Scholars LITERATURE

La Prensa Medica Argentina

Research Article

Volume 106 Issue 5

# Bacterial Contamination of Intensive Care Unit and Other Specialized Units in Al-Hussein Teaching Hospital

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## Abstract

This prospective study aims to identify and compare the incidence of bacterial contamination of hospital units and the distribution of species responsible for the contamination. The study has examined the level of bacterial contamination in these specialized care units in Al-Hussein Teaching Hospital. A total of 270 isolates have been collected and analyzed, 53.7% (n=145) were positive for bacterial growth and Pseudomonas aeruginosa approximately predominate in all the units sampled followed by Staphylococcus aureus 22% (n=32), Enterobacter spp. 20% (n=29), Escherichia coli 14% (n=20), Klebsiella pneumonia 11% (n=16), Acinetobacter spp. 3.4% (n=5), Citrobacter spp. 1.4% (n=2) and the least were Enterococcus spp. and Proteus spp. 0.7% (n=1). The relatively low level of bacterial contamination of the air compared to the high level with equipment and objects indicates the need for periodic microbiological surveillance aimed at early detection of bacterial contamination level.

**Keywords:** Bacterial contamination; Operating theatre; Burn unit; Intensive care unit; Recovery room

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**Citation:** Zainulabdeen SMS, Alzyad MMB, Jabbar AA (2020) Bacterial Contamination of Intensive Care Unit and Other Specialized Units in Al-Hussein Teaching Hospital. Prensa Med Argent, Volume 106:5. 222.

**Received:** March 12, 2020; **Accepted:** March 28, 2020; **Published:** April 02, 2020

## Introduction

Microbial contamination is the most influential parameter in health care environments. In the hospital environment, especially the operating theatre and other specialized units had continued to increase the prevalence of nosocomial infection [1,2]. With the resultant effect of high morbidity and mortality rate among patients on admission for post-operative surgery, those in intensive care units with multi-drug resistant strain like methicillin-resistant Staphylococcus aureus (MRSA) and difficulty in infection control [3]. In a hospital setting, reduction of microbial contamination impact depends primarily on improved cleaning and proper disinfection of the hospital environment, especially high-risk areas, as these measures are crucial to stemming down the dissemination of these microbial contaminations. Source of microbial contamination is diverse, from surgical/medical team, movement within the units, theatre gown, foot wares, gloves and hands, drainage of the wounds, transportation of patients and collection bags [4].

It was previously shown that stethoscopes, white coats, keyboards, faucets, mobile phones, writing pens, case notes, medical charts, and even wristwatches can be contaminated by environmental or pathologic microorganisms such as methicillin-resistant *S. aureus* (MRSA), vancomycin-resistant enterococci (VRE), Pseudomonas aeruginosa, and Klebsiella pneumonia. [5,6]. Such opportunistic or causative pathogens can be found on the surfaces of these personal belongings and facilities within the wards [7-9].

The intensive care units (ICU) is often called the epicenter of opportunistic infections with 25% of all healthcare-associated infections (HAI) occurring in ICU patients, resulting in increased morbidity, mortality and healthcare costs [10,11]. ICU patients have an increased risk of HAI due to their underlying conditions, impaired immunity, exposure to multiple invasive devices that bypass and disrupt patients' protective barriers (for example, urinary catheters), and the administration of drugs that can predispose patients to infection [12], however, there are few studies on bacterial contamination of hospital medical charts, and two of these reports are a brief report and a letter, respectively [13], therefore, the present study measures bacterial concentrations in different units in the hospital.

## Materials and Method

**Sampling collection:** A total of 270 samples were collected for microbiological analysis at different hospital units between January 1, 2019, to December 31, 2019. Certain hospital units (Burn unit, ICU, Recovery room, and Operating theatre) were used for bacteria swabs collecting.

**Microbiological procedures:** After field sampling, the swab sticks were inoculated on sterile blood agar and MacConkey plates, and the open plates were incubated at 37°C for 24 h. After incubation, bacterial colonies were identified by standard bacteriological procedures [14].

Antibiotic susceptibility testing of the bacterial isolates was determined. Typing is based on phenotype properties such as the ability to grow on various culture media (using the different substrate for energy harvesting), antibiotic -susceptibility, growth in various oxygen concentrations or with carbon dioxide in the micro-atmosphere, The VITEK 2 system analyses the data results and determines the identity of the tested bacteria based on colorimetric tests (biochemical reactions).

## Result

Of the 270 samples examined ,53.7% (n=145) yielded positive bacterial growth, The distribution of bacterial pathogens isolated is presented in (Table 1), *Ps. aeruginosa* accounted for 27% (n=39), followed by *S. aureus* 22% (n=32), *Enterobacter spp.* 20% (n=29), *E. coli* 14% (n=20), *K. pneumonia* 11% (n=16), *Acinetobacter spp.* 3.4% (n=5), *Citrobacter spp.* 1.4% (n=2) and the least were *Enterococcus spp.* and *Proteus spp.* 0.7% (n=1). The distribution of bacterial pathogens within the operating theatre and other specialized care units is presented in (Table 2), *Ps. aeruginosa* approximately predominate in all the units sampled, 23.3% (n=7) in the operating theatre (OT), 31.4% (n=11) in Burn unit (BU), 33.3% (n=11) in intensive care unit (ICU) and 21.3% (n=10) in Recovery room(Rec). S. aureus was 36.7% (n=11) in the OT, 22.9% (n=8) in BU, 9% (n=3) in (ICU) and 21.3% (n=10) in Recovery room. Enterobacter spp 13.3% (n=4) that founded in the OT, 17.14% (n=6) in BU, 27.3%(n=9) in (ICU). *E. coli* was 20% (n=6) in the OT, 8.6% (n=3) in BU, 9%(n=3) in (ICU) and 17%(n=8) in Recovery room. *K. pneumonia* was 3.3% (n=1) in the OT, 11.4% (n=4) in BU, 15.15%(n=5) in (ICU) and 12.8% (n=6) in recovery room. *Acinetobacter spp.* was 3.3% (n=1) in the OT, 6% (n=2) in (ICU) and 4.3% (n=2) in recovery room. *Citrobacter spp.* was 0.1 %(n=1) in the BU and 2.1% (n=1) in recovery room. *Enterococcus spp.* and *Proteus spp.* that were isolated in burn unit 2.9% (n=1).

The previous study showed that *Ps. aeruginosa* may be transmitted from contaminated sinks to hands during hand washing [15]. While survival on dry surfaces may only be transient, persistent reservoirs of these organisms can be traced to biofilm adherent to surfaces on sinks, sink traps, pipes, water lines, and hospital drains [16]. Biofilm is made up of a multifaceted matrix of living organisms, which contaminates internal plumbing and provides a long-term reservoir for water-associated organisms, including pathogens. The biofilm structure itself is resilient and situated on multiple surfaces inside traps, pipes, and internal water filters. bacteria are also likely to demonstrate an increased capacity for antimicrobial resistance [17].

**Table 1:** Bacterial pathogens isolated and frequency of occurrence.

| Organism | Frequency (%) |
|---|---|
| *Pseudomonas aeruginosa* | 39(27%) |
| *Staphylococcus aureus* | 32(22%) |
| *Enterobacter spp* | 29(20%) |
| *Escherichia coli* | 20(14%) |
| *Klebsiella pneumonia* | 16(11%) |
| *Acinetobacter spp* | 5(3.4%) |
| *Citrobacter spp.* | 2(1.4%) |
| *Enterococcus spp* | 1(0.7%) |
| *Proteus spp.* | 1(0.7%) |
| Total | 145(100) |

**Table 2:** Distribution of bacterial pathogens isolates from operating in theatre and other specialized care units sampled.

| | OT | ICU | BU | Rec | Total |
|---|---|---|---|---|---|
| *Pseudomonas aeruginosa* | 7 | 11 | 11 | 10 | 39 |
| *Staphylococcus aureus* | 11 | 3 | 8 | 10 | 32 |
| *Enterobacter spp* | 4 | 9 | 6 | 10 | 29 |
| *Escherichia coli* | 6 | 3 | 3 | 8 | 20 |
| *Klebsiella pneumonia* | 1 | 5 | 4 | 6 | 16 |
| *Acinetobacter spp* | 1 | 2 | - | 2 | 5 |
| *Citrobacter spp.* | - | - | 1 | 1 | 2 |
| *Enterococcus spp* | - | - | 1 | - | 1 |
| *Proteus spp.* | - | - | 1 | - | 1 |
| Total | 30 | 33 | 35 | 47 | 145 |
| OT=Operating theatre, ICU=Intensive care unit, BU=Burn unit, Rec=Recovery room | | | | | |

Evidence that near-patient surfaces in hospitals could host methicillin-resistant *S. aureus* (MRSA) was put forward by [2,18]. This study also showed that health care staff could contaminate their gloves by handling or touching sites near patients colonized with MRSA. This contrasts with a study published 16 years later, showing that thorough cleaning failed to reduce health care worker gown and glove contamination after caring for patients with MRSA (and multidrug-resistant *Acinetobacter spp.* [18].

One further study provides evidence to support the importance of cleaning in controlling outbreaks of Acinetobacter [15]. As with most of the studies described, this outbreak also occurred in an ICU, and an extremely resistant outbreak strain resisted carbapenem antibiotics. Carbapenem-resistant A. baumannii was grown from multiple environmental samples during the outbreak, including a mattress, a vital signs monitor, near-patient horizontal surfaces, computer components, and a glucometer.

Hospital sinks represent one of the most frequently implicated reservoirs for MDR Gram-negative bacilli, including MDR coliforms [19,20]. *K. pneumoniae* strains demonstrating prolonged survival within plumbing components are also more likely to harbor extended-spectrum-lactamases [17]. Persistent reservoirs of resistant *K. pneumoniae* were detected from multiple sites associated with a contaminated sink in a large Scottish hospital [21].

## Conclusion

The resultant effect of bacterial contamination is much more pronounced in post-operative /or open wounds that could occur during dressing or contaminated air atmosphere in the operating theatre and other specialized units.

In conclusion, the high level of bacterial contamination in the sampled units, particularly with the equipment and objects used calls for prompt attention and intervention measures. This measure is achieved by improvement in the cleaning and disinfection procedures and sometimes needs for periodic fumigation of the units. The importance of clean hospitals has not been widely accepted as a key component in infection control despite the increasing interest in HAI during the latter part of the 20$^{th}$ century. Now it is finally receiving the attention it deserves.

This is to be welcomed since it is quite possible that accumulating data on environmental reservoirs and pathogen transmission in health care environments will also benefit healthy people in their homes and the community at large. Furthermore, with the advance of antimicrobial resistance increasing for virtually all pathogens, the science underpinning infection control, including cleaning, will attain a status hitherto unrecognized. Preventing the transmission of pathogens will be the focus of the 21$^{st}$ century unless we rapidly find alternative methods for treating infection other than antimicrobial chemotherapy. Reduction in antibiotic usage is generally beneficial for the bacterial ecology of the hospital and ICU cost containment.

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