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Research Article

MICROORGANISMS ON HUMAN-COMPUTER INTERFACES: AN EXAMINATION OF AUTOMATED TELLER MACHINES AND CYBERCAFES IN ILESA AND IJEBU-JESA, NIGERIA

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ABSTRACT

Objective: The objective of this study was to examine automated teller machines (ATMs) and keyboards in public cybercafés of Ilesa and Ijebu-Jesa, Nigeria for the presence of bacteria of health significance.

Methods: A total of 10 ATMs in Ilesa and 10 cybercafés each in Ilesa and Ijebu-Jesa were sampled at random and cultured by standard procedures. Total bacterial counts and coliform counts were recorded. The susceptibility of isolates to commercially available antibiotics was assayed by the disk diffusion method.

Results: The mean heterotrophic count of keyboards from Ilesa was 2.01×10^5 CFU/ml whereas the mean coliform count was 1.50×10^3 CFU/ml. *Staphylococcus aureus* made up 50% of isolates from ATMs in Ilesa, 90% of those from cybercafés in Ilesa and 20% of cybercafes in Ijebu-Jesa. *Pseudomonas* sp. was 10% of isolates from ATMs surfaces in Ilesa and keyboards in Ijebu-Jesa cybercafés and 30% of those from keyboards in Ilesa. Isolates were 53% susceptible to common antibiotics.

Conclusion: The study concluded there was a high presence of bacteria on the surfaces of ATMs and keyboards in Ilesa and Ijebu-Jesa, some of which were potentially pathogenic and drug resistant.

Keywords: Drug resistance, Microbial, User-computer interface, Disinfection, Nigeria.

INTRODUCTION

Human-computer interaction or man-machine interaction involves communication between humans and computers [1]. They essentially allow humans to tell computers what to do and enable humans understand results of such queries after processing by computer [2]. Human-computer interfaces (HCI) encompass software and hardware components as well as system environment and human organization [3]. Existing HCI devices basically rely on three human senses to function: Vision, audio, and touch [2]. One of the essential components in design of HCIs is a consideration for their effects on people [3]. Human interactions with computers have engendered simplification and automation of many daily tasks thus increasing productivity in diverse areas of endeavors. The advancement has not being without its setbacks, especially on human health. Microorganisms are ubiquitous and more so in public environments with little or no arrangement made for their consistent elimination. Automated teller machines (ATMs) and keyboards are HCIs that offer such environments for many microorganisms since they are accessed publicly and infrequently disinfected. Microbes such as *Bacillus* sp., coagulase negative Staphylococci (CoNS), *Staphylococcus aureus, Escherichia coli* had been isolated from ATMs bringing to fore their potential for colonization by human pathogens [4]. Onuoha and Fatokun [5] identified *S. aureus,* CNS, *Streptococcus* sp., *Pseudomonas* sp. and *E. coli* from swabs of ATM machines in Ebonyi, Nigeria. Most of these organisms are being reported increasingly resistant to conventional antibiotics [6-9]. Nagajothi *et al.* [10] found *Klebsiella* sp., CoNS, *Pseudomonas aeruginosa*, *E. coli*, and *S. aureus* on inoculation of swabs from ATM centers. Keyboards and mice are HCIs which serve as input devices for most desktop computers common in cybercafés. Malik and Naeem [11] reported that all swabs (n=300) from surfaces of computer keyboards and mice were contaminated with pathogenic bacteria.

Eltablawy and Elhifnawi [12] had also shown the presence of pathogenic bacteria with different degrees of resistance to conventional antibiotics on the surfaces of keyboards and mice and demonstrated the effectiveness of some commercial disinfectants in removing these microbial contaminants. This study was undertaken to examine ATMs and keyboards in public cybercafés of Ilesa and Ijebu-Jesa, Nigeria for the presence of bacteria of health importance.

METHODS

10 ATMs in Ilesa (7.6395° N, 4.7588° E), and 10 cybercafes each in Ilesa and Ijebu-Jesa (7.6796° N, 4.8080° E) were sampled at random. Sterile swabs moistened with sterile saline solution were moved over sample surfaces and then swirled in 1 ml sterile saline solution [13,14]. Sample suspensions were inoculated by the pour-plate method in nutrient agar and MacConkey agar for total viable and gram-negative bacterial counts, respectively. Cultures were then incubated at 37°C for 48 hrs after which distinct colonies were counted. Some of the isolated bacteria were identified by Gram stain and standard biochemical techniques [15]. Isolates common to all locations were subjected to antimicrobial sensitivity testing by the disc diffusion method with commercial antibiotics discs [15,16]. After 24 hrs incubation period, zones of inhibition were measured to the nearest millimeter [15].

RESULTS AND DISCUSSION

ATMs 1-3 had 2.08×10^5 CFU/ml, 2.28×10^5 CFU/ml and 2.43×10^5 CFU/ml total bacterial counts, respectively and were the only three ATMs that had Gram-negative bacteria isolated from them. Their Gram-negative counts were 1.00×10^5 CFU/ml, 1.29×10^5 CFU/ml and 1.50×10^5 CFU/ml, respectively. Total bacterial counts from ATM surfaces in Ilesa ranged from 2.80×10^5 CFU/ml to 1.90×10^5 CFU/ml and the mean count was 2.08×10^5 CFU/ml (Fig. 1).

The first three keyboards swabbed in Ilesa were devoid of coliform bacteria but had total heterotrophic counts of 1.68×10^5 CFU/ml, 1.92×10^5 CFU/ml and 2.32×10^5 CFU/ml, respectively. The highest heterotrophic count (3.90×10^5 CFU/ml) was observed on the 7th keyboard swabbed, and it was also one of the only two keyboards with coliform bacteria (1.00×10^3 CFU/ml). The mean heterotrophic count was 2.01×10^5 CFU/ml, whereas the mean coliform count was 1.50×10^3 CFU/ml (Fig. 2).

Keyboards from the first three cybercafés in Ijebu-Jesa had total bacterial counts of 1.06×10^5 CFU/ml, 2.90×10^5 CFU/ml, and 1.74×10^5 CFU/ml, respectively. The maximum bacterial count was observed on the 4th keyboard sampled; also the only keyboard from which coliform bacteria was isolated (1.00×10^3 CFU/ml) (Fig. 3). The mean heterotrophic count was 2.42×10^5 CFU/ml.

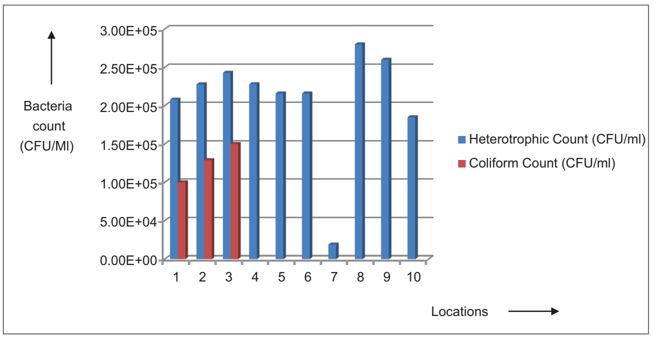

Fig. 1: Bacteria counts of automated teller machine swabs in Ilesa

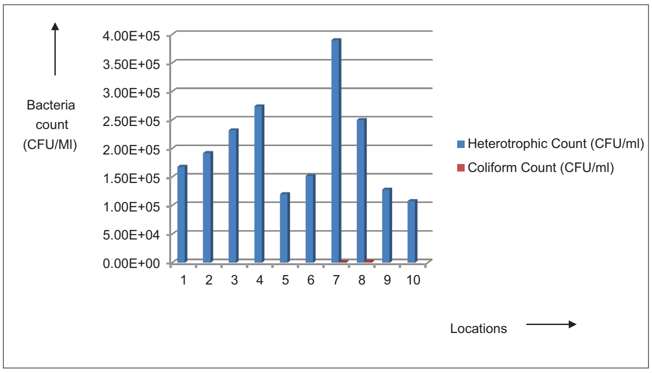

Fig. 2: Bacteria counts of keyboards swabs in Ilesa

Bacteria are ubiquitous, and their isolation from sampled HCIs in the present studies conforms to existing literatures on the research theme [4,5,10-12]. HCIs in Ilesa bore more coliform bacteria (Figs. 1 and 2) and this could be attributed to the higher population of the town increasing the probability for encountering ATMs and keyboard users with poor sanitary habits. Higher population also makes sanitation of these public utilities a more difficult job and therefore engendering less routine cleaning of public HCIs in populous places.

S. aureus made up 50% of isolates from ATMs in Ilesa, 90% of those from cybercafés in Ilesa and 20% of cybercafés in Ijebu-Jesa (Table 1). *Pseudomonas* sp. was 10% of isolates from ATMs surfaces in Ilesa and keyboards in Ijebu-Jesa cybercafés and 30 % of those from keyboards in Ilesa.

Isolates were 53 % susceptible to common antibiotics. *S. aureus* was susceptible to all antibiotics, *E. coli* was susceptible to metronidazole and kanamycin alone and *Micrococcus* sp. was resistant to metronidazole alone (Table 2).

Previous studies [4,5] had shown the presence of *S. aureus, E. coli, and Pseudomonas* sp. on the surfaces of ATMs. This was corroborated in the present work (Table 1). Onuoha and Fatokun [5] noted a 100% resistance to common antibiotics by organisms isolated from HCIs of public use in their study. This study found 47% resistance to common antibiotics. Eltablawy and Elhifnawi [12] had shown the effectiveness of commercial disinfectants in ridding the surfaces of keyboards of microorganisms. The resistance patterns of microbes on HCIs being reported by studies, including the present one, point to a need for increased cleansing of these utilities to reduce their potential for spreading pathogenic microorganisms.

CONCLUSION AND RECOMMENDATION

This study concluded there was a high presence of bacteria on the surfaces of ATMs and keyboards in Ilesa and Ijebu-Jesa, some of which were potentially pathogenic and drug resistant.

Constant cleaning of keypads of ATMs and keyboards in public cybercafés is recommended. Further studies should be carried out to

Table 1: Frequencies of bacterial isolates

Bacteria isolated/locations	Frequencies		
	ATMs in Ilesa (n=10)	Cybercafés in Ilesa (n=10)	Cybercafés in Ijebu-jesa (n=10)
S. aureus	5	9	2
E. coli	4	6	1
Salmonella sp.	2	3	3
Pseudomonas sp.	1	3	1
Klebsiella sp.	3	2	2
Micrococcus sp.	Nil	Nil	1

S. aureus: *Staphylococcus aureus*, *E. coli*: *Escherichia coli*, ATM: Automated teller machine

Table 2: Antibiotics susceptibility of isolates

Bacteria isolated/antibiotics	Zones of inhibition (mm)				
	Metronidazole	Chloramphenicol	Penicillin	Augmentin	Kanamycin
S. aureus	7	10	15	10	5
E. coli	10	Nil	Nil	Nil	20
Salmonella sp.	5	5	Nil	Nil	Nil
Pseudomonas sp.	Nil	10	Nil	Nil	Nil
Klebsiella sp.	Nil	Nil	Nil	6	15
Micrococcus sp.	Nil	5	5	7	10

S. aureus: Staphylococcus aureus, E. coli: Escherichia coli

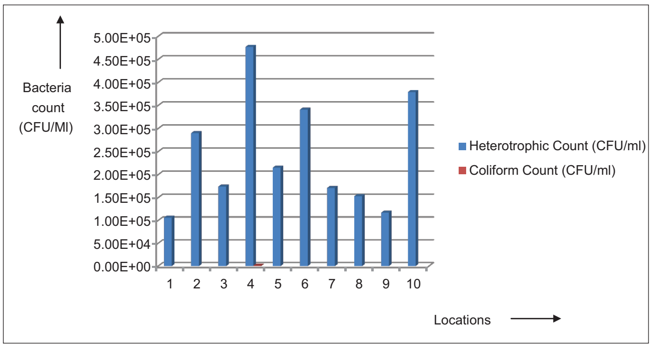

Fig. 3: Bacteria counts of keyboards swabs in Ijebu-jesa

know the rate of daily cleansing with commercial disinfectants that will considerably lower the daily mean bacterial counts of these publicly utilized HCIs.

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