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Research Article

Public Health Risk from Multidrug Resistant Bacteria from the Use of ATMs in Qassim Region, Saudi Arabia

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Abstract

Automated Teller Machines (ATMs) are widely reported to harbor diverse group of microorganisms, particularly bacteria. Presence of pathogenic and antibiotic resistant bacteria in the ATM keypads pose threat to the health of the users. For this reason, a study was carried out to evaluate the health risk for the users of ATM in the Qassim region of Saudi Arabia by isolating bacteria from the ATMs located inside and outside of six banks in the region. Microorganisms were isolated using blood agar and MacConkey agar and identified following standard microbiological procedure. Siemens MicroScan Walkaway system was used for determination of antibiotic susceptibility pattern. A total of 20 bacterial species and one fungal species were isolated and identified. The frequently isolated bacterial species include *Staphylococcus epidermidis, S. hominis, Bacillus* spp*. Micrococcus* spp*. S. aureus, Pseudomonas agglomerans* and *E. coli.* Only fungal species isolated was *Aspergillus fumigatus*. Six species of *Staphylococcus* were found multidrug resistant and one *S. aureus* as resistant to methicillin (MRSA). Six Gram negative bacteria were also found resistant to different number of widely used antibiotics. The results of the study reveal that using ATMs in the Qassim region pose risk to the health of the public users. Proper hygienic measures and regular surveillance are recommended for public health safety of the users of ATMs in the region.

Keywords: *Staphylococcus; Multidrug Resistant; ATM; Public Health Risk; MRSA*

Introduction

With increase of urbanization and digitalization of the banking system, the use of Automated Teller Machine (ATM)s has been spreading and increasing globally.

It was reported in 2014 that an estimated over 2.4 million units of ATMs, the most widely used form of computer driven public technology, were in use since their invention and use in the late 1960s [1]. An ATM is typically used to withdraw or deposit money, pay bills by slotting a card into a recipient hole and following on-screen instructions, by touching the screen or by punching the keys of the metallic Keypad to enter secret codes and commands. ATMs have over time become an essential part of our daily life [2]. They are used daily by hundreds of individuals of different hygiene and health status for various financial services [3].

ATM keypads on screen are open to be contaminated with variety of microorganisms from unrestricted human touches [4]. Most of the ATM centres are air conditioned. This makes the ATM Keypad suitable habitat for growth of microorganisms and spreading different

diseases. So unhygienic ATM use pose threat to public health [5]. Several studies have revealed presence of pathogenic microorganisms in the Keypad of ATM. Pathogenic bacteria like *Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Bacillus subtilis, Klebsiella spp., Enterobacter spp., Bacillus cereus, Micrococcaceae spp*. *Salmonella spp*. and *E. coli* [1,2,5-9] were reported found in the ATMs. Some of these studies reported antibiotic resistant bacteria in the ATMs [1,3,7,10].

Aim of the Study

The aim of the study was to assess the public health risk from the use of ATMs in Qassim region of Saudi Arabia by isolating and identifying bacteria from the ATMs and determining their antimicrobial sensitivity pattern.

Materials and Methods

Study area

This study was carried out in Qassim region of Saudi Arabia. The study was undertaken between September and December 2019.

Sample collection and processing

A total of sixty (N = 60) swab samples collected from 30 (5 ATMs from each bank) ATMs of six different banks situated in Qassim region in Saudi Arabia were used for the study from September to December 2019. Five ATMs were selected for each bank. Sterile cotton swabs made on applicator stick was slightly moistened with sterilized saline water before collecting sample from the ATM surfaces.

Using the saline wet swabs, 60 samples (two from each) were taken from the surfaces of the ATM keypad of six different banks. The swab was put into nutrient broth media and transferred immediately to the microbiology laboratory of the Department of Medical Laboratories in Qassim University, Saudi Arabia and incubated for 30 minutes in order to enhance growth. Swabs were cultured onto nonselective Blood agar (Oxoid) and selective MacConkey agar (Oxoid) plates for incubation at 37°C for 18 - 24 hours.

Identification and characterization of isolates

The isolates were identified, using their colonial and cellular morphology, Gram reaction and conventional biochemical identification procedures following standard microbiological methods [11,12].

Antibiotic susceptibility testing

For the isolated strains, antibacterial susceptibility patterns were tested using Siemens MicroScan Walkaway system [13].

Results

Microbial contamination of the ATMs of the six banks in Qassim region

All the five ATMs of each bank were found contaminated with microbial population. Among the targeted 6 banks, the highest number of bacterial populations was isolated from bank 1. Twenty different microorganisms were isolated from bank 1 (23%). Sixteen bacteria were found in each of bank 3 and 6 (18.4% each). Bank 2 was colonized by 13 different microorganisms (15%), while bank 4 and 5 were found to be colonized by 11 microorganisms and the rest have the lowest percentage of contamination, being 12.6% for each. It seems that there is relationship between the level of contamination and popularity of the bank to the public. Bank one is the most popular bank and it has highest contamination. The trend is also true for other banks. The more popular the bank, the more people use the ATMs and the more contaminated the ATMs (Figure 1).

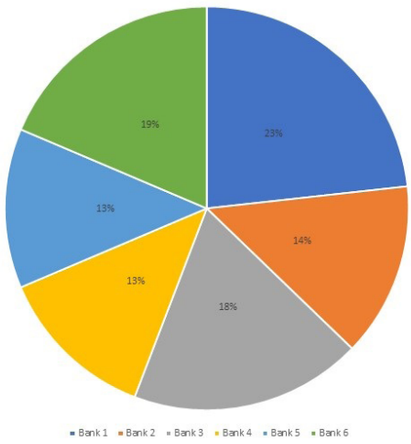

Figure 1: The percentage of bacterial isolates from ATMs keypad of different banks. Bank 1 had the highest bacterial population with a percent of 23%. Both bank 3 and 6 had the same percentage, 18.4%. Bank 2 had 15% of microorganism contamination. The lowest percentage was in both banks 4 and 5, 12.6% for each

Presence of pathogenic bacteria in the keypad of the ATMs

A total of 20 bacterial species and one fungal species were successfully isolated and identified from the 30 ATMs by standard procedures and MicroScan walkaway system when required. Both gram positive and gram-negative pathogenic bacteria were found in the ATM keypads. Gram-positive bacteria found in the ATMs include *Staphylococcus aureus* including MRSA, *S. epidermidis, S. hominis, S haemolyticus, S. sciuri, S auricularis*, *S. warneri, S. hyicus* and *S capitis, E. faecalis, Micrococcus* spp. and *Bacillus* spp. Gram-negative bacteria found in the ATMs were *Enterobacter cloacae, Pseudomonas stutzeri, Pantoea agglomerans, E. coli, K. pneumoniae, Acinetobacter baumannii* and *Serratia plymuthica. Aspergillus fumigatus* was the only isolated fugus. The predominant isolated genus was *Staphylococcus* spp. (50.38%). *S. epidermidis* and *S. hominis* were 16.0% each, followed by *S. warneri* (5.5%), *S. aureus* (3.2%), *S. capitis* (2.2%) and *S. sciuri* (2.2%), while *S. auricularis, S. hyicus, S. haemolyticus* and MRSA were isolated once (1.13% each). These isolated microorganisms include pathogenic, opportunistic pathogen and nosocomial pathogens. All the isolated microorganisms and their relative abundance are shown in figure 2.

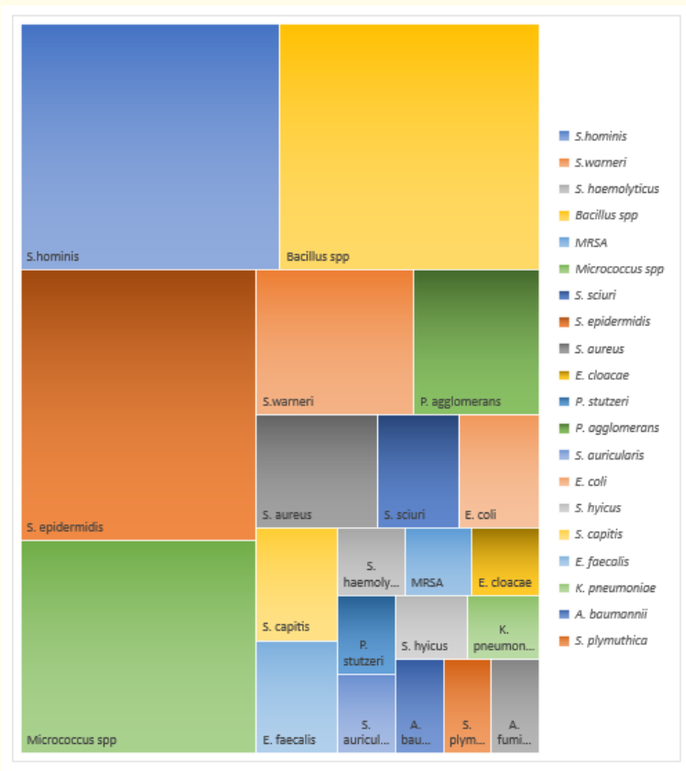

Figure 2: The isolated bacterial species and their relative abundance in the ATMs of the banks. Twenty bacterial and one fungal species were isolated from 30 ATMs of six banks in the Qassim region in the spring of the year.

Antibiotics resistance of the isolated pathogenic bacteria

The antimicrobial susceptibility pattern against 22 antibiotics (Figure 3) from different groups were determined for all the isolated bacteria using MicroScan walkaway system. Only those that are resistant to different antibiotics are reported here. Figure 3 shows the antibiotic susceptibility pattern of 8 *Staphylococcus* species. Only one methicillin resistant *Staphylococcus aureus* (MRSA) was found. Other seven *Staphylococcus* spp. were found to be resistant to antibiotics from more than three groups of antibiotics (Figure 3). So, these seven *Staphylococcus* spp. are multidrug resistant and a big threat to the health to the users of the ATMs.

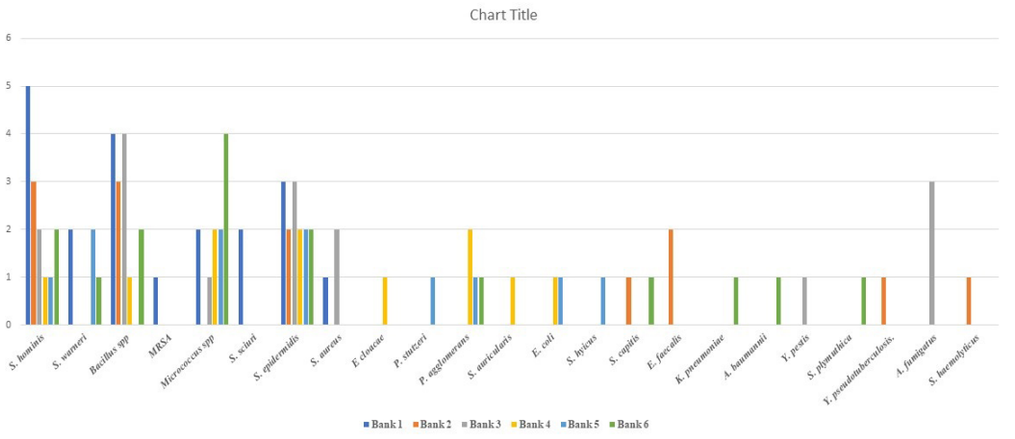

Figure 3: The Antimicrobial Susceptibility Pattern of the *Staphylococcus* spp. Six spp. were found to be resistant to more than 3 different group of antibiotics and one species resistant to methicillin.

Eight Gram-negative bacterial strains from four bacterial species such as 2 strains of *E. coli,* 4 strains of *P. agglomerans* and 1 strain each of *K. pneumonia* and *E. cloacae* were found to be resistant to 5 different antibiotics. These antibiotics were ampicillin/sulbactam, cefuroxime, ampicillin, cefoxitin, and piperacillin. *E. cloacae* was resistant to 4 antibiotics, while *K. pneumonia* and *P. agglomerans* were resistant to 2 antibiotics. Moreover, *E. coli* was found resistant to only 1 antibiotic (Figure 4). These result shows that ATMs in the Qassim regions harbour antibiotic resistant bacterial population.

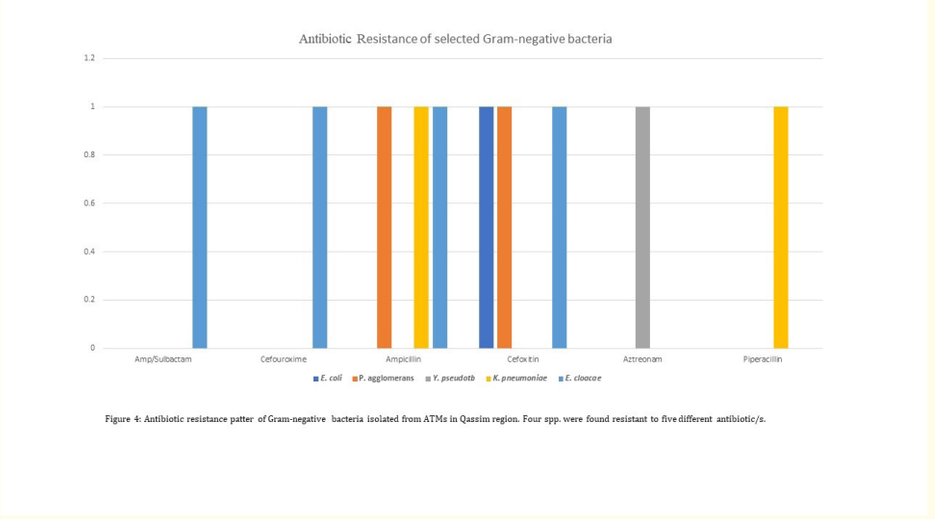

Figure 4: Antibiotic resistance patter of Gram-negative bacteria isolated from ATMs in Qassim region. Four spp. were found resistant to five different antibiotic/s.

Discussion

In this study, we found that the presence, diversity and antibiotic resistance of Microorganism present in the ATMs are of public health concern for the ATM users of diverse background. The findings of this study, like some other previous studies [14] shows that ATM Keypads are contaminated with microorganisms. In this study, we found that all the ATMs sampled in the Qassim regions from six banks were contaminated. This reveals that all these ATMs pose threat to the health of the users.

Real threat to public health comes from the presence of pathogenic bacteria found on the ATMs. Different types of pathogenic bacteria were found in the ATM Keyboards. Among the total of 20 bacterial species, skin flora such as Coagulase - negative *Staphylococcus (CNS), S. aureus, E. coli, Streptococcus spp and Enterobacter spp.* were found abundantly. Other pathogenic bacterial included *P. agglomerans* and *Y. pseudotuberculosis*, *K. pneumonia, and Micrococcus spp*. and these were less abundant.

Some of these bacteria are pathogenic under normal condition and few are opportunistic pathogens. Others are nosocomial pathogens. Presence of nosocomial pathogens indicate the use of ATMs by people visiting hospitals or working in hospitals or clinics. The health risks associated with the majority of these normal or opportunistic or nosocomial pathogenic bacteria are well documented in book [15,16].

Risk to public health became complicated from the presence of multidrug resistant and methicillin resistant bacteria. Seven species of *Staphylococcus* isolated from the ATMs were found multidrug resistant (Figure 3). Methicillin resistant *S. aureus* was also found. Antibiotic resistance of bacteria isolated from ATMs were reported previously [3,7,14,16,17].

From the above discussion it is evident that ATMs in the Qassim region present risk to the users. So, measures should be taken to eliminate or reduce the risk as it was found in a previous study that microorganisms transfer to the users' hand from the ATMs [5]. In the same study in Saudi Arabia it was found that use of hand sanitizer can reduce 99% of the microbial load in the hand of the ATM users. So, it is highly recommended to arrange hand sanitizer in the ATM centres for the public health safety, particularly at this time of pandemic by corona virus which survives on metal surfaces for long time. Along with providing hand sanitizers for users, it is also highly imperative to clean the ATM keypads regularly to reduce microbial load in the keys of the ATM [6,19,20]. Nationwide study should be carried out to determine the prevalence of antibiotic resistant microbial loads in the keypad of the screen in the ATMs.

Conclusion

This study of the bacterial contamination on ATM metallic keypads in the Qassim region of Saudi Arabia revealed the presence of pathogenic and multidrug resistant bacteria like *S. aureus,* Methicillin resistant *S. aureus, S. epidermidis, Coagulase- negative Staphylococcus (CNS), Streptococcus spp, P. aeruginosa, Enterobacter species and Escherichia coli*.

The result of this study is of public health importance as it uncovers that ATM devices are potential habitat for multidrug resistant bacterial pathogen. ATM users and Authorities must be made aware that ATMS can be source of infection. Use of hand sanitizer after use of ATMs and regular routine cleaning of these machines by the authorities is recommended to reduce public health risk from the ATMs and to not take the risk of causing epidemics. Further investigations are required to determine the presence of viruses and funguses in the ATMs. Reporting of antibiotic-resistant bacteria and seasonal variation of bacterial flora from ATM centres in different study emphasize the need for continuous microbiological surveillance of ATMs.

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