Detection of common bacterial pathogen and their Anti-microbial susceptibility pattern in various medical laboratories in Shendi Town, Sudan

ABSTRACT

Background**:** Laboratory infections can be classified as occupational and nosocomial infections. Laboratory-related infections are generally recognized as a potential risk for clinical laboratory workers. Some types of bacteria can survive longer on dry surfaces and more on wet surfaces can infect other places and environments. ***Objective*****:** To detect common bacterial pathogens in various medical laboratories in Shendi City. ***Materials and Methods*****:** A cross-sectional analytical study was conducted in Shendi City from August to December 2021. This study included 17 laboratories and 50 samples collected by wet exchange from various locations including laboratory surfaces, microscopes, centrifuges, CBC devices, staining racks, and CBC devices. ***Results*****:** This study included *Staphylococcus aureus* 11 (22%), *Staphylococcus epidermidis* 10 (20%), *Escherichia coli* 1 (2%), *Klebsiella pneumonia* 9 (18%), and *Pseudomonas aeruginosa* 2 (4%). Significant growth of pathogenic bacteria was shown. Among all the organisms isolated, there is moderate resistance to antibiotics, some bacteria are very resistant, others are resistant, and some organisms are resistant to some they were highly sensitive to the substance and resistant to other antibacterial agents. Bacterial isolates (39.4%) were resistant to Amoclane, 12 (36.4%) were resistant to gentamicin, and 11 (33.3%) were resistant to Ciprofloxacin and Imipenem. ***Conclusions*****:** At the end of this study, pathogen contamination was found on laboratory surfaces and equipment (approximately 66% of exchanged items contained pathogens), dry surfaces may use these organisms as a source of laboratory infection.

Keywords: Nosocomial infections**,** Laboratory infections**,** *Staphylococcus aureus*, Shendi, Sudan.

INTRODUCTION

Working with pathogenic microorganisms requires good laboratory practices, risk assessments, and bio safety/bio security measures to ensure the safety of personnel, communities, and the environment from accidental or intentional infection. . Occupational infections of laboratory personnel, called laboratory infections (LAI), have been described in the scientific literature since 1897. Accidental or exposure events leading to LAI may include inhalation of infectious aerosols or contact with mucous membranes, droplets, contacts, spills, or transmission via per cutaneous routes (bites, cuts, accidental self-inoculation). However, in many of his LAI cases, the actual cause often remains unknown or uncertain **[1].** Nosocomial infections, also called "nosocomial infections", can be defined as infections that occur in patients in hospitals or other healthcare facilities where the infection was absent or latent at the time of admission. These include nosocomial but post-discharge infections and occupational infections among facility staff (WHO, 2002). Nosocomial infections (NIs) are known worldwide and, despite scientific and technological health advances **[2],** are a major concern, especially in developing countries, due to limited resources. Remains an issue **[3].** Healthcare-associated infections (HAIs) are an important cause of inpatient morbidity and mortality. The severity of infection depends on the characteristics of the microorganisms involved and the frequency of resistant pathogens in hospital settings **[2].** Several recent studies suggest that environmental contamination plays an important role in nosocomial infections with multidrug-resistant bacteria (MDROs), viruses, mycobacteria, and fungi **[4].** A caring environment consists of the three elements of a building or space used for patient care. Devices are used to support patient care or to safely operate buildings and spaces. People, including staff, patients, and visitors. Some pathogens can persist in the environment for long periods and serve as vehicles for transmission and spread in hospital settings. Cross-infection of these pathogens can occur through the hands of healthcare workers, directly by contact with patients, or indirectly by touching environmental surfaces. Less commonly, direct contact with contaminated environmental surfaces can lead to patient colonization **[4].** The role played by medical devices and work surfaces in transmitting these organisms inevitably contributes to increased mortality, morbidity, and antibiotic resistance **[3].** The emergence of multidrug-resistant bacteria has exacerbated this problem, especially in resource-poor countries, as a result of overuse, abuse, and inadequate antimicrobial management policies in healthcare systems. Broad-spectrum and first-line antibiotics are widely used and resistance is exacerbated due to the lack of hospital antimicrobial teams and strict adherence to treatment guidelines. This resistance results in longer hospital stays and a total economic burden due to treatment with correspondingly higher morbidity and mortality **[3].** The implementation of surface microbiological controls in healthcare facilities is part of the policy to prevent nosocomial infections. Preventive and corrective actions can be implemented with a better understanding of microbial ecology, demonstrating that monitoring the hospital environment is an essential component in controlling nosocomial infections. Such microbiological monitoring can measure the risk of infection by identifying infectious bacteria and comparing local data with data from other institutions **[5].**

MATERIALS AND METHODS

Study Design:

This is an analytical cross-sectional study aimed at determining the types of pathogenic bacteria found in the laboratory setting and their susceptibility to antibiotics.

Study area:

A medical research institute in Shendi, Nile State, Sudan.

Study Population:

Medical laboratories at the Shendi Local Market.

Inclusion Criteria:

All surfaces and equipment.

Sampling:

All surfaces and equipment are included in the sample.

Data collection tools:

Data were collected from the results of actual bacterial cultures of the collected samples.

Collection of Samples:

Contaminated swab samples from surfaces and equipment were collected with saline-soaked swabs, after which the samples were transferred to the Shendi University Microbiology Laboratory as soon as possible in approximately 30 min.

Culturing of samples:

All samples were cultured on MacConkey agar and blood agar and subculture to obtain pure microorganisms.

Antimicrobial susceptibility testing:

Isolated bacteria were tested for antimicrobial susceptibility using the standard Kirby-Bauer disc diffusion method. Gram-positive bacteria are tested for susceptibility to Co-amoxiclav, ceftriaxone, ciprofloxacin, and gentamicin; gram-negative bacteria are susceptible to Co-amoxiclav, Ceftriaxone, Ciprofloxacin, Gentamicin, and Imipenem was tested.

Data analysis:

Data were manually analyzed and presented in tables.

Ethical Approval and Consent:

Not applicable

RESULTS

In this study, 50 swabs samples have been amassed from different sites in the laboratories inclusive of surfaces, microscopes, centrifuges, staining racks, and CBC devices, The percentage of a pathogenic microorganism comes as follows: the table surfaces confirmed a relatively infected location of approximately 11 (92%) of swabbed surfaces incorporate pathogenic microorganism, approximately 9 (89%) of centrifuges incorporate pathogenic microorganism, 4 (67%) of CBC gadgets incorporate pathogenic microorganism, 10 (56%) of microscopes are infected with the aid of using a pathogenic microorganism, the racks which can be used for staining display the decrease wide variety of pathogens approximately 14% only (figure 1). 8 samples of the amassed 50 samples confirmed no increase in microorganisms. From the isolated microorganism, 9 cultures confirmed the natural increase of gram-high-quality bacilli (18% of all cultures incorporate increase), in keeping with gram stain and colonial morphology, it changed into *Bacillus* species, additionally. *Bacillus* species changed into determined blended with the different pathogenic microorganism in lots of cultures, the Gram-positive cocci have been 21 microorganisms (42% of all isolated microorganism), 12 microorganisms have been Gram-negative bacilli (24%) **(Table 1).** The species of these bacteria according to the site of sample collection were showed in the **(Table 2).** The isolated Gram-positive cocci encompass *Staphylococcus aureus* 11 (22% of all isolated microorganisms), *Staphylococcus epidermidis* 10 (20%), the Gram-negative bacilli encompass *Klebsiella pneumonia* 9 (18%), *Escherichia coli* 1 (2%), *Pseudomonas aeuroginosa* 2 (4%) **(Table 3).** The result of antimicrobial susceptibility changed into proven in tables from **(Table 4-9).**

Table-1: The Percentage of gram-positive and gram-negative among isolated bacteria

Age group	*Frequency*	*Percent %*
Gram positive cocci	21	42%
Gram negative bacilli	12	24%
Gram positive bacilli	09	18%
Gram positive bacilli mixed with other species	20	40%
No growth	08	16%
Total	**62**	**100.0**

Table-2: The isolated bacteria according to site of sample collection.

Type	MIC	STR	CEN	DS	CBC
No growth	5	1	0	0	2
S. aureus	3	0	3	3	2
S. epidermidis	2	1	3	3	1
E.coli	1	0	0	0	0
K. pneumoniae	3	0	2	3	1
P. aeuroginosa	0	0	0	2	0
Bacillus spp	10	4	8	4	3

Table 3: The percentage of isolated bacterial species.

Type	*No*	*Percent %*
S .aureus	11	22%
S. epidermidis	10	20%
E.coli	01	02%
K. pneumoniae	00	18%
P. aeuroginosa	02	04%
Total	**33**	**100%**

Table 4: Sensitivity of *Staphylococcus aureus* to antibiotics.

Antibiotics	*Sensitive*	*Resistant*
Co-amoxiclav	7 (63.6%)	4 (36.4%)
Ceftriaxone	3 (27.3%)	8 (72.2%)
Ciprofloxacin	4 (36.4%)	7(63.6%)
Gentamycin	9 (81.8%)	2 (18.2%)

Table 5: Sensitivity of *S. epidermidis* to antibiotics.

Antibiotics	*Sensitive*	*Resistant*
Co-amoxiclav	5 (50%)	5 (50%)
Ceftriaxone	2 (20%)	8 (80%)
Ciprofloxacin	3 (30%)	7 (70%)
Gentamycin	4 (40%)	6 (60%)

Table 6: Sensitivity of *E.coli* to antibiotics.

Antibiotics	*Sensitive*	*Resistant*
Co-amoxiclav	0	1(100%)
Ceftriaxone	0	1(100%)
Ciprofloxacin	0	1(100%)
Gentamycin	0	1(100%)
Imipenem	0	1(100%)

Table 7: Sensitivity of *K. pneumoniae* to antibiotics.

Antibiotics	*Sensitive*	*Resistant*
Co-amoxiclav	5 (55.6%)	4 (44.4%)
Ceftriaxone	1 (11.1%)	8 (88.9%)
Ciprofloxacin	5 (55.6%)	4 (44.4%)
Gentamycin	4 (44.4%)	5 (55.6%)
Imipenem	6 (66.7%)	3 (33.3%)

Table 8: Sensitivity of *P. aeuroginosa* to antibiotics.

Antibiotics	*Sensitive*	*Resistant*
Co-amoxiclav	1 (50%)	1 (50%)
Ceftriaxone	0	2 (100%)
Ciprofloxacin	0	2 (100%)
Gentamycin	1 (50%)	1 (50%)
Imipenem	0	2 (100%)

Table 9: The Amount of resistant bacteria among all isolated organisms of to antibiotics.

Antibiotics	*Resistant*
Co-amoxiclav	13 (39.4%)
Ceftriaxone	15 (45.4%)
Ciprofloxacin	11 (33.3%)
Gentamycin	12 (36.4%)
Imipenem (Gram negative)	4 (33.3%)

DISCUSSION

This study was conducted from August to December 2021 to detect bacterial contamination found in laboratories. It was conducted in Shendi City. This study included 17 laboratories and the number of samples collected was 50 samples collected from different locations, including laboratory surfaces, microscopes, centrifuges, staining racks, and CBC machines. This study showed that there was significant growth of pathogenic bacteria other bacteria accounted for (40%) of all isolated pathogenic bacteria; included. 10 *Staphylococcus epidermidis* (20%), 1 *Escherichia coli* (2%), 9 *Klebsiella pneumoniae* (18%), 2 *Pseudomonas aeuroginosa* (4%). Antimicrobial susceptibility did not affect the *Bacillus spp*, so it was not pathogenic. *Staphylococcus aureus* showed the highest percentage. This is consistent with **Ivan Sserwadda** In 2018 and his colleagues found that: 75.4% of contaminant bacteria in post-operative wards are *Staphylococcus aureus* **[3].** Also, he agrees with **Laila Chaoui** and her colleagues in 2019 **[2].** Other prevalent bacteria include coagulase-negative *staphylococci* and *Klebsiella pneumonia*. This finding is agreement with **Ivan's. Serwadda and Laila Chaoui [3].** Considering antimicrobial susceptibility and antibiotic resistance, the antibiotics tested in this study were imipenem for Gram-negative bacteria only and coamoxilab, ceftriaxone, and ciprofloxacin for both Gram-negative and Gram-positive bacteria, and gentamicin. Among all organisms isolated, there was moderate resistance to antibiotics, some bacteria are highly resistant, others are susceptible, and some organisms are highly susceptible to certain types of antibiotics and resistant to other antibacterial agents. Ceftriaxone has a high rate of resistance, with approximately 15 (45.4%) of the isolates resistant to this antibiotic indicated by Amoclane and 13 (39.4%) of the isolates resistant to Amoclane, 12 (36.4%) bacteria are resistant. are resistant to gentamicin and 11 (33.3%) bacteria are resistant to ciprofloxacin and imipenem. The high resistance to ceftriaxone and amoclane indicates that these antibiotics are frequently prescribed by doctors in our country without testing the antimicrobial susceptibility to these antibiotics, or without shedding the prescribed dose. It has been suggested that this is due to patients using unreasonably large amounts. I oppose the use of these antibiotics. Among the isolated bacteria, only one sample showed growth of *Escherichia coli* (100%) resistant to all antibiotics, and two samples had *Pseudomonas aeruginosa* with high antibiotic resistance and susceptibility to Amoclane. *K. pneumoniae* showed the highest resistant to Ceftriaxone, about 8 (88.9%) of isolated bacteria and highly susceptible to Imipenem, while *staphylococcus epdermids* showed the highest resistant to Ciprofloxacin, about 7 bacteria (70%) followed by *S. aureus*, about 7 bacteria (63.6%) and 9 bacteria (82%) of *S. aureus* susceptible to Gentamycin, *Staphylococcus epidermidis* show proportionally high resistant to almost all antibiotics, than other isolated bacteria and have proportionally low sensitivity.

Conclusion

At the end of this study, contaminating pathogenic bacteria were found on laboratory surfaces and equipment, and the bacterial species isolated were *Staphylococcus aureus, Staphylococcus epidermidis, Escherichia coli, Klebsiella pneumoniae,* and *Pseudomonas aeruginosa*. Some of these bacteria are multi-drug resistant and most of them can survive on dry surfaces for long periods. Due to poor personal hygiene, laboratory workers can become infected with these organisms and pass them on to patients, colleagues, the community, and others. Laboratory workers and other healthcare workers may also hand-infect these organisms in other areas of the healthcare center, such as patient wards and intensive care units, where susceptible populations are found. , which can lead to the spread of these microbes. Lack of infection control programs and regular surveillance of laboratory infections may also act as pathways to the spread of nosocomial infections. Improper cleaning and disinfection of laboratory surfaces and equipment can lead to high levels of laboratory contamination.

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