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# At Your Fingertips, Get Money and More: The Story of Acquired Teller Microorganisms

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***Abstract:*** **Raising community awareness towards more healthy daily practices undoubtedly is very noble. Definitely, there is mounting increase in in the number of Automated Teller Machines (ATMs) users in Al-Ahsa, KSA. Unfortunately, there is a misleading sense of security among users of that machine, being unaware of the fact that germs are everywhere! To address this, this descriptive comparative study aimed to characterize the bacterial load, if any that is harboring the keypads and touch screens of the ATMs and compared its type(s) and susceptibility to those harboring the flush buttons of the toilets that was randomly selected from different regions of Al-Ahsa. The research team addressed a still viable question: Why hand-sanitizers are only available in the outpatient clinics of health care facilities to deliver antimicrobial protection for health care providers? Is not ATMs more worthy of the presence of such hand-sanitizers? The unexpected results of this study will certainly shed some light for care providers fighting communicable diseases that cost the Saudi economy millions of Riyals annually.**

***Keywords:*** **Automated Teller Machines, Hand sanitization, environmental screening & communicable diseases.**

## 1. INTRODUCTION

Cutting edge and competitive health research is the cornerstone of the mission and vision of The College of Medicine, King Faisal University in Al-Ahsa, the largest city in the Eastern province, with an area of 530.000Km and a population number of 1220665[10].

Raising community awareness towards more healthy daily practices undoubtedly is very noble. Many are not aware of a scientific fact that on the earth today there is an estimated five nonillion (5 x 10 to the power of 30) bacteria are alive and thriving [1]! This certainly means that we as humans are not only continually surrounded by microbes, but also we do contain a lot of "good" and "bad" bacteria. And of the interesting facts about these germs that each square of human skin alone harbors about 100.000 bacteria [11]. Also, different surfaces can allow the bacteria to live from just a few hours to even months.

Reynolds et al. (2005) proved that contamination from outside surfaces was transferred to 86% of exposed individual's hands that can carry infectious doses of pathogens for many hours later [6].

Keeping an eye on the communicable diseases that costs the Saudi economy billions of Riyals annually, this descriptive comparative study aimed to characterize the bacterial load, if any that is harboring the keypads and touch screens of the ATMs and compare its type(s) and susceptibility to those harboring the flush buttons of the toilets that was randomly selected from different regions of Al-Ahsa.

It is difficult to accurately count the number of persons that touch the ATM key pads and screens every day! Also, it is even more difficult to know if these persons are healthy, diseased or carriers for microorganisms that can be easily transmitted to other healthy ATM users. Certainly, there are cameras for security purposes, but no tool is available to

record the invisible enemies that can steal the money that you collected by your fingertips simply by sticking to them causing unexpected morbidities.

Is it not fair to wonder why hand-sanitizers are only available in the outpatient clinics of health care facilities to deliver antimicrobial protection for health care providers? Is not ATMs more worthy of the presence of such hand-sanitizers?

## 2. AIM OF THE WORK

This study aims to characterize the bacterial load, if any that is harboring the keypads and touch screens of the ATMs and compare its type(s) and pathogenicity to those harboring the flush buttons of the toilets that was randomly selected from different regions of Al-Ahsa.

## 3. MATERIALS AND METHODS

This study started in January1st 2015. During a 7 days period, a pre-study pilot survey was designed to examine a sample of the community for their awareness about cleanliness of daily used public premises through an electronic questionnaire using Google forms. The questionnaire contained three questions:

1- Do you think that flush buttons of public toilets are contaminated?

2- Do you think that there are other public premises that may be more contaminated than toilets' flush buttons?

3- If yes, what premises are more contaminated?

Based on random selection using closed envelops, a total of 30 ATMs located downtown at shopping malls and markets were chosen. Also, a similar number of public toilets' locations were randomly selected. To be included in the study, the ATM machine should not be out of order and it must be a built-in ATMs not a freestanding ones like those in the drive-through lane at fuel stations. Also, toilets had to be used all day long to be included in the study.

***Sample Collection Technique:***

Four investigators from the research team were trained for the conventional swabbing technique as the standard recovery method to ensure that they have the same manual skills for correct sampling from the target surfaces.

***Details of the applied swabbing technique:***

1- Gloved hand throughout the sampling procedure.

2- The swab tube is labeled with sufficient detail.

3- The swab stick is removed from the sterile wrapping Fig. 1.

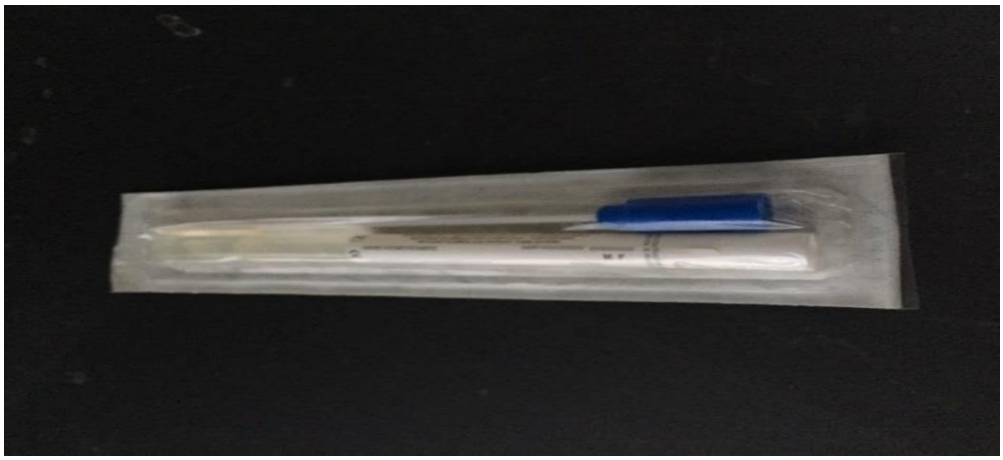


**Fig. 1. Photo of one of the used swabs**

4- The tip is moistened using 0.1% sterile peptone water container.

5- No templates were used.

6- The Cotton tip is rolled over the entire targeted surface area.

7- The swab cotton tip is vortexed in its sterile container.

8- The sampled area is finally disinfected with alcohol wipes.

9- Inoculated swabs are kept in a cool container (1-4◦C) and sent to the laboratory for immediate examination within one hour of collection.

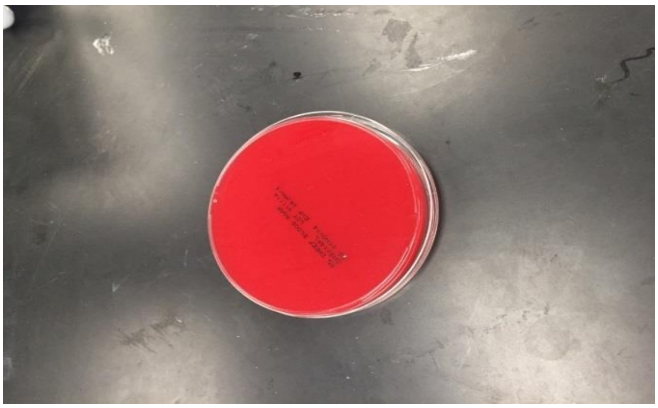


**Fig. 2. Photo of the used Blood agar**

**Fig. 3. Photo of the used MacConkey agar**

In the laboratory as per standard pour plate technique [4], swabs were processed for streaking the Blood and MacConkey agar (Oxoid UK) surfaces, incubated aerobically at 37°C for 18-24hours and examined for colonial morphology. Fig. 2. & Fig. 3. show the used agar plates). For quality assessment, extra 5 randomly chosen control swab samples were also tested. Isolates were identified by the standard microspic cultural and biochemical characterization.


**Fig. 4. Photo of the Densichek instrument (S.N. 0A002305)**

Fig. 4. Shows the photo of Densichek instrument used to measure the optical density of a microorganism suspension before utilizing the VITEK®2 system shown in Fig. 5. VITEK®2 compact is a fully automated microbiological system

that performs microbial identification utilizing growth-based technology. The system uses the colorimetric reagent cards that are incubated and interpreted automatically.

**Fig. 5. Photo of the VITEK 2 Compact Biomerieux**

Sensitivity analysis for antimicrobial susceptibility was done using the fully automated Thermo Scientific™ Sensititre™ ARIS™ 2X Instrument.

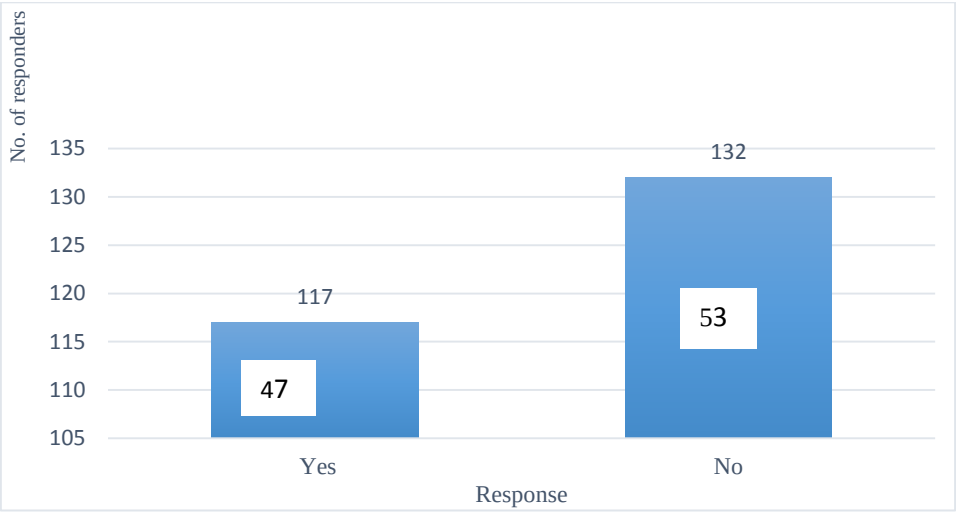
***Statistical Methods:***

The primary endpoint of this descriptive study was to investigate if there was a more significant bacterial load on the touch screens and keypads of ATMs compared to public toilets' flush buttons. Data were compiled in an Excel spreadsheet and analyzed as appropriate using descriptive statistics. The p-value was calculated using $\chi^2$-test. A p-value ($p < 0.05$) was considered statistically significant.

A secondary sensitivity analysis was conducted to determine the type of organism isolated and whether nature of the sampled surfaces was associated with the growth of antibiotic resistant organisms.

## 4. RESULTS

A total of 249 responders completed the pilot questionnaire through the allowed 7 days, they were anonymous and no personal data requested. All of them responded by yes for the first question. For the second one, 53% of the responders did believe that no public facility is more contaminated than toilets' flush buttons, while only 47% believed in the existence of more contaminated places; Graph I. illustrates this finding.




**GRAPH I. Do you think that there are other public premises that may be more contaminated than toilets?**

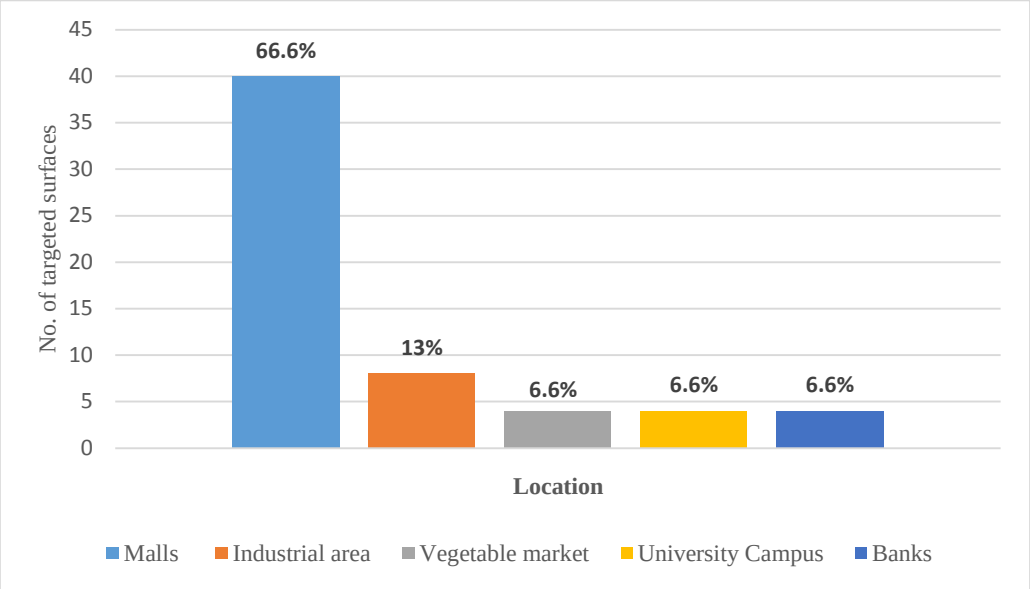
The third question asked about the places that one might think it is more contaminated than public toilets flush buttons. No one of the responders mentioned the ATM Key pads or touch screens among the different answers.

The randomly chosen five control swab samples showed no growth, reflecting the high quality of the used swabs.

The different locations of the randomly selected ATM machines and public toilets varied as shown in table I. Anyway, the majority of the sampled surfaces were obtained from malls and hypermarkets (66.6%).

**TABLE I. The different locations of the sampled surfaces**

| Location | Targeted Surfaces | |
|---|---|---|
| | No. | % |
| Malls and Hypermarkets | 40 | 66.6 |
| Industrial area | 8 | 13 |
| Central Vegetable Market | 4 | 6.6 |
| KFU University Campus | 4 | 6.6 |
| Banks | 4 | 6.6 |



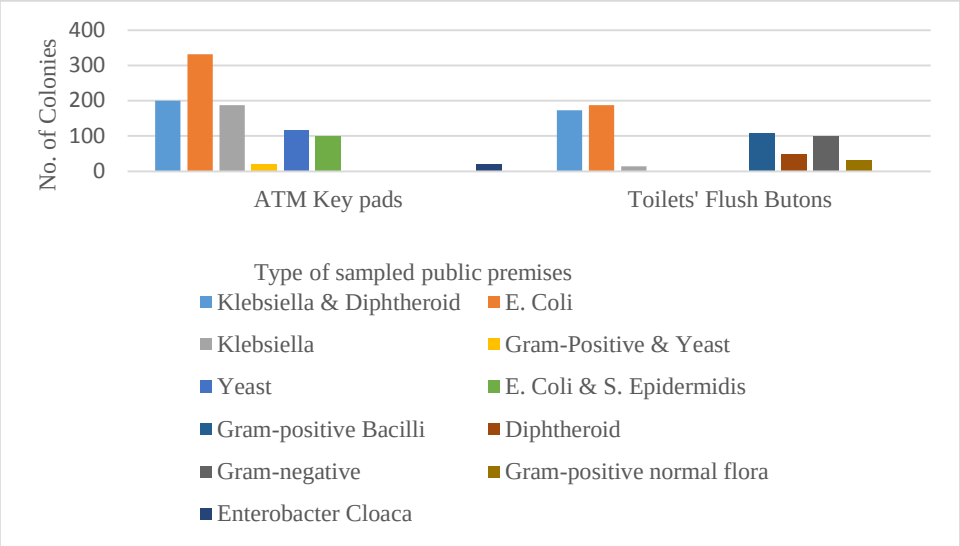

**Graph II. The different locations of the sampled surfaces**

Percentage distribution of different bacterial isolates recovered from the sampled surfaces of ATMs and public toilets respectively is illustrated in table II.

**TABLE II. Taxonomic composition and percentage distribution of the bacterial flora recovered form ATMs and Public Toilets' flush buttons**

| Bacterial isolate | ATM Keypads | | Toilets' Flush Buttons | |
|---|---|---|---|---|
| | No. of colonies | % | No. of colonies | % |
| Klebsiella & Diphtheroid | 200 | 13.3 | 173 | 13.3 |
| E.Coli | 332* | 26.6* | 187 | 13.3 |
| Klebsiella | 187* | 20* | 14 | 6.6 |
| Gram-positive &Yeast | 21* | 6.6* | 0 | 0 |
| Yeast | 116* | 20* | 0 | 0 |
| E.Coli & S.epidermidis | 100* | 6.6* | 0 | 0 |
| Gram-positive Bacilli | 0 | 0 | 108* | 20* |
| Diphtheroid | 0 | 0 | 49* | 20* |
| Unidentified Gram-negative | 0 | 0 | 100* | 6.6* |
| Gram-positive normal flora | 0 | 0 | 33* | 20* |
| Enterobacter Cloaca | 20* | 6.6* | 0 | 0 |

*= *Significant at p<0.05*




**GRAPH III. Taxonomic composition and percentage distribution of the bacterial flora recovered form ATMs and Public Toilets' flush buttons**

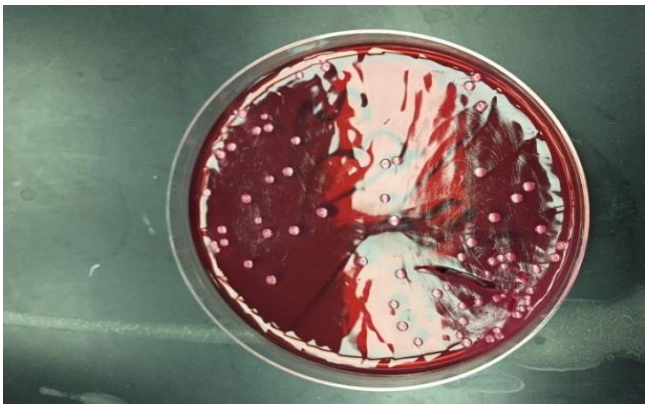


**Fig 6. N. Photo of E. coli colonies on MacConkey agar**

Sensitivity analysis of surface total viable counts, recovered from both ATM keypads and public toilets' flush buttons, as regards the antibiotic susceptibility identified Enterobacter Cloaca species from 6.6% of the sampled ATMs which were Cefoxitin resistant.

## 5. DISCUSSION

The pre-study pilot questionnaire results showed that 53% of the responders denied the existence of a more contaminated places than public toilets compared to 47%. Also, no one listed ATM keypads or touch screens among the different places named as an answer for the third question. This clearly reflected poor public awareness for the potential contamination of the daily touched surfaces and the consequent dissemination of pathogenic microorganisms that might be responsible for a great deal of communicable diseases for susceptible persons. Of interest, this is the first study that tackled that point as a pre-intervention pilot study for testing the misleading feeling of security in the expanded use of ATM machines for daily financial procedures.

Approximately, 66.6% of the randomly selected locations were at malls and hypermarkets. This finding is axiomatic as shopping areas contain large number of ATMs and public toilets.

Inanimate objects like ATM keypads or touchscreens had been shown to play a role in the transmission of human pathogens either directly by surface to mouth or indirectly by contamination of fingers and subsequent hand to mouth contact [7].

In this study, Escherichia Coli, the well-known Gram-negative bacilli were significantly abundant at 26.6% of the ATM sampled surfaces, compared to public toilets' flush buttons (13.3%). In addition, the total number of isolated colonies was

markedly higher in the ATM sampled surfaces. This finding was surprisingly higher than that of Tekerekoglu et al, 2012 [9]. The conflict between the two studies could be explained by many confounding factors like climate difference between Malatya in Turkey and Alhasa in KSA. In Tekerekoglu et al [9], study findings, all ATMs sampled harbor bacillus spp., while in this study only 26.6% of ATMs harbored bacilli spp. Dust storms and hot climate at Alhasa again may explain these findings, as isolated microorganisms varied by incidence density with temperature. The temperature-dependent seasonality of potentially pathogenic microbes has implications for the discriminative preponderance of certain species at certain surfaces [8].

Of interest, Gram-positive microorganisms, yeast and S. epidermidis were isolated from ATM surfaces only and not recovered from public toilets. While Gram-positive microorganisms, diphtheroids and Gram-positive normal flora were only recovered from toilets and not from ATM surfaces. The selective abundance of definite microorganisms at ATMs keypads compared to public toilets could be explained by the difference between the nature of the sampled surface, regular cleaning, humidity of the atmosphere and misleading feeling of security in dealing with ATMs keypads compared to the more careful behavior when one is in the public toilet. In addition, the difficulty in cleaning and disinfecting the ATM keypads might play a role in encouraging certain bacterial species to grow [5].

A highly pathogenic strain of Enterobacter Cloacae was isolated from 6.6% of the sampled surfaces of ATM keypads and touch screens. This type of bacteria is a rod-shaped gram-negative from the Enterobacteriaceae family. Enterobacter cloacae can be found on human skin and tissues as well as fruits and vegetables [2]. Enterobacter cloacae are nosocomial pathogens that can be acquired through the skin, gastrointestinal tract, urinary tract or derived externally due to the ubiquitous nature [3]. Isolated strains were Cefoxiten resistant. However, this bacterial species were not recovered from public toilets' flush buttons! Perhaps, the misleading sense of security while touching the ATM keypads or touch screens, compared to the more careful attitude in the toilets may be responsible for such outcome.

## 6. CONCLUSION AND RECOMMENDATIONS

This study has shown that the road is still long to achieve a satisfactory degree of social awareness especially towards infectious diseases. Indispensable ATM machines harbor a more significant and aggressive bacterial load than public toilets' flush buttons, an alarming finding that hopefully can modify individual behavior while touching ATM keypads and touch screens . The selective preponderance of definite bacterial isolates on ATM key pads like gram-positive microorganisms and their paucity on the flush buttons of public toilets is a strange finding that needs further studies that will investigate the causes for such findings. The presence of resistant strains like Enterobacter cloacae on some ATM key pads and touch screens is a dangerous outcome that must have a positive repercussion on individual behavior while dealing with ATMs. In addition, further wider scale researches are required to isolate viral loads. Anyway, the need for hand-sanitizers next to the ATM machines is an urgent necessity that should be implemented in the near future, an issue that deserves to be raised to the decision makers for better quality of life in our society.

***Conflicts of Interest:***

The authors declare no conflict of interest.

## ACKNOWLEDGMENT

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