Microbial Sampling and Analysis Taken from Fingerprint System Devices Located at Al-Yarmouk Teaching Hospital in Baghdad - Iraq

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KEYWORDS
finger print device, biometric scanner, Bacteria, Fungi contamination, Hospital, Antimicrobial.

ABSTRACT:
Biometric devices (BDs) are nowadays common in use for a variety of purposes. This system involves physical contact between the skin and surface of the device, which is likely to be contaminated by microorganisms of multiple users. However, it can be a source of multiple microbiological contaminations.
This study was done at AL-Yarmouk Teaching Hospital-Baghdad- Iraq, during the period started from 15th November 2023 till 15th March 2024. It was designed to find out the most common bacteria and fungi that might contaminate the fingerprint devices and performing antimicrobial susceptibility tests. Forty-six sterile swab samples taken from Twenty-three fingerprint system devices distributed in twelve different hospital departments. From each device we took two swabs, one before sterilization other after, and tested sensitivity patterns against 16 antimicrobials.
Four Gram positive bacteria scored on fingerprint devices, in Medicine, Surgery, Orthopedics and Obstetrics & Gynecology departments represented by Coagulase-negative Staphylococci (CoNS). Response to sensitivity test for antibiotics, especially Moxifloxacin, Linezolid, Teicoplanin, Vancomycin, Tigecycline and Rifampicin, 100%, as well other antibiotics but in varying degrees, and not any type of fungi were isolated.
In conclusion, Gram positive bacteria population was the most common organisms, and highly response in varying degrees to the most Sixteen antibiotics used in sensitivity test, however, should proper maintenance and educational practices must be applied to minimize contamination.

1. Introduction

Biometric devices (BDs) are the integral component of the present-day lifestyle, and their use has grown spreading rapidly to enter different institutions to mark attendance, withdraw money, to pay bills and for availing various services and to enter and exit airports and seaports to ensure the identity. (D'Onofrio et al., 2010; Cepas et al., 2019; Dumaru et al., 2019).

Hospitals are one of these institutions where the biometric fingerprinting devices can serve as an environmental vehicle for transmission of pathogens as well as a commensals source of microorganisms from one user to subsequent users, it could be a vehicle of nosocomial infections. (Olise and Simon-Oke,2018) because latent prints left on the scanner surface by the deposition of finger moisture perspiration or oils can contaminated the surface of this devices (Gomez-Barrero et al., 2022).

Study in 2019 conducted on fingerprint scans in hospitals have led to the discovery of 40 species of, Gram positive bacteria, pneumococci and strains of Enterococcus faecalis have been detected(Singh et al.,2019), In the same context, Okereafor and et al announced that the unclean fingers could leave the bacteria , fungi and viruses on the surface of the scanner after use, thereby increasing the possibility of transmitting germs that cause illnesses , which is predominantly spread via droplets and contaminated hands or surfaces (Okereafor et

al., 2020). From the study in 2022 revealed, whether or not microorganisms exist on the surface of biometric devices, as well as the types of the microbes by determining the bacteria growth and identification, especially the Gram-negative bacteria are resistant to multiple drugs and are increasingly resistant to the most available antibiotics (Nazri et al., 2022).

The use of disinfectant in biometric finger printing device may could reduce the risk of the bacteria resistance in biofilms for most of the antibiotics and disinfectants (D'Onofrio et al., 2010; Dumaru et al., 2019) at the same time, regular use of these disinfectant could be more dangerous cause they induction of drug-resistance in biofilm-forming microbes (Kaplan, 2011; Nhung et al., 2015; Ebrahimi et al., 2017). Nevertheless, study of Norton and et al recorded, no bacterial growth in 10% of the devices after disinfection with 70% alcohol and in 78.9% of devices after disinfection with isopropyl alcohol chlorhexidine. (Norton et al., 2021)

The Aims

1-To detect the presence of microbial contaminants on the fingerprint system Machines at AL-Yarmouk Teaching Hospital in Baghdad- Iraq, before and after sterilizations.

2-Performing culture to diagnose bacterial isolates with conducting antibiotic sensitivity tests.

3-Direct examination (wet test) of the swabs to confirm if fungi are there.

2. Materials and Methods

This study designed over a period of 4months, from 15th November 2023 till 15th March 2024 to reflect the rate/level of the microbiological contamination of the fingerprint system devices at AL-Yarmouk Teaching Hospital in Baghdad -Iraq.

2.1. Samples collection

Forty-six sterile swabs moistened in sterile normal saline (Sodium Chloride, 0.9%) were used to take samples from the Twenty-three fingerprint system devices distributed in twelve different hospital departments. Each device two swabs taken, one before sterilization and one after by used 70% Alcohol M.P.C. (Based Rapid Spray Disinfectant for all types of surfaces, bactericidal, fungicidal, virucidal) which is used in the same hospital, Samples collection were performed according to Pluta (Pluta et al,2013).

2.2. Media preparation

The culture media were prepared by using the MediaClave and MediaJet (Integra-Biosciences KK-/Japan). This system can process up to 1100 INTEGRA Petri dishes in a single hour and provides truly fast and reliable walk-away operation media. It is Equipped with a UV lamp, and the filling chamber where Petri dishes are automatically filled with agar medium which is kept free from c o n t a mi n a t i o n. (h t t p s: / / w w w. I n t e g r a b i o s c i e n c e s .com/Japan/en/media-preparation/mediajet). The media used in this study include blood agar, chocolate and MacConkey agars

2.3. Bacteriological analysis

Inoculation of all the swabs on Blood agar and MacConkey agar, were incubated at 35-37°C aerobically for 24 hours while chocolate agar was incubated at 35-37°C for 72 hours under 5-10% CO2 concentration to give chance for microaerophilic fastidious bacteria growth (Jawetz et al. ,2019). Plates were examined daily for bacterial growth, identifying these isolates by using colony morphology, Gram strain of bacteria drawn from bacterial colonies.

Species identification was then carried out using matrix-assisted laser desorption ionization time-of-flight mass spectrometry on a VITEK®2 Compact ID/AST cards device (Biomerieux /France) according to the manufacturer's instructions (Scheer et al., 2019). VITEK®2 Compact device could offer platform for phenotypic identification methods to /more than 300 species of organisms (Gram Positive, Gram Negative, Neisseria and Haemophilus bacteria).

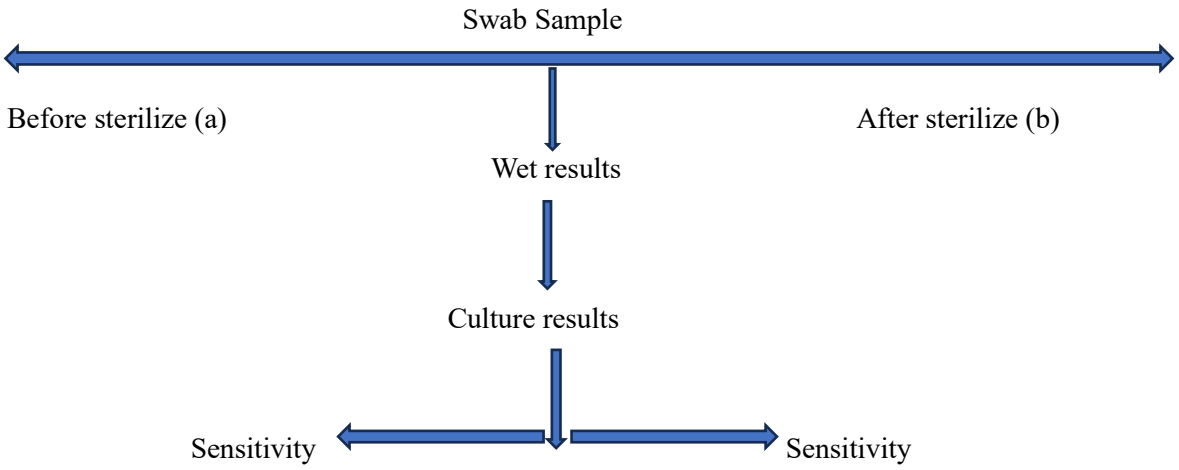
Moreover, this device provided an option of automatic pipetting and dilution for antimicrobial susceptibility testing and all the positive samples for bacterial growth in this study were subjected to antimicrobial susceptibility test, these results coupled with Biomerieux advanced expert system provide an optimal level of clinically relevant information.

2.4. Questionnaire design

The questionnaire was used to determine their white coats maintenance and handling practices (see the design below)

Sample number

Fingerprint punch unit:



3. Results

A total of 46 swabs (before and after sterilization) were taken from the 23 fingerprint devices in twelve different hospital departments, the samples taken before disinfection, only 4 swabs (8.7%) were reported positive results from the 46, while 42 swabs (91.3%) showed negative results. All samples taken after disinfection were sterile

In this study(table-1) recorded the lowest contamination rate in fingerprint devices in different departments, which only seen in Medicine, Surgery, Obstetrics & Gynecology and Orthopedics, moreover, these positive swabs were represented by the Gram-positive bacteria isolates

Table 1: Represent the total swabs were collected from fingerprint devices in different hospital departments with the positive bacterial growth

Departments	No. of finger print devices	No. of swab	No. of bacterial growth
Medicine	2	4	1
Surgery	3	6	1
Orthopedics	2	4	1
Emergency	3	6	-
Burns unit	1	2	-
Radiology	1	2	-
Obstetrics & Gynecology	1	2	1
Laboratories	4	8	-
Administration	1	2	-
Blood donation center	1	2	-
Consultation clinics	3	6	-
Blood bank	1	2	-
Total	23	46	4

Table- 2- Total positive swabs for bacterial cultures collected from fingerprint devices in different hospital departments and their percentages during the studied period

Department		Total swabs	Bacterial isolates%	
	Bacterial isolates		Before (+ve)	After
Medicine	Staphylococcus hominis	4	1(25%)	-
Surgery	Staphylococcus epidermidis	6	1(16.7%)	-
Obstetrics & Gynecology	Staphylococcus haemolyticus	2	1(50%)	-

Orthopedics	Staphylococcus hominis	4	1(25%)	-
Total		16	4(25%)	-

Throughout the study period, we came to found that Staphylococcus epidermidis and Staphylococcus haemolyticus showed equally in numbers (only one isolate) in Surgery and Obstetrics & Gynecology departments respectively, while, Staphylococcus hominis recorded two isolates found in Medicine and Orthopedics departments (one isolate for each them), table 2. Out of total 16 swabs were taken from fingerprint devices determined only four Gram positive bacteria isolates (25%), and the high percentage isolate was Staphylococcus haemolyticus (50%), followed by Staphylococcus hominis and Staphylococcus epidermidis (25%), (16.7%) respectively.

In table- 3, bacterial isolates exhibited a high frequency of sensitive (100%) to most of common antibiotics such as: Moxifloxacin, Linezolid, Teicoplanin, Vancomycin, Tigecycline ,Rifampicin, and moderate frequency of sensitive(75%) for Gentamycin , Tobramycin, Levofloxacin , Clindamycin, Trimethoprim / sulfamethoxazole, while Tetracycline showed less frequency of sensitive (14.3%), nevertheless, bacterial isolates reviled completely resistant to the other antibiotic used in this work, Benzylpenicillin, Oxacillin, Erythromycin and Fusidic acid.

Table 3: Antibiotics sensitivity test of the Staphylococcus species isolated during this study

Antibiotics n=16	Staph. hominis	Staph. epidermidis	Staph. haemolyticus	Staph. hominis	
	Medicine n=1	Surgery n=1	Obst& Gyne n=1	Orthopedics n=1	Total=4
Benzylpenicillin	-	-	-	-	-
Oxacillin	-	-	-	-	-
Gentamycin	1	1	-	1	3
Tobramycin	1	1	-	1	3
Levofloxacin	1	1	-	1	3
Moxifloxacin	1	1	1	1	4
Erythromycin	-	-	-	-	-
Clindamycin	1	-	1	1	3
Linezolid	1	1	1	1	4
Teicoplanin	1	1	1	1	4
Vancomycin	1	1	1	1	4
Tetracycline	1	-	-	1	2
Tigecycline	1	1	1	1	4
Fusidic acid	-	-	-	-	-
Rifampicin	1	1	1	1	4
Trimethoprim/sulfamethoxazole	1	1	1	-	3

4. Dissection

The hospital environment, medical instruments and health care staff considered as a reservoir of potential pathogens that colonized by microorganisms which can cause infections. Bacteria could be survived up to months on dry inanimate surfaces and could be transmitted to the patients or visitors through the hand when contact with contaminated medical devices. (Sserwadda et al, 2018).

In this study, when samples taken before sterilization from the 23 fingerprint devices in different hospital departments, 4 out of 23(17.4%) were reported positive results, while 19(82.6%) showed negative results, Our study findings are supported by a similar study done in 2017 , which reported a total of 14 biometric devices were studied for bacterial contamination, 2 out of 14 (14.28%) yielded bacterial growth, while 12 (85.7%) no growth (Banu et al ,2017). But our study results did not match other studies which recorded that, samples were collected from the 25 biometric devices, out of 25 swabs 15 (60%) were positive growth of bacteria, but 10 (40%) negative result (Jogender and Gupta ,2019). In the same context, another study in 2021 showed, that all existing biometric identification devices in the hospital ,20 have been (100%) identified different bacterial species which is a high percentage compared with our results (Norton et al, 2021). These results exemplify by the study in 2020 which illustrated, that hands contact with a contaminated surface can result in different levels of potential microbial transfer from the surface to the hands and vice versa, as well, the variance in positive

samples number from one place to another because of differences in the number of users. (Okereafor et al, 2020).

Our results showed, out of 64 swabs were taken from the fingerprint devices , only 4 swabs (8.7%) were positive results while 42 swabs (91.3%) showed negative results which was lowest than the other studies from Nirupa et al and Suhag et al in 2016 published , 39(46%) and 10 (33%) of the samples were culture positive out of the total number of swabs 84 and 30 respectively (Nirupa et al,2016)(Suhag et al, 2016), in the same context, Funmilayo study in 2021 who found from totally 221 samples , 203 (92%) containing microbial organisms grew (Funmilayo etal,2021)

Our study showed that only four Gram positive bacteria were isolates represented by : two Staphylococcus hominis(1.9%) followed by one for each of Staphylococcus epidermidis and Staphylococcus haemolyticus (0.9%) percentage, which are low score results when compared with previous studies in India that showed among culture positives the coagulase-negative Staphylococcus (CoNS) species (49%) were the most common organisms, Gram-positive bacilli (44%) and Gram-negative bacilli (7%) (Nirupa et al, 2016), also (Suhag et al, 2016) scored ,out of 30 samples evaluated growth ten of Staphylococcus aureus(33.3%), followed by studies in 2019 incompatible with our results when Singh and et al scored Gram-positive bacteria were detected on all 17 finger print scanners in addition to 18 Gram negative bacteria (Singh et al, 2019) and Jogender with et al founded samples collected came positive for S. aureus(42.1%), CoNS (36.9%),Klebsiella pneumoniae (10.5%) and Pseudomonas aeruginosa (10.5%) (Jogender and Gupta, 2019) , on the other hand, in Portugal Norton and et al published ,mostly S. epidermidis 32 (41%) followed by S. aureus 7 (8.9%)were isolated (Norton et al ,2021), furthermore, study in Nigeria detected that out of 221 total samples ,(92%) containing microbial growth, bacteria isolated included: Staphylococcus aureus (29.6%)as well as Gram negative bacteria (Funmilayo et al, 2021). Olise with his team pointed out, most infections outbreak that associated with inanimate objects are as a result of items that should be sterile, but it is contaminated by pathogens (Olise and Simon-Oke, 2018) , also (Jogender and Gupta,2019) mention, the biometric fingerprinting system is frequently used for identification and attendance, so, when health care workers use these devices, it may play a possibility route of infectious organism transmission and lead to Hospital Acquired Infection, in simultaneously,(Samad et al, 2022) confirmed ,strict adherence to control like this infection through : wash hands by soap or disinfected agents, installing antiseptic agents near the finger-print device, disinfection of high-touch areas, with hospital workers health awareness ,likely to lower these risks ,and may help to minimize Hospital Acquired infection.

The susceptibility patterns were varied from one bacterial isolate to another depending on the type of antibiotics. The susceptibility tests against 4 genus of Staphylococcus isolates and 16 commercially antibiotics, were available at that time. The current study shows highly to moderate frequency of Staphylococcus sensitive to the antibiotics 6(100%) and 6(75%) respectively, at the same time, bacterial isolates reviled, completely resistant to the other rest 4 antibiotic which are used in this work, these result when compared with Singh and et al study published, all 22 isolates of Staphylococci were resistant to Linezolid ,Methicillin, Vancomycin, and Oxacillin and 20 had multiple drug-resistance were detected in finger print scanners ,our study agreement only with Linezolid consequence (Singh et al, 2019). Our finding corresponding with (Funmilayo et al, 2021) almost with Staphylococcus CoNS antibiotic sensitivity test results, but not conformable with other outcome about Gram negative bacteria and the fungi because nor bacteria neither fungus was isolated in present study. Direct contact on the scanner surface can increase the chances of either acquiring or depositing harmful contagions, as well as ,rate of use and site of the device when a large number of people using a single machine , personal hygiene of the users, virulence of the microbe, and dose of infective microbes, immunity level of the individual, relative humidity, temperature , biofilm formation , and contaminated hands through food or water .For all above may play an important role for cross-contamination through biometric devices.

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5. Conclusions

Present study indicated that, lower bacteria population in general, which was represented by four Gram positive isolates as the most common organisms from Twenty-Three fingerprint system Machines in Twelve different Departments from AL-Yarmouk Teaching Hospital, which represented by Coagulase-negative Staphylococci (CoNS) and it's safer regardless of the products used for its cleaning. The majority of the bacteria found are commensal skin microorganisms, it turns out, highly response in varying degrees to the most Sixteen antibiotics used in sensitivity test, which is a good and interesting. Furthermore, after methodical cleaning and disinfection of finger print system, not any bacterial or fungal contamination was detected. We conclude that disinfection and sterilization materials which is used in the hospital, are clearly effective, in addition to the extent of personnel hygiene and health awareness of our hospital workers.

6. Recommendations

Biometric fingerprinting system in the hospital could be a point of transmission bacteria to health care workers, patients and community which is among the most significant public health problems in the world due to their resistance to antibiotics.

We Recommend:

-Change the use of biometric devices to more safer techniques, to avoid the spread of microorganisms in these workplaces and probably our community, such as using the online attendance system or using staff I.D. card for punching or the use of Eye Scanner devices.

-Further research studies are required in other different hospitals to evaluate the possibility roles of these fingerprint system devices in the transmission of bacteria and fungi.

-The need for sanitization & training regarding hand hygiene practicing, among healthcare workers and regular cleaning of inanimate objects like Biometric device for reduction the rate of hospital acquired infections.

-Healthcare professionals should wash and disinfect their hands carefully before touch their patients.

-Installing hand disinfectants with proper antiseptics near these devices is recommended to reduce contamination with using biometric fingerprinting clocking devices.

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Conflicts of interest

All authors reported no conflicts of interest as relevant to this article.

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