacter*. The findings of this study are consistent with the existing literature on the subject, which reports that approximately 36% of cases of neonatal sepsis are attributable to *Klebsiella pneumoniae* and 25% to *Staphylococcus* species [ref]. Not many studies determined the incidence of HAIs in Senegal among neonates, an earlier study in 2001 at the neonatal unit in DAKAR in 2001 reported that the germs responsible for the fatal infection were primarily *Klebsiella pneumoniae* (79.2%), *Enterococci* (14.6%), and

Colibacillosis (2.1%) [12]. However, the frequency and species causing HAIs may vary between countries, regions and healthcare structures, for example in Paris, Gram-positive cocci were involved in 75% of cases of neonatal nosocomial infections and in more than 50% of pneumonias [11]. *K. pneumoniae* colonizes the human body and can cause infections especially in neonates. Indeed, in Tunisia 27% of a population of newborns were colonized by *Klebsiella pneumoniae* (15% at admission and 12% in intensive care) [13]. A study conducted in Paris in 2001 reported that *K. pneumoniae* can colonized newborns and in the Coagulase-negative *staphylococci*, involved in 35% to 45% of neonatal bloodstream infections, in 45% to 65% of sepsis cases, but in 85% of catheter-related sepsis, are methicillin-resistant in 70% to 80% of cases. *S. aureus* is responsible for most skin and postoperative infections, 3% to 16% of bacteremia, and 9% to 27% of pneumonias [14]. They are rarely resistant to methicillin (10%) [15]. The bacterium *K. pneumoniae* is an *Enterobacterium* responsible for numerous and severe infections, mainly nosocomial. About 8% of HAIs in Europe and the United States are caused by this bacterium. Infections with *Klebsiella pneumoniae* are common in neonatal units, particularly in intensive care units and among premature infants. [16]. HAIs due to *K. pneumoniae*, could be from the hands of healthcare workers, the gastrointestinal tract of the hospitalized neonates. However, it was not found in the samples collected in the environment of the neonate clinic.

The bacterium *S. aureus* has been observed in the nasal cavity (typically transiently) of approximately 30% of healthy adults, and on the skin of approximately 20%. *E. coli*, *Enterobacter*, *C. albicans* and *Acinetobacter* also colonized different parts of the human organisms and could be responsible for HAIs. *P. aeruginosa* is a ubiquitous bacteria found in the hospital environment and is frequently responsible for HAIs.

The mortality rate attributable to HAIs is estimated to range from 2 to 11% [11, 17, 18], though it exhibits a marked increase with increasing postnatal age. In this study, the mortality rate among neonates who had HAIs was 58.82% and represented 21.3 % globally underscoring the imperative for vigilant monitoring and surveillance. The germ in question is a significant risk factor for mortality: it reaches 40% in HAIs with *Gram-negative bacilli* and 28% in fungal infections.

The neonatology unit was colonized with bacteria involved in HAIs, the predominant bacterial species identified included *Enterobacter*, *Pseudomonas*, non-fermentative gram-negative bacilli and *S. aureus*. These bacteria exhibited a higher prevalence in incubators, baby bottle basin, faucet, breast pump, and vacuum cleaner. *K. pneumoniae*, *E. coli*, *Acinetobacter*, *C. albicans* and *Burkholderia* spp, were not found in the environment of the neonatology unit. To establish the role of the environmental contamination in the acquisition of HAIs diagnosed it will be important to use sequencing tools.

HAIs may be transmitted through the commensal microorganisms of the patient, or the pathogens present in the hospital environment. During the period of hospitalization, the patient's flora may undergo alterations due to the colonization of hospital germs. This phenomenon underscores the necessity for a comprehensive understanding of the potential sources of HAIs, which may include not only direct transmission from pathogens carried by healthcare workers but also indirect transmission via the hospital environment.

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Therefore, it is important to implement hand washing procedures for healthcare workers and adequate cleaning of the hospital environment to prevent these infections, which have a high morbidity and mortality rate, especially in resource-limited countries.

During HAIs, the initial antibiotic therapy must be effective against methicillin-resistant *Staphylococci*, *Enterobacteria*, and *P. aeruginosa*, if this germ has been previously isolated from the patient or according to the epidemiology of the unit. The most used combination currently includes vancomycin, ceftazidime or cefotaxime, and an Aminoglycoside [19]. Hence the use of the combination of cefotaxime (Claroforan®) and an Aminoglycoside (Amiklin®) on the HAIs patients during this study by the neonatology clinicians.

The isolation of *Candida* from blood cultures, urine, and/or CSF requires parenteral antifungal treatment [21, 22]. Fluconazole is the sole antibiotic available in the country; however, it is ineffective against *Candida glabrata* and *Candida krusei*. Consequently, alternative antifungal medications, such as amphotericin B, triazoles, or echinocandins, must be utilized. These medications are not currently available within the country. To address this critical need, it is essential to establish reliable diagnostic tests that can differentiate between species and ensure the effective availability of antifungals in country.

Prevention of neonatal HAIs begins with prevention of prematurity, management of pregnancy and childbirth with consideration of nosocomial risk, and control of maternal antibiotic prescription. Strict hygiene throughout neonatal care is essential; human milk feeding should be encouraged, which would reduce the risk of sepsis by 60% [23]. Appropriate preventive measures and targeted interventions are needed [24].

CONCLUSION

The incidence of HAIs and its mortality rate among neonates is high in the neonatal clinic at Dalal Jamm Hospital. The leading bacteria identified are *K. pneumoniae*, *S. aureus* and *E. coli*.

Using next generation sequencing tools will be extremely useful to investigate the Therefore, it is necessary to establish an investigative plan and preventive methods, such as hand hygiene, to improve the quality of care and avoid HAIs, thus reducing the morbidity and mortality.

Current state of knowledge on the subject

- In Africa and in some developing countries, the highest prevalence rate of these infections is estimated at 25.0%.

In Senegal, with the establishment of a National Programmed for the Fight against Nosocomial Infections (PRONALIN) in 2004, a few studies have been initiated to take stock of the situation and evaluate the effectiveness of activities to combat HAIs. A survey conducted in 2007 in 15 regional hospitals found a prevalence of HAIs of 4.8% [6]. In 2006, a study reported a rate of 10.9% at the National University Hospital Centre (CHNU) in Fann.

Among nosocomial infections, septicemia infections were the most frequent (37%), followed by respiratory infections (26%) and infections due to meningitis (7%).

- The microbiological examination revealed seven germs responsible for an infection associated with care.

In infected patients: Klebsiella pneumoniae (36.1%), Staphylococcus aureus (22.2%), Escherichia coli (11.1%), Enterococcus spp. (8.3%), Candida albicans (5.6%), Pseudomonas aeruginosa (5.6%), and Acinetobacter baumannii (2.8%).

Contribution of our study to knowledge

- Our study adds the prevalence of a healthcare-associated infection. The overall prevalence is 36.2%.
- The following risk factors have been associated with healthcare-associated infections: length of hospitalization (patients admitted for long stays, stays longer than seven days, had a higher risk than those admitted for short stays, stays of seven days or less).

Four families were most used; Cephalosporins, Fluoroquinolones, Aminosides and Carbapenems. Amikacin was the antibiotic most frequently used alone or in combination with cefotaxime and/ or ciprofloxacin.

Conflicts of Interest

The authors declare no conflicts of interest.

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Author Contributions

- Awa Fall: the author of the article, university Cheikh Anta Diop of Dakar and Master's degree in genetics. Contribution: writing of the article, design, realization of the survey, analysis and interpretation of the data.
- Diouf Ndeye Marieme: Pediatrician. Contribution: conception, recruitment, diagnosis and treatment of patients, carrying out the survey.
- Ndour Daouda: Pediatrician. Contribution: conception, recruitment, diagnosis and treatment of patients, realization of the survey
- Tine Alioune: Pharmacist-biologist. Contribution: survey design, implementation, data analysis and interpretation.
- Ba Abou: Professor, Pediatrician. Contribution: design, recruitment, diagnosis and treatment of patients, survey implementation.
- Ba Awa: Professor, Bacteriology Virology. Contribution: design, survey implementation, data analysis and interpretation.
- Fortes Louise: Professor, Infectious Diseases. Contribution: survey design, implementation, data analysis and interpretation, article review.
- Badiane Aida Sadikh: Professor, Parasitology, Mycology. Contribution: conception, realization of the survey, data analysis and interpretation.

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Annexed
TABLE: patient profile IAS

patients	sex	Weights (gram)	Diagnostic at day 0	germs	antibiotics	Length of hospitalization	OUT COME
P1	F	1800	Premature of 32 weeks plus 6 days for PES / Timellare	*Enterobacteriaceae spp*	No antibiotic	16 days	death
P2	F	700	Premature 35 weeks, FPN, RCIUS	*SCN*	ciprofloxacin, flagyl, amikacin	6 days	death
P3	F	960	Very premature 11 weeks and 3 days, newborn with erythrosis, thin skin, malformation	*Staphylococcus spp, E. coli, Klebsiella pn*	ciprofloxacin, flagyl, amikacin, cefotaxime	7 days	death
P4	F	1000	Premature 28 weeks plus 4 days	*Staphylococcus spp, Staphylococcus epidermidis*	ciprofloxacin, flagyl, amikacin	42 days	Exeat
P5	F	720	29 weeks premature, severe DR	*Staphylococcus aureus*	amikacin, cefotaxime	3 days	death
P6	M	3400	Complex non-cyanotic congenital heart disease with common truncus arteriosus type 2 with double ASD and subvalvular VSD	*Staphylococcus epidermidis*	ciprofloxacin, amikacin, cefotaxime	14 days	death
P7	F	3090	large preemie of 35 weeks and 6 days born from klebsiella meningitis pneumoniae	*klebsiella pneumoniae, Enterobacteria spp, Pseudomonas aeruginosa*	imipenem, flagyl, cefotaxime and lincomycin	28 days	Exeat
P8	M	1225	Premature with reduced maturity of 34 weeks and 4 days and severe IUGR	*Klebsiella pneumoniae*	No antibiotic	6 days	death
P9	F	1135	Premature of 29 weeks and 4 days	*Klebsiella pn, Candida albicans*	imipenem, flagyl, amikacin, cefotaxime	30 days	Exeat
P10	F	2270	IMM complicated by severe dehydration and severe malnutrition	*Burkholderia spp*	amikacin, cefotaxime	7 days	Exeat
P11	F	1795	IMF, cardiomyopathy and MMH	*Klebsiella pn*	ciprofloxacin, flagyl, amikacin, cefotaxime	15 days	Exeat
P12	F	775	big Premature of 27SA and 6 days	*Staphylococcus saprophyticus, Candida albicans*	vancomycin, amikacin, ciprofloxacin	14 days	death
P13	M	1810	Poor adaptation to life and IUGR AND Premature 37 weeks	*Non-fermentative gram - negative bacillus, pseudominiae aeriginosa, Staphylococcus aureus, E. coli, Klebsiella pn .*	imipenem, amikacin, ciprofloxacin	21 days	Exeat

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P14	F	1395	Severe respiratory distress plus IUGR	*E. coli*	ciprofloxacin, flagyl, amikacin	7 days	death
15	M	1570	33 weeks premature and IMN AND hyaline disease	*Klebsiellapneumoniae*	imipenem	12 days	Exeat
16	M	1055	Very premature 29 weeks and 1 day and IMF	*E. coli, Klebsiella pn*	Rifamycin, vancomycin, amikacin, cefotaxime	12 days	death
17	M	1314	Very premature 29 weeks and 1 day and IMF	*Klebsiella pn*	Vancomycin, amikacin, cefotaxime	8 days	death