Original Article

Investigation of Bacterial Contamination in Automatic Teller Machines in the Center of Iran

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Abstract

Aims: The use of automatic teller machines (ATMs) daily has increased the chances of hand-borne transmission of microorganisms to the machine's surfaces, and they can have an important role in microorganisms' transmission to individuals. This study aimed to investigate microbial contamination in ATMs in the center of Iran. **Materials and Methods:** This cross-sectional study was used to collect samples from the keyboards and monitors of the ATMs in Kashan. After 24 h of incubation, the swabs were inoculated on different selective media, including MacConkey agar and blood agar. Microbiological tests were used to confirm bacterial isolates. **Results:** The most frequently contaminated ATMs were government banks, with 69% contamination. The most frequently isolated bacterium was *Staphylococcus epidermidis*) 37/77%). The other bacteria were also identified, including *Bacillus* spp. (17/77%), *Escherichia coli* (7/77%), *Micrococcus* spp. (7/77%), *Myroides odoratus* (4/44%), *Klebsiella pneumoniae* (2/22%), *Staphylococcus aureus* (2/22%), *Staphylococcus saprophyticus* (1/11%), and *Klebsiella oxytoca* (1/11%), respectively. **Conclusions:** The most tested ATM keyboards in this study were contaminated with at least one microorganism. According to our results, it is recommendable to disinfect the hands after entering public places to hinder the spread of critical pathogens.

Keywords: Automated teller machines, bacteria, diseases, Kashan, keyboard

Introduction

Microbes exist everywhere, including soil, air, water, food, skin, noses, throats, mouths, and intestinal cavities. As a result of adapting to most environmental conditions, they can grow on many surfaces.[1-3] Most bacteria are normal flora and do not cause serious illness in humans, but some of them can be medically important.[4] Bacteria can persist or grow on any surface, including computer keyboards, door handles, mobile phones, and elevator buttons.[5] A global challenge in the transmission of environmental bacteria is fomites. Recovered microorganisms from the hands are either transient or resident. The hands are considered as a potential reservoir for microorganisms that are involved in the spread of microbes and diseases. Hand transmission causes the spread of nosocomial infections. They are also important even in foodborne illnesses.[6,7] Several studies have proved that contaminated surfaces played a critical role in the spread of infectious diseases.[8,9] According to the latest research, the transmission of bacteria is affected by various factors, including surface characteristics, bacterial species, moisture, and the number of bacteria inoculated.[10] Many banking services today are offered through ATMs, and people prefer to use ATMs to save time. Therefore, the use of ATMs is unavoidable. Despite the ubiquity of ATMs, they are mostly concentrated in shopping malls, health centers, and city centers.[11,12] The point of contact is the customer's hands to the surfaces of the keypad or screen of these devices.[5,13]

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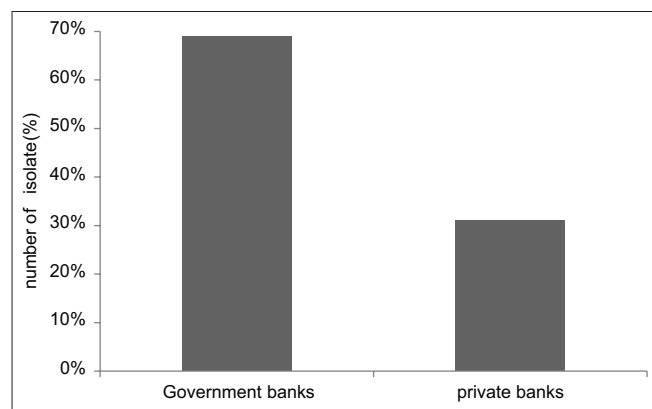
Every day, many people with different health, social and economic conditions use ATMs. Bacteria such as *Bacillus* spp., coagulase-negative Staphylococci, *Staphylococcus aureus,* and *Escherichia coli* had been isolated from ATMs that show their potential for colonization by human pathogens.[6,14] There is limited information about the status of microbial colonization on ATMs in Iran. The culture of microorganisms could be a "gold standard" for determining various bacteria causes of infectious disease. Therefore, examining the bacterial load of ATMs can help to decontaminate these machines. The aim of this study was to investigate microbial contamination in ATMs in the center of Iran.

MATERIALS AND METHODS

This study was carried out in Kashan, Iran. A total of 90 samples were collected randomly from various ATMs on different days of the week using a sterile wet cotton swab dipped in tryptic soy broth from the keyboards and monitors of the ATM devices during 2018–2019. The cotton swabs were transferred immediately to the laboratory. Following 24 h incubation for further possible bacterial growth, swabs were cultured on blood agar, MacConkey agar, eosin methylene blue agar, and mannitol salt agar plates and overnight incubation at 37°C. The isolated bacteria were identified using Gram staining and standard biochemical tests, including catalase, oxidase, growth in triple sugar iron agar medium, indole production, methyl red, Voges–Proskauer reaction, ability to use citrate, urease, coagulase, DNAase, and novobiocin susceptibility test.[15,16]

RESULTS

Of 90 samples collected from the surfaces of ATMs, 76 of which were contaminated with various bacterial species. Figure 1 shows that the most frequently contaminated ATMs belonged to the government banks, with 53 (69%) cases. The prevalence of isolated bacteria included *Staphylococcus epidermidis* (37.77%), *Bacillus* spp.(17.77%), *E. coli* (17.77%), *Micrococcus* spp. (17.77%), *Myroides odoratus* (4.44%), *Klebsiella pneumoniae* (2.22%) *Staphylococcus aureus* (2.22%),

Staphylococcus saprophyticus (1.11%), and *Klebsiella oxytoca* (1.11%) [Figure 2]. Furthermore, according to Table 1, most of the bacterial isolates were obtained from the ATMs in the early days of the week.

DISCUSSION

ATMs are simple social devices that are present in all local government areas, and the level of personal hygiene is one of the important factors affecting ATMs contamination.[17,18] The presence of microorganisms in ATM keyboards can be spread to the hands, which have always been concerned about contamination.[10,19] All bacteria are isolated from the keyboard and buttons of the ATMs. The device monitor ATMs is not exposed to hand contamination, it was not examined in this study. According to our findings, ATMs are important in the transmission of microbial contamination between users. In the present study, the members of the *Enterobacteriaceae* family, especially *E. coli*, were the most commonly isolated microbes. Several studies have confirmed the role of contaminated surfaces in the spread of microbes.[20] Similar to our study, in Ebonyi State, Nigeria, most bacteria isolated from ATMs were related to Gram-positive bacteria.[21] The results of a study conducted by Ramesh in India showed that the prevalence

Table 1: Number of bacterial isolates from the automatic teller machines according to days of the week

Time (day)	Number of isolated from ATMs
Sunday	25
Monday	20
Tuesday	12
Wednesday	9
Thursday	10

ATM: Automatic teller machines

Figure 1: The number of contaminated automatic teller machines according to banks
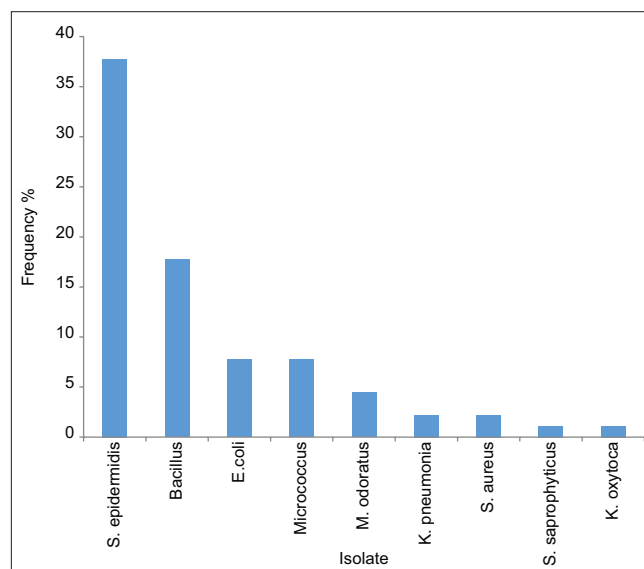
Figure 2: Distribution of bacterial species isolated from automatic teller machines

of Gram-positive bacteria was higher than Gram-negative bacteria.[22] The results of this study were consistent with our study. According to a study conducted in Mecca, 64% of the ATMs were positive for bacterial contamination, which was not in accordance with our results.[23] This low contamination can be a result of the better function of the health system. Some researchers found that the external surface of computer keyboards and mice are contaminated with pathogenic bacteria such as *E. coli*, *Salmonella* spp., *Shigella* spp., and *Staphylococcus* spp.[24] The result of a study conducted in Hamedan, Iran, showed that the most frequently isolated bacteria were *S. epidermidis*, *B. subtilis*, and *Enterobacteriaceae*.[25] This was corroborated in the present work. Previous studies had shown the presence of *S. aureus*, *E. coli*, and *Pseudomonas* spp. on the surfaces of ATMs.[3,26,27] Furthermore, the findings of Nouri-Ahmadabadi M, indicated that all the samples under study were positive regarding the existence of pathogenic bacteria and a higher percentage of samples were polluted by the fecal bacteria.[28] This difference in the prevalence of bacterial infections in different studies may be due to differences in climatic and geographical conditions. Among the factors that increase the prevalence of pollution in ATMs in Kashan, we can mention the importance of this city in terms of tourism. Because visitors can play a role in transmitting pollution.

Conclusions

Without any doubt, ATMs contamination is a serious public health issue leading to disease transmission. Based on our findings, most of the bacteria isolated from ATMs were related to Gram-positive bacteria. Furthermore, most of the contaminated samples were collected from government banks in the early days of the week. The importance of this study is that most people in the community currently use ATMs daily. Therefore, these devices are contaminated by various bacteria and can be a source of infectious agents in the community. The results of this study and similar studies can be useful for bank staff, health-care staff, and researchers. Due to the widespread use of ATMs, the existence of a general protocol to reduce the contamination of this device is necessary. Therefore, studies are needed to investigate the pollution and identify possible microorganisms; besides, strategies should be implemented to prevent and reduce this infection.

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Conflicts of interest
There are no conflicts of interest.

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