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# Bacteriological Evaluation of Some Automated Teller Machine In Akure Metropolis

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**Background:** Automated Teller Machines (ATMs) represent a good transient environment for development of pathogenic microbes. Investigation on the level of bacterial contaminants on keypads of ATMs was carried out in Akure, Nigeria.

**Methods:** A total of sixty ATMs keypads were sampled in two major locations (main market and Federal University of Technology, campus) in Akure. Samples were collected from key-pad and screen parts of the ATM devices with sterile swab sticks and was cultured immediately on Nutrient agar, Manitol salt agar, and MacConkey agar mediums for Microbial examination. Standard bacteriological methods were employed in the analysis of the sample. Presumptive identification of bacterial isolates was by cellular morphology, Gram staining reaction, motility, catalase, coagulase test, oxidase strip test and MICROBACT Biochemical Identification system was used to identify the species of the oxidase negative Gram negative bacteria.

**Results:** Out of 30 ATMs keypads examined in the two locations, 28 and 22 yeilded bacteria growth in Akure main Market and FUTA Campus respectively. The organisms isolated were *Staphylococcus aureus*, *Klebsiella* species, *Escherichia coli*, *Pseudomonas* and *Bacillus* species. All the bacterial isolates showed high resistance to Ampicillin but low resistance to Ciprofloxacin.

**Conclusion:** The study confirmed the presence of pathogenic bacteria species on ATM keypads with possible health implications in Akure, Nigeria. Daily and regular cleaning regimen of the keypads with sanitizers, and public enlightenment on the hygienic usage of the keypads is necessary to reduce health risks to the users.

**Keywords:** Automated Teller Machine Antibiotics, Bacteria, Akure metropolis

## 1.0 INTRODUCTION

Customers of financial institutions perform financial transactions, such as transfer of funds, obtaining account information, cash withdrawals and deposits at their convenience without direct interaction or contact with bank officials using Automated Teller Machines (ATMs) [1]. Requirements for ATMs has increased parallel to their expanded functions in financial procedures. They are not only used for cash supply, they also offer service on different kind of monetary procedures such as money transfer, stock market transactions, and bill payments. The use of ATMs has provided an avenue for high human dermal contact with microrgnisms serving as a source of infection and health hazard.

Microorganisms are found everywhere and constitute a major part of every ecosystem. In these environments, they are free living or parasitic [2]. In some cases, they live as transient contaminants in fomites or hands where they constitute a major health hazards as sources of community and hospital-acquired infections [3]. Contamination of environmental objects and surfaces by microorganisms is a common phenomenon. The presence of viable pathogenic bacteria on/in inanimate objects has been reported by some researchers [4,8,14 ]. ATM machine can be contaminated by users' exhalation; sneezing, nasal droplets, water or mucus from mouth and nose, air microorganisms brought by winds which settle on them and other reactions which leaves the key boards contaminated [5].

ATMs represents a good transient environment for development of pathogenic microbes especially *Salmonella, Escherichia coli* as previously reported [6,11,20]. The faecal coliform group includes genera such as Enterobacter and *Klebsiella* which are commonly associated with public devices [7]. Pathogens spread among people with direct or indirect contact on hands or on inanimate objects [8]. Most ATMs in Nigeria are mainly located in city centres, trade areas, and sometimes around hospitals. Hundreds of people whose socioeconomic levels and hygienic status are quite different with each other make use of ATMs daily. The point of contact is the customer's hands to the surfaces of keypad and/or screen of these devices. Anastasiades et al [9] reported that ATM's located in hospitals were most contaminated (100%) while those in fast food centres were least contaminated (50%). The levels of contamination could be linked to several factors ranging from frequency of machine use, hygiene status of users and the surrounding environment. Keypads of ATMs located within and around campuses ranked next to those in hospitals, in levels of contamination, revealing that users of the ATM on campuses are not acquainted with simple hygiene tips [2]. It was reported that keypads of ATMs located in banks and fast food centres were least contaminated [10], this differs with the work by Oluduro et al [11] who recorded more contamination in keypads located in banks than those located elsewhere. Investigation of the microbial load of ATMs is of great importance since the the electronic devices is spread accross many areas and is easily contaminated with pathogenic bacteria. The aim of this study was to assess the bacterial contamination of ATMs in Akure, ondo State Nigeria

## 2.0 METHODOLOGY

### 2.1 Study Area

The study was carried out in Akure, Ondo-State, Nigeria. Akure is the capital and largest city of Ondo-State, South Western Nigeria. It covers a land area of 14,793 square kilometres. It lies between latitude 7.250771 and longitude 5.210266 with gps coordinates of 7°15"2.77N and 5°11'42"E . Akure has a population of about 484, 798. The people are of Yoruba ethnic group. The study vicinity has a subtropical weather, the raining season is usually from April to October while the dry season begins in November and ends in the month of February with relative humidity between 70-85%.

### 2.2 Sample Collection

A total of 60 ATM devices were sampled, with thirty each in Akure Market Centre and The Federal University of Technology Akure (FUTA) Campus respectively. The ATMs were selected for swabbing in the early hours of 5:00 to 6:30 local time. Sampling was repeated thrice. Samples were collected from keypad and screen parts of the ATM devices with sterile swab sticks. The swabs were immediately dipped into labelled tubes containing nutrient broth and transported to the Biology Research laboratory in ice chest.

### 2.3 Isolation and Identification of Bacterial Isolates

The samples were cultured immediately on Nutrient agar, Manitol salt agar, and MacConkey agar mediums for Microbial examination and frequency counts respectively. Cultures were then incubated at 37°C for 24 hours for microbial growth and isolation. The isolated colonies were examined and recorded based on the type of growth, elevation, size, colour, margin, edge, consistency, opacity, and change in medium [12]. Gram staining technique was carried out as previously described [12].Catalase test was carried out on the Gram-

positive cocci to differentiate *Staphylococcus spp* from *Streptococcus spp* [12]. Coagulase test was done to identify *S. aureus* which produces the enzyme coagulase. Oxidase test was done on the Gram-negative bacilli (GNB) to identify *Psuedomonas species* from other Gram -Negative bacilli [12]. MICROBACT Biochemical Identification system was used to identify the species of the oxidase negative GNB. MICROBACT standardised micro-substrate systems was used for the rapid identification of Enterobacteriaceae and common miscellaneous Gram-negative bacilli (MGNB) .

### 2.4 Antibiotic Susceptibility

Broth dilution technique described by Clinical Laboratory Standards Institute [13] guidelines was used for the antibiotic susceptibility tests on the urine isolates. The test was carried out by using conventional antibiotic disc. The antibiotic disc was placed gently on solidified agar plate already inoculated with the test organism. Isolates were considered sensitive after incubation for 24 hours at 35$^{o}$C by measuring zone of inhibition with meter rule which was then compared with zone diameter interpretative to Clinical and Laboratory Standard Institute 2015. The tested antibiotics were Ampicillin, Tetracycline, Ciprofloxacin, Amoxicillin and Erythromycin.

## 3.0 RESULTS

### 3.1 Microbial Contamination of ATMs and Locations

Table 1 shows the relationship between the sample location and the bacteria isolated from each ATMs. Twenty-eight (93.3%) and 22 (73.3%) out of the 30 sampled ATMs were contaminated in main Market and FUTA Campus respectively. A total of 102 and 86 bacteria were isolated from the main Market and FUTA Campus respectively. No significant difference was observed between the locations .

**Table 1:** Microbial contamination of ATMs based on their locations in Akure

| Location | No of ATMs examined | No +ve for bacteria | Total no of organisms isolated |
|---|---|---|---|
| Akure main Market | 30 | 28 | 102 |
| FUTA Campus | 30 | 22 | 86 |

P= 0.029

### 3.2 Relationship Between Microbial Isolates, Source of Collection and Its Frequency

Table 2 shows the relationship between the six bacteria isolates recovered from the ATMs in the two locations. *S. aureus* were isolated from ATMs in the main market and FUTA camus at a frequency of 26 (86.7%) and 22 (73.3%) respectively, *Bacillus* spp. at a frequency of 28 (93.3%) and 18 (60%) respectively, *Pseudomonas* spp at a frequency of 16 (53.3%) and 13 (43.3%) respectively and *Klebsiella* spp. at a frequency of 18 and 12 respectively. The result shows a significant difference ($p<0.05$) between the sources of collection. For *E. coli* at a frequency of 22 (73.3%) and 17 (56.7%)and *S. epidermis* at a frequency of 10 (33.3%) and 11 (36.7%) in the main market and FUTA campus respectively, no significant difference in relation to the sources of collection was observed.

**Table 2:** Relationship between Microbial isolates, Source of collection and its frequency

| Microbial isolates | ATM Location | Frequency ±SE (n=30) | Df | t - value | p value |
|---|---|---|---|---|---|
| *S. aureus* | Market | 26.00 ±1.73 | 1 | 6.930 | 0.020 |
| | Campus | 22.00 ±1.15 | | | |
| *E. coli* | Market | 22.00 ±1.15 | 1 | 2.890 | 0.102 |
| | Campus | 17.00 ±0.58 | | | |
| *Bacillus* sp | Market | 28.00 ±1.15 | 1 | 17.320 | 0.003 |
| | Campus | 18.00 ±0.58 | | | |
| *Pseudomonas* sp | Market | 16.00 ±1.15 | 1 | 5.200 | 0.035 |
| | Campus | 13.00 ±0.58 | | | |
| *Klebsiella* sp | Market | 18.00 ±1.15 | 1 | 10.390 | 0.009 |
| | Campus | 12.00 ±1.73 | | | |
| *S. epidermis* | Market | 10.00 ±1.73 | 1 | -0.870 | 0.478 |
| | Campus | 11.00 ±0.58 | | | |

Table 3 shows the antibiotics resistance pattern observed in the isolates. All the bacterial isolates showed high resistance to Ampicillin but low resistance to Ciprofloxacin. *Bacillus* species showed the lowest resistance to three out the five antibiotics sampled.

## 4.0 DISCUSSION

This study evaluated the microbial contamination of ATM keypads in Akure metropolis. Of the 60 ATMs keypads sampled, 50 (83.33%) were contaminated with bacteria which is relatively high. This result is consistent with the work of Igbo et al [14] in Calabar, Nigeria. The level of contamination observed could pose serious health

**Table 3:** Antibiotics Resistance Pattern in Bacterial Isolates from ATMs

| Bacteria Isolates | Ampicillin | Tetracycline | Ciprofloxacin | Amoxicillin | Erythromycin |
|---|---|---|---|---|---|
| *S. aureus* | 76.0 | 51.2 | 34.0 | 64.1 | 50.0 |
| *E. coli* | 75.0 | 39.1 | 28.0 | 64.0 | 65.1 |
| *Bacillus sp* | 60.2 | 50.0 | 11.6 | 38.1 | 43.1 |
| *Pseudomonas sp* | 97.2 | 50.0 | 52.4 | 98.6 | 100.0 |
| *Klebsiella sp* | 96.1 | 76.4 | 27.2 | 52.0 | 78.0 |
| *S. epidermis* | 62.7 | 46.0 | 4.8 | 28.1 | 60.7 |

risks to the ATM users. This level of contamination also reflects the poor hygiene status of users and the contributory factors of the polluted environment. Keypads of ATMs located in the market were more contaminated than those from the banks on FUTA campus. Reasons for this may be that more people use the ATMs in the market place than the on campus and also the different hygienic status of the users, considering the fact that about 80% of infectious diseases are spread through hand contact with contaminants or fomites [15]. The users in the market which are mostly traders take hygiene with levity, they tend to touch different dirty objects and in the process of using the machines for transactions inoculate these microorganisms into them. However, this result is contrary to the works of Chairman et al [16] and Oluduro et al [11] who reported higher contamination of ATM keypads located in banks.

The result of this study corroborates the work of Okoro et al [17] in Ebonyi state, Nigeria which showed that *S. aureus* are ubiquitous and can be found on several expose surfaces. The presence of *S. aureus* and *S. epidermis* on these machines is of great public health concern. The identified microorganisms have pathogenic potential and hence their presence on such surfaces could serve as a source of cross-transmission of bacterial and fungal infections to the ATM users [18]. *Staphylococcus aureus* was the most frequently isolated bacteria which are present in human nose and skin, and known to be responsible for several infections such as bacteremia, endocarditis, urinary tract infections, boils, and abscess of wound infection [17,18,19]. Various disease such as pathogens related to throat infection, pneumonia, urino-genital tract infection and lung abscess have also been reported to spread through ATM machines [20]. Isolation of bacterial from ATM keypads have confirmed that they may play an important role in the transmission of pathogenic microorganisms as well as in the spread of bacteria drug-resistant strains in the community. Antimicrobial resistance is a global phenomenon that has resulted in high morbidity and mortality as a result of treatment failures and increased health care costs [21].

This study has confirmed the presence of pathogenic bacteria species on ATM keypads which may have possible health implications. The need to combine technological innovation with safe and healthy use is therefore advocated for. Transmissions of these bacteria especially antimicrobial resistant strains may lead to serious infections. Hygienic measures such as thorough hand washing with soap after using the keypads should be observed. Regular hand washing and the use of hand sanitizer should be encouraged by the users of ATM machines through public enlightenment [22]. The daily and regular cleaning regimen of the keypads with sanitizers should be encouraged and enforced.

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