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Original Article

Bacterial Contamination of Neonatal Intensive Care Unit

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ABSTRACT

Background and objectives*. The environmental impact assessment plays an important role in ensuring environmental media. This study aimed to assess the environmental pollution of the neonatal intensive care unit in Al-Jala hospital of obstetrics and gynecology, Tripoli, Libya through environmental monitoring of bacteria on different surfaces.* ***Methods****. A cross-sectional, descriptive study was carried out in the neonatal intensive care unit from December- to February 2022 at Al-Jala hospital, Tripoli. A total of 61 samples were collected with a sterile swab from high-contact environmental surfaces. Isolation, identification, and antibiotic resistance of bacterial isolated were performed by standard technique. Blood culture isolates from neonatal intensive care unit patients were compared with the environmental isolates during the study period.* ***Results.*** *Out of 61 samples, bacterial growth was observed in 58 samples, out of which 40 (68.9%) were gram-positive and 18 (31.03%) were gram-negative. The observed gram-positive bacterial isolate was Staphylococcus aureus 13(32.5%), and most of gram-positive isolates were recovered from an incubator, suction tip, stethoscope, ambu bag, and staff hand. The potential gram-negative bacterial isolates were E. coli 10 (55.5%), and the majority of gram-negative isolates were recovered from the door handle, suction tip, neonate breathing tube, and staff hand. The isolated bacteria were resistant to amoxicillin (41.3%), clindamycin (39.6%), imipenem, and tetracycline (27.5%). Common potential pathogens isolated from the blood culture of NICU patients were staphylococcus aureus.* ***Conclusion****. Bacterial contamination of objects and instruments in neonatal intensive care units was high (95%). This study emphasizes the need for rigorous decontamination protocols and hand hygiene. Clindamycin and tetracycline may be used for empirical therapy in clinically suspected cases of isolates.*

Keywords. *NICU, Nosocomial Infection, Environmental Monitoring, Staphylococcus Aureus, Antibiotic Resistance.*

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INTRODUCTION

Nosocomial or 'healthcare-associated infections (HCAIs) occur in a patient receiving medical treatment in a hospital or other healthcare facilities but were not present at the time of admission. These infections can develop during the treatment of other diseases as well as after the patients have been discharged. Furthermore, they include occupational illnesses among medical workers [1]. Of every hundred hospitalized patients, seven in developed and ten in developing countries can acquire one of the healthcare-associated infections [2]. Infections associated with neonatal care present a real public health problem responsible for increased neonatal morbidity and mortality and prolonged length of hospital stay. Literature reports a prevalence of health-care-associated infections (HAI) in neonatal intensive care units (NICU) varying from 8.7% to 74.3% [3,4,5]. Each year, 3.6 million infants are estimated to die in the first four (04) weeks of life (neonatal period), but most of the neonates continue to die at home and are uncounted. There are three major causes of neonatal death, mainly infections, complications of preterm birth, and intrapartum-related neonatal deaths (birth asphyxia). They account for approximately 0% of all neonatal deaths globally [6]. Newborns admitted to intensive care units (ICUs) are at high risk for developing nosocomial infections (NIs) because of the severity of their illness and exposure to invasive medical devices such as mechanical ventilators and central venous catheters (CVCs) and resistant microorganisms [4]. According to Dramowski et al. (2017) hospitalized neonates are considered a vulnerable population due to their immature immune systems and the lack of antibodies and immunity in a premature baby's immune system, which means they can't fight off bacteria, viruses, or fungi in the same way that full-term babies may be able to, also frequent infectious disease exposures through contact with healthcare staff, parents, other patients, equipment, and the hospital environment [7]. The pattern of organisms causing infections differs from place to place and over a while. Additionally, the emergence of resistant organisms to antimicrobial agents has become a major health threat worldwide [8].

According to a study done by Sales et al. (2014) [9], there is a relationship between the presence of resistant pathogens on hospital surfaces and equipment and the frequency with which they are cleaned, how they are cleaned, the proper use of disinfectants and the proper disinfecting, Both Gram-negative and Gram-positive bacteria have been isolated from inanimate surfaces and can survive up to months on dry surfaces, with longer persistence seen under humid and lower temperature conditions [9].

Many factors influence and affect the rate of contamination and cross-contamination in the ICU. This includes the type of organism, source and destination surfaces, humidity level, and size of the inoculum. Other factors that play a role include hand hygiene compliance, the number of nurse staffing levels, the number of colonized or infected patients, and ICU structural features [10]. Various bacterial agents have been implicated in the contamination of the ICU. Clinically important potential pathogens include S. aureus including methicillin-resistant S. aureus (MRSA), Klebsiella species, E. coli, Pseudomonas species, Acinetobacter species, and Enterococcus species [11]. Antimicrobial resistance is on the rise, as are multidrug-resistant (MDR) organisms including MRSA and vancomycin-resistant S. aureus (VRSA), extended-spectrum beta-lactamase (ESBL) producing Enterobacteriaceae, and Acinetobacter species in NICU result in high morbidity and mortality. These MDR pathogens like [MRSA, VRSA, ESBL-producing, Enterobacteriae, and Acinetobacter baumanii] are used as indicator organisms for evaluating the level of adherence to basic standard procedures in intensive care units. as failure in this basic procedure tends to increase the dissemination of these pathogens within the units and hospital.

The present study aimed to determine the level of bacterial contamination of the instruments/objects commonly touched by HCWs (Hospital Care Workers) and/or that frequently come in contact with neonates. Bacteriological examination of NICU environmental samples could provide information about the level of bacterial contamination, find out antibiotic resistance patterns of the isolates, and the effectiveness of cleaning/disinfection procedures.

METHODS

Study design and setting

This study was a cross-sectional study carried out in a neonatal intensive care unit (NICU) in Al-Jala hospital of obstetrics and gynecology / Tripoli, Libya from December- to February 2022, and was approved by the ethical committee of the faculty of medical technology, university of Tripoli, Libya.

The study entailed the collection of 61 swab samples from high contact environment surfaces of [all sides of incubators, bed of neonate, suction tips, ventilators, stethoscopes, ambu bags, door handles, window handle, digital weighing machines, laryngoscope, bedside locker, telephone sets, sink, waterspout, the wheel, floor, the wall, mask of oxygen, oxygen cylinder, table for staff & instrument, blood pressure machine, station counter, wall BPL monitor, as well as from the hands of HCWs in NICU, Majority of these sites either come in direct contact with healthcare professionals or neonates.

Detailed information regarding cleaning/disinfection of objects/instruments in the NICU was obtained, the hospital used a total 5 disinfectants detergent for cleaning, these disinfectants were liquid soap, chlorine, enzymatic soap [used for sterilizing devices and equipment], Dettol, and benzal konam chloride detergent. Hence that the incubator is completely dismantled and cleaned with water, liquid soap, and chlorine, as well as the floor, is mopped twice a day with the same detergents and Dettol to sterilize the ground, they use enzymatic soap to clean the parts of the incubator and equipment that comes in direct contact with neonates or HCW.

Sample collection

Samples were collected by sterile cotton swabs well labeled and transported in a tube provided by distilling water, swabs were transported to the laboratory within 1 hour of sample collection, and upon arrival were inoculated onto nutrient agar overnight at 37°C. Subculture was performed on MacConkey agar, blood agar, and mannitol salt agar plates, and plates were incubated aerobically at 37 °C for 24 h. The isolates were identified by standard microbiological techniques such as colony morphology, microscopic features, standard phenotypic characters, and biochemical tests such as catalase, coagulase, and oxidase.

Some samples were identified by using the BD PHOENIX 100. The BD Phoenix Automated Microbiology System is intended for Vitro rapid identification (ID).

Antibiotic susceptibility of the isolated bacteria

After isolation and identification, antibiotic susceptibility tests are used using modified Kirby–Bauer disk diffusion according to the Clinical and Laboratory Standards Institute (CLSI), guideline [12]. It is a filter paper tablet that contains a specific amount of the antibiotic at a known concentration and this concentration represents the minimum inhibition concentration (MIC) by using the Muller Hinton Agar (MHA) that's considered the standard medium for the Kirby-Bauer method of susceptibility testing [13].

The bacterial suspension was prepared with one drop of sterile normal saline mixed with one pure colony of bacteria. The entire surface of the MHA plate was swabbed with the test organism suspension. turning the plate 360 degrees, repeating the process three times, and leaving the dishes to dry completely. The antibiotic tablets were transferred to the inoculated plates by tongs the dishes were incubated for 24 hours at a temperature of 37°C. And by using the included ruler, areas of inhibition were measured around each antibiotic tablet to determine the sensitivity of the isolates for different antibiotics, some areas devoid of microbial growth were observed around the disc, and the presence of an area around another disc, this means that the antagonist is effective, and other areas there is a growth of microbiome around the disc, which indicates that there is no zone around the disc, which means that the antagonist inactive.

The antibiotic disks used in the study were amoxicillin 10 mg (AML 10), erythromycin 15 mg (E 15), clindamycin 5 mg (CD 5), tetracycline 10 mg (TE 10), ciprofloxacin 5 mg (CIP 5), trimethoprim + sulphamethoxazole 25 mg (SXT 25), imipenem 10 mg (IMI 10).

Details of bacterial isolates from the blood culture of the neonates admitted to the general NICU during the study period were extracted from the medical record, and compared with the environmental isolates of this study.

Statistical analysis

Data were presented as frequency and percentages. Statistical analysis was performed using Package of Social Sciences (SPSS) version 26.

RESULTS

A total of 61 analyzed swabs showed bacterial growth in 58 (95%) specimens while 3 (4.9%) samples did not show bacterial growth after 48 hours of incubation. The results showed that out of them 40 (68.9%) were gram-positive and 18 (31.03%) were gram-negative bacteria.

The potential Gram-positive organism isolated was staph. aureus 13 (32.5%), followed by Bacillus cereus 6 (15%), staphylococcus epidermidis, Enterococcus faecalis with 4 (10%) both, Enterococcus faecium, Neisseria lactamica, Bacillus subtilis 2 (5%). All, Lefsonia aquatic, Streptococcus viridan, streptococcus agalactiae, streptococcus pneumonia, streptococcus pyogens, Bacillus pumilus, and Staphylococcus xylosu were 1 (2.5%). The majority of staph. aureus isolated were recovered from the incubator, suction tip, stethoscope, neonate bed, and tube holder, were Bacillus cereus isolated from staff hands, door handle, stethoscope, and ambu bag.

The potential Gram-negative organism isolated was E. coli 10 (55.5%) followed by Acinetobacter baumannii 3 (16.6%), Pseudomonas aeruginosa 2 (11.1%) Klebsiella pneumonia, Vibrio cholera, Paracoccus yeei 1 (5.5%) as shown in table [1].

The majority of E. coli isolated were recovered from staff hands, door handle, suction tip, stethoscope, and Neonates breathing tube. other Gram-negative isolates were recovered from the weighing machine, the outside surface of the incubator, the cabinet, the staff mobile, and the table for the instrument.

Table 1: Total percentage of gram-positive and gram-negative bacteria

Type of isolates	Gram-positive (n =40)	Gram-negative (n = 18)
	40 (68.9%)	18 (31.03%)
(Gram-positive) **Isolates Species**		
Staphylococcus aureus	13 (32.5%)	
Bacillus cereus	6 (15%)	
Staphylococcus epidermidis	4 (10%)	
Enterococcus faecalis	4 (10%)	
Enterococcus faecium	2 (5%)	
Neisseria lactamica	2 (5%)	
Bacillus subtilis	2 (5%)	
Streptococcus veridans	1 (2.5%)	
Streptococcus agalactiae	1 (2.5%)	
Streptococcus pneumonia	1 (2.5%)	
Streptococcus pyogens	1 (2.5%)	
Lefsonia aquatic	1 (2.5%)	
Bacillus pumilus	1 (2.5%)	
Staphylococcus xylosus	1 (2.5%)	
(Gram-negative) **Isolates Species**		
E.coli	10 (55.5%)	
Acinetobacter baumannii	3 (16.6%)	
Pseudomonas aeruginosa	2 (11.1%)	
Klebsiella pneumonia	1 (5.5%)	
Vibrio cholera	1 (5.5%)	
Paracoccus yeei	1 (5.5%)	

The antibiotic resistance patterns of bacterial isolates are shown in Table [2]. The majority of the bacterial isolates were resistant to amoxicillin (41.3%), clindamycin (39.6%), imipenem, and clindamycin (27.5%) both. A high percentage of multidrug resistance was observed among E. coli, S. aureus, Staphylococcus epidermidis, and Enterococcus faecalis.

Common isolates from blood culture records were staphylococcus aureus (33.3%), Klebsiella spp (5.5%) and E. coli (5.5%), pseudomonas spp (5.5%).

Table 2: Antibiotic resistance pattern of bacterial isolates:

Antibiotics	Bacterial isolates																				
	S.aureus / n=13	*E.coli/ n=10*	*B.cereus / n=6*	*S.epidermidis/n=4*	*Entero.faecalis n=4*	*A.baumannii/n=3*	*Entero.faecium /n=2*	*N.lactamica/ n=2*	*B.subtitlis/ n=2*	*Ps.aeruginosa/n=2*	*Strep.agalactiae /n=1*	*Strep.pneumonia/n =1*	*Strep.viridans/n=1*	*Strep.pyogens/n=1*	*Lefsonia aquatica /n=1*	*K.pneumonia/n=1*	*B.pumilus /n=1*	*V.cholera /n=1*	*S.xylosus/ n=1*	*P.yeei /n=1*	**Total**
AML	4 (30.76%)	5(50%)	5 (83%)	2 (50%)	0	2 (66.6 %)	1(50 %)	0	1 (50 %)	1 (50 %)	0	0	1(100 %)	0	0	1 (100 %)	0	0	1 (100 %)	0	24 (41.3 %)
E	2 (15.38%)	4 (40%)	1 (16.6 %)	0	2(50%)	1 (33.3 %)	1(50 %)	0	0	0	0	0	1(100 %)	1(10 0%)	0	1 (100 %)	0	1 (100 %)	1 (100 %)	0	16 (27.5 %)
CD	2 (15.38%)	5 (50%)	0	1 (25%)	4(100 %)	1 (33.3 %)	1(50 %)	1 (50 %)	2 (10 0 %)	2 (100 %)	0	0	1(100 %)	0	0	1 (100) %	1 (100) %	0	1 (100 %)	0	23 (39.6 %)
TE	0	1 (10)	0	1 (25% %)	2(50%)	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (100 %)	0	5 (8.6%)
CIP	4 (30.76%)	1 (10%)	0	0	2(50%)	0	0	1 (50 %)	0	0	0	0	0	0	0	0	0	0	0	0	8 (13.7 %)
SXT	2 (15.38%)	1 (10%)	4 (66.6 %)	1 (25%)	2(50%)	0	0	1 (50 %)	0	0	1(10 0%)	0	0	1(10 0%)	0	0	0	0	0	1 (100 %)	14 (24.1 %)
IMI	4 (30.76%)	2 (20%)	0	1 (25%)	1(25%)	2 (66.6 %)	1(50 %)	1 (50 %)	2 (10 0 %)	1 (50 %)	0	0	0	0	0	1 (100 %)	0	0	0	0	16 (27.5 %)

DISCUSSION

Patients in ICUs are at the highest risk for HAI (hospital-acquired infection) due to their low immunity due to invasive medical procedures during their hospitalization. The ICU staff and physicians can serve as vehicles for the spread of resident pathogens from different hospital wards to ICUs. As a result, HCWs and ICU personnel's hands must adhere to the strictest hygiene standards. In addition, contamination of the ICU environment plays a significant role in the acquisition of nosocomial diseases by both patients and HCWs. Investigation of the rate of bacterial contamination of the hands of HCWs and the ICU environmental surfaces could provide recommendations for preventing the transmission of pathogenic bacteria to patients and personnel in healthcare settings [14].

Contact between contaminated HCWs and hospitalized patients in ICUs could result in dangerous infections.

Because the skin squamous contains viable microorganisms that are shed daily from normal skin, it is not surprising that patient gowns, bed linens, bedsides, and other objects in the ICU environment become contaminated [14]. Bacterial contamination in NICU is one of the major factors responsible for higher incidences of nosocomial infections. Non-critical medical equipment and inanimate surfaces can harbor bacteria for a long time and can become in contact with patients and medical personnel during disease management [15,16]. Most gram-positive bacteria, such as Staphylococcus aureus, including methicillin-resistant Staphylococcus aureus (MRSA), survive months on dry surfaces (7 days to 7 months). Many Gram-negative species, such as Acinetobacter spp, Escherichia coli, and Klebsiella spp can survive for up to 30 months on dry inanimate surfaces [17].

Our study showed contamination of the inanimate environments by diverse groups of bacteria, including Gram-positive bacteria (68.9%) and Gram-negative bacteria (31.03 %). This is comparable to a study done by Tajedinn et al. (2015) in Iran, where Gram-positive bacteria comprised a greater percentage of the bacterial isolates (60.7%) compared to Gram-negative bacteria (39.3%) [14]. More Gram-positive organisms are isolated because they are known to be members of the body flora of both asymptomatic carriers and sick persons. These organisms can be spread by the hand, expelled from the respiratory tract, or transmitted by animate or inanimate objects (Maryam et al. 2014). [18]. The result from this study is different from a study done in Nigeria in the Neonatal Intensive Care Unit (NICU) of Manipal Teaching Hospital, Pokhara, Nepal, in which Gram-negative bacteria (66.3%) comprised the greater percentage of the bacterial isolates as compared to Gram-positive bacteria (33.6%) [20].

The NICU had high bacterial contamination of regularly touched objects/instrument. The overall bacterial contamination rate in NICU was (95%) which is higher than other studies (77.5%) and (74.6%) [19,20] respectively. The result from this study is also in line with a study done in a hospital in Fez city, Morocco, in which the contamination rate was 96% [22]. A contamination rate of 86.1% was seen in a study done in Zimbabwe in the Intensive Care Units of a Tertiary Hospital in Bulawayo (Mbanga et al. 2018) [21]. This percentage difference is could be because different surfaces were sampled, it can also be attributed to irregular disinfection, the difference in the types of disinfectants used, hygienic conditions, and overcrowding.

High bacterial contamination in NICU may be attributed to the admission of neonates with a variety of clinical conditions, overcrowded units, fecal contamination, easy access to visitors, understaffing, and poor compliance with infection control practices. Prolonged NICU stay necessitates frequent visits by mothers and HCW results in increased human activities facilitating the exchange of bacterial flora. Klebsiella, E. coli, Pseudomonas, and S. aureus are the pathogens most frequently implicated in neonatal infections in resource-poor nations [23].

The predominant bacterial contaminants in this study as presented in (Table-2), where Gram-positive bacteria represent the highest percentage of bacterial isolates and accounted for 40 (68.9%), the Staphylococcus aureus was represented as the predominant organism isolated from the Gram-positive bacteria which accounted for 13 (32.5%), followed by Bacillus cereus with 6 (15%), and both staphylococcus epidermidis, Enterococcus faecalis with 4 (10%). A similar study done in Nigeria in 2021, have reported the predominant Gram-positive organisms were coagulase-negative Staphylococcus aureus (CONS), staphylococcus aureus, and Enterococcus spp, which accounted for 22 (40%), 18 (32.7%), 15 (27.2%) respectively [20]. Another study was done in intensive care units at a tertiary hospital in Bauchi, Northeastern Nigeria which reported that Gram-positive bacteria comprised the greatest percentage of bacterial isolates (95%) compared to Gram-negative bacteria (4.7%), with predominant Gram-positive bacterial isolates being bacillus spp 13 (32.5%) followed by Staphylococcus aureus 11(27.5%) and Streptococcus pneumonia 2(5%) [11]. The high contamination rate with S. aureus is attributed to the fact that these pathogens are normal flora of human skin and clothing fabrics that are continuously shed during routine activity and clothing fabrics [11]. The majority of s. aureus was recovered from the incubator, suction tip, stethoscope, neonate bed, and tube holder, presence of S. aureus on these surfaces increases the risk of transmission and may subsequently result in sepsis and pneumonia. Isolated Bacillus spp were recovered from staff hands, door handle, stethoscope, and ambu bag, in a similar study the Bacillus spp were isolated from the incubator (inborn), preterm unit (floor & wall), and isolation unit [11].

From the isolated Gram-negative bacteria that recorded 18 (31.03%), the predominant organisms were E. coli which accounted for 10(55.5%), followed by Acinetobacter baumannii 3 (16.6%), and P. aeroginosa 2 (11.1%). our results are in line with that of a study done in Nigeria in 2021, where the predominant Gram-negative bacteria was E. coli which accounted for 27 (42.1%), followed by K.

pneumonia, and P. aeroginosa with 21 (32.8%), 9 (14.06%) respectively, and Acinetobacter baumannii with 7 (10.9%) [20]. On other hand, there is a study done in Nigerian Hospital with the same bacterial isolated from our study but in different percentages which Acinetobacter baumannii and K. pneumonia represent the predominant organism isolated with 38 (49.3%), 32 (41.5%) respectively, and E. coli represented the lowest organism isolated 5 (6.4%) with P. aeroginosa 2 (2.5%) [24]. Our study reports that E. coli were isolated from staff hands, door handle, suction tip, stethoscope, and Neonate's breathing tube, a similar study has reported that E. coli were recovered from the suction tip, radiant warmer, and incubator [20]. E. coli is frequently associated with neonatal sepsis and is one of the most common causes of acute pyogenic meningitis among neonates. Surface contamination of NICU by E. coli and S.aureus leads to a greater risk of systemic infections like neonatal septicemia, pneumonia, and meningitis, especially among premature neonates.

The microbial flora of NICU surfaces is not significantly different from other units of the hospital environments. Furthermore, the high susceptibility of premature and immunocompromised neonates provides an additional challenge in preventing nosocomial infections in the NICU. Colonization of NICU surfaces by opportunistic nosocomial pathogens like Acinetobacter species, staphylococcus aureus, Pseudomonas species, and Enterococcus species are important for high-risk neonates such as low birth weight, and premature and congenital abnormalities.

In this study, we observed high resistance of bacteria isolated to amoxicillin (41.3%), clindamycin (39.6%), imipenem, Erythromycin (27.5%), trimethoprim + sulphamethoxazole (24.1%), ciprofloxacin (13.7%), and finally tetracycline (8.6%).

E. coli has observed resistance to commonly used antibiotics like amoxicillin and clindamycin (50%) both, and erythromycin (40%), The resistance percentage of amoxicillin in other studies was high (81.8%), and slight resistance to ciprofloxacin and tetracycline (18.2%) (27.3%) respectively [25]. In another study, there is a difference in E. coli resistance, which was high with ampicillin (100%), with little resistance to ciprofloxacin (29.6%), and sensitivity to imipenem and amikacin [20]. The greatest resistance of S. aureus was to amoxicillin (30%), ciprofloxacin (30.76%), and imipenem (30.76%). were Only sensitive to tetracycline, our study is in line with a study done in Northern Ethiopia where S. aureus was resistant to amoxicillin (63%) and ciprofloxacin (23.9%) [25]. On other hand, the resistance percentage of S.aureus was (0%) to clindamycin and ciprofloxacin, with high sensitivity to tetracycline (100%) in a study done in Nigeria [20].

A high percentage of MDR among bacterial pathogens could be attributed to using a higher generation of antibiotics for empirical treatment and prophylactic antibiotics for high-risk mothers and neonates. Data on antibiotic resistance patterns of bacterial pathogens would help clinicians to formulate empirical antimicrobial therapy in suspected cases of nosocomial infections in the NICU. This may help in reducing the duration of NICU stay and neonatal mortality. The long-term effect will encourage antimicrobial stewardship.

Blood culture is one of the most common microbiological investigations ordered from the NICU. After conducting the necessary tests to know the types of bacteria present in the general NICU of AL-JALAA hospital, the results of our study were compared with the results of neonate's blood culture during the study period by reviewing the records, newborns range in age from 2 to 24 days. it was noted that most organisms isolated from this culture are from S.aureus represent (33.3%), which confirms the result of our study, as the percentage of S. aureus is the highest (32.5%), some of which were acquired at birth and others from the intensive care unit environment. We also found other types of bacteria such as E. coli, Klebsiella spp, and Pseudomonas spp (5.5%), also some of the samples had no growth (50%).

Blood culture data of NICU patients revealed that S. aureus and Klebsiella species were the two most common causes of neonatal sepsis, observed in a study in Nigeria [20]. From other studies done in

Ethiopia and Iran where the Gram-positive bacteria represent the most commonly isolated organisms causing neonatal sepsis, this finding is incongruent with our study [26,27].

Standard cleaning/disinfection criteria are not followed properly in the NICU due to the high bed occupancy. This results in increased bacterial colonization and subsequent spread within NICU. It is practically difficult to maintain sterility in the NICU environment because of the high rate of HCW activities and the use of equipment. Meticulous cleaning/disinfection protocols are necessary to prevent the retention and spread of virulent microbial pathogens insensitive environment of the NICU. In this study, we have included most of the objects/instruments commonly touched by HCWs and objects which frequently come in contact with neonates. This is an attempt to determine the relevance of flora on these objects and their role in nosocomial infections. The findings of this study have provided baseline information about the degree of contamination and resistance patterns of environmental isolates.

CONCLUSION

Nosocomial infection is an important complication of hospitalized neonates with a high incidence in NICUs. Bacterial contamination of objects/instruments in the NICU was high (95%). Isolation of potential pathogens like S. aureus, E. coli, and bacillus cereus is a threat to neonates. Blood culture data from NICU reflects the possibility of nosocomial infections from contaminated sites. In light of this, this study emphasizes the need for suitable decontamination protocols and hand hygiene. Regular surveillance and effective disinfection techniques would reduce bacterial colonization and transmission to neonates. The hospital environment is a complex ecosystem, and various actions are required for effective infection control. Lack of a universal procedure for surveillance of nosocomial infection, poor hand hygiene, and high level of bacterial contamination on hospital environmental surfaces are the most important problems in hospital settings. Clindamycin and tetracycline may be used for empirical therapy in clinically suspected cases of sepsis.

RECOMMENDATION

Based on the results obtained from this study, we recommend the following:

1. Expedite the adoption of an urgent implementation plan to control pollution inside the care unit, and process its results, effects, and consequences by the provisions and contents of the Environmental Protection Law.
2. Increased attention to sterilizing equipment, dressings, drugs, intravenous fluids, and the new mattress.
3. To rationalize the correct way of dealing with antibiotics so that they are not misused leads to an increase in the proportion of resistant bacteria and thus increases the percentage of contamination.
4. Conducting comprehensive sterilization of the care unit in particular and the hospital in general, and the selection of detergents Conducting research on the effectiveness of some disinfectants and trying to benefit from them in sterilization of Hospitals because some types of bacteria adapt to some disinfectants, such as *P. aeruginosa* bacteria.
5. Researching the possibility of finding an alternative to an antibiotic or searching for new antibiotics bacteria cannot resist.

Disclaimer

The article has not been previously presented or published and is not part of a thesis project.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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