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EVALUATION OF TRANSIENT MICROBIAL FLORA ON BIOMETRIC SYSTEMS OF HEALTH-CARE PROFESSIONAL AS A POTENTIAL SOURCE OF INFECTION IN TERTIARY CARE HOSPITALS- INDIA

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ABSTRACT
Biometric system is a device used as a scanner to verify the identity of human beings by measuring the patterns of their behavioral or physiological characteristics. Some biometric systems are contactless and do not require direct touch to perform these measurements and others such as fingerprint verification system, require the user to make direct physical contact with the scanner for a specified duration for the biometric pattern of the user to be properly read and measure the identity.

Therefore they may increase the possibility of contamination with pathogenic microorganisms and can cause Hospital Acquired Infection.

The purpose of this Study was to evaluate the Transient microbial flora on Biometric system of health-care professional as a potential source of infection in hospital settings. The Analytical study was conducted in the Department of Microbiology, attached to a Tertiary Care Hospital in central India over a time period of two months after obtaining ethical clearance.

Ten out of 30 samples evaluated showed growth of *Staphylococcus aureus , of which* 7 (70%) were MRSA & 3 (30%) MSSA when tested using *Cefoxitin* Disk Diffusion Test. MRSA strain were resistant to *Erythromycin, Ampicillin, Clindamycin & Cefepime* and both MRSA & MSSA strains were sensitive to *Co-trimoxazole*. Biometric devices of Medical hospital were found to be carrying the pathogenic microorganisms more than that of Dental hospitals and that too which were being used by Para-clinical faculties.

Present study highlights the need of sensitization & training sessions regarding hand hygiene practices among health care professionals and regular cleaning of inanimate objects like Biometric devices for reduction of HAIs and other severe infection like COVID-19.

INTRODUCTION

Biometric system is an identification system used to identify personnel, grant authorized access to offices and hospital settings, and maintain the accurate records of staff's attendance [1].

Fingerprint authentication is one of the most reliable, popular and publicized biometric technology. The primary purpose of fingerprint recognition or identification systems is to provide trustworthy verification of users to control access to resources such as computers as well as to critical facilities such as offices and hospitals. These systems also provide useful data for generating summary, periodic reports on usage statistics [2]

It is important to note that skin surface serve as a habitat for variety of commensal microorganisms predominantly Gram positive bacteria. In addition to it, skin surface of health-care professionals are being colonized by pathogenic bacteria that are contracted through their contact with the patient.[3]

Several factors influence the survivability of microorganisms on environmental surfaces.[4] Most microorganisms survive for more than 30 minutes on the hands and with regular hand hygiene practices it can be controlled [5], but many bacterial pathogens on non-living objects can survive for days to weeks, becoming an exogenous source of infection in Hospital Associated Infections (HAI)[4]

Most common Gram positive bacteria transmitted through health-care professionals contact are *Staphylococcus aureus*, *Pseudomonas aeruginosa* & *Acinetobacter baumannii* and their resistant variants like Methicillin Resistant *Staphylococcus Aureus* (MRSA), Vancomycin Resistant *Enterococcus* (VRE) whereas multidrug resistant Gram negative bacteria are also not uncommon. These microorganisms have the ability to survive in dry-surface environment, which may then become a source for transmission detected by Jonathan A. Otter,Saber Yezli *et al 2011.*[6]

Now a days almost all Health Care Professionals are coming in contact with Biometric system on day to day basis at least twice a day or somewhere four times in a day to mark their attendance.

Various studies shows that the surface of biometric system serve as a potential source of transmission of infection. Thus the study was undertaken to find out transient microbial flora on biometric system along with antibiogram of the pathogenic microorganisms, which might get transmitted from one physician to another causing HAI or other COVID-19 like infections.

MATERIAL AND METHODS:

This Prospective Analytical study was conducted in the Department of Microbiology, attached to a Tertiary Care Hospital in India Over a time period of two months from 1st August to 31st October 2015 after obtaining Ethical Clearance.

A total of 30 Biometric systems of 1 Medical and 2 Dental Colleges in use by health care professionals were included in this study.

Collection of Samples:

Samples were collected using a sterile cotton swab (Hi-Media Pvt.) moistened with Sterile distilled Water from all the Biometric systems by rotating the swab on the area of finger contact for 5 to 10 seconds and were transported immediately to the Microbiology laboratory for further processing. Samples were inoculated on Blood agar and MacConkey agar & incubated at 37 °C for 24 hours. Direct smear examination after Gram staining were also observed to rule out contaminants to eliminate bias.

After 24 hours of incubation, the isolated organisms were identified using the standard microbiological procedures like colony morphology, Gram staining and biochemical reactions. [7] Antibiotic sensitivity pattern of the identified organism was done according to CLSI guidelines.[8]

RESULTS

A total 30 samples collected from all respective areas. out of the thirty samples 12, 8 & 10 samples were taken from Group I: Medical College, Group II: Dental Sciences III: Dental Academy & teaching Group respectively. Each group is further divided in to 3 study units - Clinical©, Para-clinical (PC) & Pre-clinical (PC) units.

Out of 30 samples, 10 (33%) sample were culture positive. The distribution of culture positive samples in different units of the 3 groups is shown in Table 1.

Out of total 10 positive samples, 4 samples (40 %) were culture

positive from Para-clinical followed by 3 each (30%) from Clinical & Pre-clinical units.

All ten isolated microorganisms on biometric system were *Staphylococcus aureus.* Out of 10 isolated *Staphylococcus aureus*, 7 (70%) were found to be MRSA (Methicillin resistance *Staphylococcus aureus*) & 3 (30%) were MSSA (Methicillin sensitive *Staphylococcus aureus*) when tested for Methicillin resistance using Cefoxitin Disk Diffusion Test. Antibiotic resistance pattern of the all isolates are shown in Table 2.

The culture positivity was compared between two Groups (Group I & Group III) by using Pearson's Chi-square test & statistically significant difference was observed between the two with p value of 0.0034. Whereas the difference of growth between the Group I & Group II was not found to be statistically significant. We also compared Medical college with Dental colleges and statistically significant difference were observed (Table 3)

DISCUSSION:
As I mention above Biometric system is becoming a new tool for spreading the HAIs now a days. A Culture positivity of 33.33 % was observed in our study whereas study done by Christine R. Blomeke (2007) reported 0.10**%** culture positive in Biometric device which is very contrasting. It may be because of difference in countries, and health care facilities.[7]

Similar study done by Chigozie J.Uneke *et al* (2010) reported 78.5% culture positive by other inanimate objects like stethoscopes.[9] Other finding observed by Bhoj Raj Singh *et al,* 58 bacteria (18 GNBs, 40 GPBs) culture positive by Biometric device.[10] Around 40 % samples were culture positive from biometric samples used by Para-clinical personnel's. In study done by Chigozie J., Uneke *et al* (2010), out of 84 positive samples,59(80.8%) samples were culture positive from Clinical units followed by 25 (73.5%) samples were Pre-clinical units.[9] It may be because pre- clinical personnel not come in contact with patients. In both the studies inanimate objects were observed to be harboring the microorganisms which might contribute to spread of HAI. This difference may be due to lack of awareness & practicing hand washing techniques in Para-clinical units in our study area. Failure to wash hands could facilitate the transfer of pathogens on devices that health workers use frequently, such as inanimate objects like stethoscopes, Pen, computer keyboards, biometric systems etc.

Staphylococcus aureus (n=10) was the only isolate with around 70% being MRSA. In other study done by Chigozie J.,Uneke *et al* (2010), *Staphylococcus aureus* was commonest isolate (53%) followed by *Pseudomonas aeruginosa* (19.0%) ,*Enterococcus faecalis* (14.3%) and *Escherichia coli*(13.0%) from other inanimate objects like stethoscopes.[9]

In similar study done by Singh BR, Vinodhkumar *et al* (2019), *Staphylococcus aureus* was commonest isolate in Gram positive bacteria's followed by other Gram positive bacteria and then Gram negative bacteria.[10]

In 2000, in an excellent study in an adult intensive care (ICU), Bures *et al* cultured a number of microorganisms, including MRSA, *Enterococcus* and *Enterobacter* from other inanimate objects like computer keyboards.[11]

Various studies have shown MRSA infection as the most common problem from inanimate objects. It may be due to health workers harbor/colonize MRSA on their hands/skin/ nasopharynx which serve as a reservoir of MRSA that may spread to other health workers with subsequently contact.

HAI associated MRSA are frequently resistant to a range of antibiotics including penicillin group which hinders the effective eradication of MRSA strains.[11]

MRSA strain are the strains of *Staphylococcus aureus* having chromosomally mediated resistance gene *MecA* that code for a unique penicillin binding protein PBP2a not affected and offering resistance to beta lactamase group of drugs Penicillin (methicillin, dicloxacillin, nafcillin, Oxacillin etc.), Cephalosporins like cephalexin, cefuroxime & Ceftriaxone, Monobactams like Aztreonam, Carbapenems like Imipenem. Although predominantly a hospital pathogen, MRSA is becoming more common in community i.e community acquired

MRSA strains(CA-MRSA). MRSA restricted to hospital setting are named hospital acquired MRSA strain (HA-MRSA). Hospital personnel harboring MRSA have been implicaticated as the chief source of nosocomial infection.[12]

Control measures like hand washing, routine screening of healthcare workers and disinfection of biometric device with isopropyl alcohol/ chlorhexidine should be done to minimize HAIs or spreading of other infections Like COVID-19 .

Most emphasizing point in our study, all of the ten MRSA isolates were found high susceptibility to Co-trimoxazole (67%). A recent multicenter report from several hospitals shows an increased in Co-trimoxazole susceptibility among MRSA isolates.[12,] Several factors may have influenced the emergence of *Co-trimoxazole* sensitive MRSA, including reduced usage of the drug in our institution. In setting where *Co-trimoxazole* is extensively used, a substantial increase of MRSA resistance to *Co-trimoxazole* has been observed, for eg: Martin *et al.* described a serial cross-sectional study of resistance to *Co-trimoxazole* among all clinical isolates of *S. aureus* and other *Enterobacteriaceae* during a 16-year period at San Francisco General Hospital.[13]

Cost-effective antimicrobial drug for treating MRSA infections in our hospital settings. Our study shows that, Biometric device might act as fomite playing an important role in the transmission of potential pathogenic organisms, as well as spread of antibiotic –resistant strains in the hospital environment. Screening of Health Care Workers for carriage of MRSA strains and their susceptibility pattern needs to be evaluated further with effective decolonization strategies for MRSA strains to reduce the HAI and other spreading infection like COVID-19

The attitude & practice of hand hygiene amongst the Pre-clinical and clinical faculties may be the reason for less flora on the inanimate objects in Dental groups again emphasizing the need for regular sensitization and training for hand hygiene practices Medical College.

CONCLUSION:
Present study highlights the need of sensitization & training sessions regarding hand hygiene practices among the health care workers (both clinical and Pre-clinical faculiies) and regular cleaning with isopropyl alcohol of inanimate objects like Biometric device for reduction of HAIs and prevent the spreading of transient microbial flora on such devices. It also emphasizes the need for regular surveillance of carriage of resistant strains of *Staphylococcus asureus* in Health care personals. Eventually, our data favor the use of *Co-trimoxazole* as a potentially cost-effective antimicrobial drug for treating MRSA infections which needs to be evaluated in context to different hospital settings by multi-centric trials.

Table 1: Study Unit & Study group wise distribution of culture positive samples from biometric system in a Tertiary care hospitals

	Group I : Medical college (n=12)				Group II : Dental Academy				Group III : Dental Sciences			
	C	PC	NC	Total	C	PC	NC	Total	C	PC	NC	Total
No. of sample collected	4	4	4	12	2	2	4	8	4	4	2	10
No. of culture positive	2	3	2	7	1	1	1	3	0	0	0	0
C=Clinical, PC= Para-clinical, NC= Non-clinical												

Table: 2 Antibiotic resistance pattern of the *Staphylococcus aureus* isolated from Biometric systems

Isolated Organisms- *Staphylococcus aureus (n=10)*		
Antibiotics	**MSSA (n=3)(% Resistant)**	**MRSA (n=7) (% Resistant)**
Erythromycin (E)	2(66%)	7(100%)
Clindamycin (CD)	2(66%)	7(100%)
Cefepime (CEF)	0 (0 %)	7(100%)
Ampicillin (AMP)	0 (0 %)	7(100%)
Co-trimoxazole (COT)	1(33%)	1(14%)
Doxycycline (DOX)	0 (0 %)	0 (0 %)
Ciprofloxacin (CIP)	0 (0 %)	0 (0 %)

Table: 3 Comparison of culture positive between Group I & Group III

	Group I (Medical college)	Group III (Dental Sciences)	Total	Chi-square Test
Culture positive	07	0	07	X^2= 8.55
Culture Negative	05	10	15	P value=0.0034
Total samples	12	10	22	Highly Significant
Comparison between Medical & Dental (Dental Academy + Dental Sciences) Groups:				
	Medical Group	Dental Groups	Total	Chi-square Test
Culture positive	07	03	10	X^2= 5.62
Culture Negative	05	15	20	P value=0.0177
Total samples	12	18	30	Significant

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