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Identification And Characterization Of Pathogenic Microorganisms In The Health Environment

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ABSTRACT

Healthcare facilities have the potential to be reservoirs for various pathogenic microorganisms that can cause nosocomial infections. The presence of microorganisms on the surfaces of medical devices, treatment rooms, and ambient air can increase the risk of disease transmission to patients and healthcare workers. This study aims to identify and characterize pathogenic microorganisms found in healthcare environments. The study used a descriptive laboratory design with an observational approach. Samples were taken from treatment table surfaces, door handles, medical devices, and room air using swab and air sedimentation methods. Identification was carried out through culture examination, Gram staining, and biochemical tests. The results showed the presence of pathogenic bacterial isolates such as *Staphylococcus aureus. aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Some isolates showed resistance to certain antibiotics. It was concluded that healthcare environments have the potential to be a source of infection transmission, necessitating strict infection monitoring and control.

Keywords: Pathogenic Microorganisms, Nosocomial Infections, Bacterial Identification, Health Environment





1. Introduction

Nosocomial infections, or healthcare-associated infections, are a global problem that increases morbidity, mortality, and healthcare costs. Healthcare facilities such as hospitals, clinics, and community health centers can become sources of transmission of pathogenic microorganisms if optimal hygiene and sterilization are not implemented.

Pathogenic microorganisms frequently found in healthcare environments include Gram-positive and Gram-negative bacteria, such as *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*. This microorganism can survive on surfaces for a certain period of time and spread through direct or indirect contact.

Characterizing pathogenic microorganisms is essential to determine their morphological and biochemical properties, as well as antibiotic resistance patterns. This information is essential for planning infection prevention and control programs in healthcare facilities.

Based on this background, this study aims to identify and characterize pathogenic microorganisms found in the health environment as an effort to support infection control.

2. Research Methods

This research is a descriptive laboratory study with an observational approach. The study was conducted in the Microbiology Laboratory from January to March 2025.

a. Population and Sample

The study population was all surfaces and air in healthcare facilities. Samples were taken from:

- Treatment table
- Door handle
- Medical equipment (stethoscope, patient bed)
- Room air

A total of 40 environmental samples were collected using the sterile swab method and the air sedimentation method.

b. Examination Procedure

- 1) Samples were grown on Nutrient Agar and MacConkey Agar media.
- 2) Incubate at 37°C for 24–48 hours
- 3) Colony identification based on morphology
- 4) Gram staining to determine the type of bacteria
- 5) Biochemical tests (catalase, coagulase, oxidase, sugar fermentation)
- 6) Antibiotic sensitivity test using disc diffusion method

c. Data analysis

The data were analyzed descriptively by calculating the frequency and percentage of the types of microorganisms found.

3. Research Results And Discussion



**a. Research Result**

This study analyzed 40 environmental samples from various high-risk points in healthcare facilities, including treatment table surfaces, door handles, medical equipment, and room air.

1) Distribution of Microorganisms Based on Sample Location

Sample Location	Number of Samples	Isolate (%)	Dominant Type
Treatment table	10	80%	<i>S. aureus</i>
Door handle	8	75%	<i>S. aureus</i>
Medical devices	12	83%	<i>P. aeruginosa</i>
Room air	10	60%	<i>S. aureus</i>
Total	40	75% positive pathogen	—

As many as 75% of environmental samples were contaminated with pathogenic microorganisms, with the highest contamination found on medical devices and treatment tables.

2) Distribution of Microorganism Types

Types of Microorganisms	Number of Isolates	%
<i>Staphylococcus aureus</i>	12	30
<i>Escherichia coli</i>	9	22.5
<i>Pseudomonas aeruginosa</i>	7	17.5
<i>Klebsiella pneumoniae</i>	6	15
Non-pathogenic	6	15
Total	40	100

Isolate was *Staphylococcus aureus* (30%), which generally originates from human skin flora.

3) Characterization Based on Gram Staining

Category	Amount	%
Gram positive	14	35
Gram negative	26	65

The majority of isolates were Gram-negative bacteria (65%), which are known to have complex cell walls and a higher potential for antibiotic resistance.

4) Biochemical Test





The biochemical test results showed:

- *S. aureus* : catalase (+), coagulase (+)
- *E. coli* : lactose fermentation (+), indole (+)
- *P. aeruginosa* : oxidase (+), does not ferment lactose
- *K. pneumoniae* : lactose fermentation (+), thick capsule

These characteristics confirm species identification based on clinical microbiology literature.

5) Antibiotic Sensitivity Test

Microorganisms Dominant Resistance Sensitive To

<i>S. aureus</i>	Ampicillin	Vancomycin
<i>E. coli</i>	Amoxicillin	Ciprofloxacin
<i>P. aeruginosa</i>	Cefotaxime	Meropenem
<i>K. pneumoniae</i>	Ampicillin	Gentamicin

Some isolates showed resistance patterns to first-line antibiotics, especially the beta- lactam group.

b. Discussion

The study results showed that healthcare facility environments have a relatively high level of contamination with pathogenic microorganisms (75%). This finding indicates that surfaces of medical objects and devices have the potential to act as reservoirs for bacteria that cause nosocomial infections.

Presence of *Staphylococcus aureus* as the most common isolate indicates that contact transmission via the hands of healthcare workers or patients is the primary route of transmission. This bacterium is known to survive on dry surfaces for several days to weeks, increasing the risk of cross-transmission.

Dominance of Gram-negative bacteria such as *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* poses a risk of opportunistic infections, especially in immunocompromised patients. Gram-negative bacteria have a lipopolysaccharide outer membrane that increases resistance to certain antibiotics and disinfectants.

The highest levels of contamination were found on medical devices and treatment tables, which are key touchpoints in patient care. This suggests that sterilization and disinfection procedures may not have been optimally implemented or that cleaning frequency may not have been adequate.

The antibiotic resistance patterns identified are of significant concern. Resistance to first-line antibiotics can increase the risk of treatment failure if infection





occurs. This reinforces the urgency of implementing an antimicrobial program, stewardship and rational antibiotic use policies in health facilities.

Epidemiologically, the results of this study support the theory that the healthcare environment plays a role as an environmental factor in the chain of infection. The interaction between the host (patient), agent (microorganism), and environment (healthcare facility environment) determines the risk of nosocomial infection.

➤ **Practical Implications**

The results of this study provide several important implications:

- Need to increase the frequency and quality of surface disinfection
- Compliance with hand washing procedures must be tightened
- Environmental cleanliness audits need to be carried out periodically
- Antibiotic resistance monitoring should be part of the PPI program

➤ **Critical Analysis**

The high contamination rate indicates that environmental control remains a challenge in healthcare facilities. This study emphasizes that infection control focuses not only on patients but also on environmental cleanliness and medical equipment.

4. Conclusion And Suggestions

a. Conclusion

The environment of healthcare facilities contains various pathogenic microorganisms, especially *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*. Some isolates show resistance to certain antibiotics, potentially increasing the risk of nosocomial infections.

b. Suggestion

- 1) Health facilities need to improve supervision of environmental cleanliness and sterilization of medical equipment.
- 2) Infection prevention and control programs must be strengthened.
- 3) Further research is recommended to examine antibiotic resistance patterns more broadly.

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