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ANTIBIOGRAM OF BACTERIA ISOLATED FROM AUTOMATED TELLER MACHINES WITHIN ABAKALIKI METROPOLIS

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ABSTRACT

The Automated Teller Machine (ATMs) is likely to be contaminated with various microorganisms due to their vast dermal contact by multiple users. The metallic keypads of ATMs were examined to investigate their potentials as source of bacterial contamination and also the antibiogram of the isolated organisms. The study lasted from August, 2012 to October, 2012 involving several procedures like culturing, identifying the organisms using biochemical tests and Kirby Bauer disc diffusion method for antibiotic sensitivity tests. Swabs from the keypads of 20 ATMs were examined and the results indicated the contamination of the keypads with *Staphylococcus aureus* 9 (50%), *Klebsiella* species 6 (33.3%) and *Escherichia coli* 3 (16.7%). The antibiogram were ascertained using Kirby Bauer disc diffusion method and the result showed that *Staphylococcus aureus* was 89% resistant to ampicillin, followed by penicillin (78%), nalidixic acid (78%) and augmentine (70%), while 33% and 30% were susceptible to peflacine and gentamycin respectively. *Klebsiella* species were 100% resistant to erythromycin, followed by tetracycline (83%), penicillin (83%), ampicillin (83%) and nalidixic acid (70%) but showed high level susceptibility to cotrimoxazole (65%), ciproflocacin (64%) and augmentine (64%). *Escherichia coli* were 100% resistant to tetracycline and penicillin, followed by augmentine (90%) and ampicilin (85%), but 70% susceptible to ceporex, followed by peflacine (65%) and ciprofloxacin (65%). Hand washing and proper cleaning regimen should be practiced to reduce contamination on the ATMs.

Keywords: ATMs, Bacterial Contamination, Antibiotics Resistance, Abakaliki Metropolis

1. INTRODUCTION

An Automated Teller Machine or Automatic Teller Machine (ATM) is a computerized telecommunications device that enables the clients of a financial institution to perform financial transactions without the need for a cashier, human clerk or bank teller. ATMs are known by various other names including ATM machine, automated banking machine, cash dispenser and various regional variants derived from trademarks on ATM systems held by particular banks (Rasiah, 2010). A typical usage of the ATM machine involves slotting a card into a recipient hole and following on screen instructions, by punching the keys of the metallic keypads to enter secret codes and commands; thus instructing the machine as to kind of service one requires (Sharma and Anand, 2002). The ATM machine is likely to be contaminated with various

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microorganisms due to their vast dermal contact by multiple users.

Human beings have a marked tendency to pick up microorganisms from environmental objects and the hand has been shown to play a role in the transmission of organisms. Colonization of objects by pathogenic organisms has been reported as a potential vehicle for their transmission (Neely and Maley, 2000; Gerba, 2005; Famurewa and David, 2009; Ulger *et al*., 2009; Fraser and Girling, 2009; Gholamreza *et al*., 2009). Furthermore, microorganisms found to contaminate fomites have also been shown to persist on environmental surfaces for varying periods of time ranging from hours to months (French *et al*., 2004). Hence cross infection of microorganisms between environmental surfaces and a host has equally been established (Hardy *et al*., 2006).

Salmonella species and *Escherichia coli* have also been shown to be transferred from the hands to raw processed and cooked foods, even at low levels on the fingers (Humphrey *et al*., 1994; Rusin *et al*., 2002). Kissiedu (2002) also showed that snacks eaten with the fingers can easily be cross contaminated by bacteria from the hands after handling dirty currency notes. It has also been shown that, microbes once attached to hands and some surfaces may survive for a while and may be difficult to remove (Filho *et al*., 1987; Hood and Zottola, 1997).

Few works have reported on bacterial contamination of ATMs in the banks. Hence, this present study was designed to evaluate the antibiogram of bacteria present on the touched metallic keypads of ATMs within Abakaliki Metropolis and also to ascertain the possibility of cross-contaminating fingers during use of the ATMs with these bacteria which are likely to be pathogenic.

2. MATERIALS AND METHODS

2.1. Study Area

This study was conducted within the Abakaliki Metropolis in Ebonyi State. The study was undertaken from August 13th to September 10th 2012.

2.2. Sample Collection

Twenty Automated Teller Machines (ATMs) of eight different banks (Ecobank, Diamond Bank, Stanbic Bank, United Bank of Africa, Guarantee Trust Bank, Access Bank, Zenith Bank and Enterprise bank) situated along Ezza Road/Ogoja and Water Works Road was used for the study. Permission was sought from the management of all the banks to use the facilities. The single sterile swab sticks moistened with sterile distilled water were moved over the surfaces of the metallic keypads of ATMs. The swab sticks were immediately transported to the Microbiology laboratory complex, Ebonyi State University for microbiological analysis.

2.3. Standardization of Test Organisms

0.5 McFarland scale was used to standardize the test organisms.

2.4. Susceptibility Testing

The isolates were tested for antimicrobial susceptibility using Kirby Bauer agar disc diffusion method (Cheesbrough, 2006). Various antimicrobial agents used were ampicillin, cefixime, cloxacillin, cotrimoxazole, teteracycline, penicillin, gentamycin, erythromycin, nalidixic acid, tarivid, peflacine, ciprofloxacin, ceporex and augmentin. The diameter of the zones of inhibition surrounding the antimicrobial disc was measured to the nearest mm. isolates were deemed resistant only when the zones of inhibition was less or equal to the resistance breakpoint recommended by the NCCLS (2000).

3. RESULTS

Four different bacteria isolates (*Staphylococcus aureus*, coagulase negative *Staphylococcus aureus*, *Klebsiella* species and *Escherichia coli*) were obtained from the Automated Teller Machines (ATMs) as shown in **Table 1**.

Table 2 below shows the different biochemical tests that the suspected isolates were subjected to. The isolates tested with positive or negative to oxidase, catalase, citrate, coagulase and indole test.

Table 1. Colony morphology of the isolates

Isolates	Cultural characteristics	Microscopic characteristics	Gram stain
Staphylococcus Aureus	Round, smooth and colonies with pinkish colour on raised on MacConkey agar	Cocci that forms irregular clusters and non-motile	Positive
Coagulase negative	Round, smooth and raised colonies with pinkish colour on MacConkey agar	Cocci that forms irregular shaped clusters and are non-motile	Positive
Klebsiella species	Round mucoid colonies on MacConkey agar	Capsulated rod shaped organism that are non-motile	Positive
Escherichia coli	Flat and smooth colonies MacConkey	Rod shaped motile organism	Positive

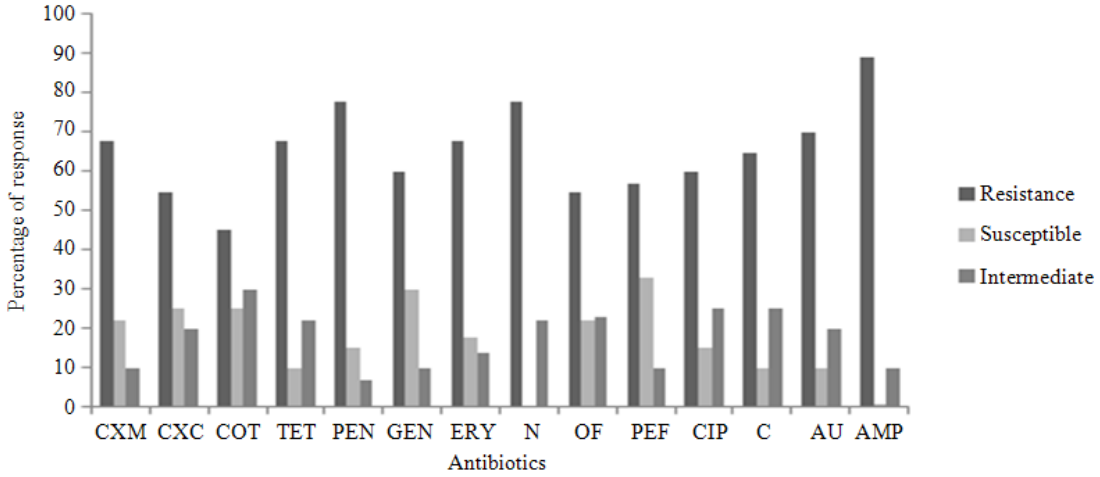

Fig. 1. Antibiotic sensitivity pattern of S. aureus in percentage

Table 2. Biochemical characteristic of the isolates

Isolates	Oxidase	Catalase	Citrate	Coagulase	Indole	Suspected organisms
1	-	+	-	+	-	*Staphyloco ccus* aureus
2	-	-	+	-	-	*Klebsiella* species
3	-	-	-	-	+	*Escherichia coli*

Key: + = Positive, - = Negative

Table 3. Frequency of bacterial occurrence in ATMs metallic keypads

Isolates	Keyboards (%)
Staphylococcus aureus	9 (50)
Klebsiella species	6 (33.3)
Escherichia coli	3 (16.7)
Total	18 (100)

Out of 20 samples analyzed, a total of 18 bacteria isolates were obtained from ATMs metallic keypads. Out of which 9 *Staphylococcus aureus*, 6 were *Klebsiella* species and 3 were *Escherichia coli* as shown in **Table 3**.

Table 4 shows the antibiotic sensitivity test result of the isolates. The zone of inhibition of the antibiotics was measured in millimeter. The organism responses were sensitive, immediate or resistive to the antibiotics. The table below shows that the organisms developed the highest resistance to penicillin and tetracycline but were susceptible to ciprofloxacin and cotrimoxazole.

Ampicillin showed the highest resistance % response profile among all the antibiotics tested against *S. aureus*, followed by nalidixic acid and penicillin, while cotrimaxole showed the lowest resistance % response profile among all the antibiotics tested against *S. aureus*. Peflacine showed the highest susceptible % response profile among all the antibiotics tested against *S. aureus*, followed by gentamycin and cotrimaxole, while nalidixic acid and ampicillin showed the lowest susceptible % response profile among all the antibiotics tested against *S. aureus*. Cotrimaxole showed the highest intermediate % response profile among the entire antibiotics test against *S. aureus*, followed by ceporex and ciprofloxacin, while penicillin showed the lowest intermediate % response profile among all the antibiotics tested against *S. aureus* (**Fig. 1**).

Erythromycin showed the highest resistance % response profile among all the antibiotics tested against *Klebsiella* species, followed by ampecillin, penicillin and tetracycline, while peflacine and augmentin showed the lowest resistance % response profile among all the antibiotics tested against *Klebsiella* species. Cotrimaxole, ciprofloxacine and augmentin showed the highest susceptible % response profile among all the antibiotics tested against *Klebsiella* species, while erythromycin, ofloxacine and ampicillin showed the lowest susceptible % response profile among all the antibiotics tested against *Klebsiella* species. Peflacine showed the highest intermediate % response profile among the entire antibiotics test against *Klebsiella* species, followed by ceporex, cefixime, cloxaciline, peflacine, ciprofloxacin and augmentin, while tetracycline, penicillin and erythromycin showed the lowest intermediate % response profile among all the antibiotics tested against *Klebsiella* species (**Fig. 2**).

Tetracycline and penicillin showed the highest resistance % response profile among all the antibiotics tested against *Klebsiella* species, followed by augmentine, while gentamycin, peflacine and ciprofloxacin showed the lowest resistance % response profile among all the antibiotics tested against *Escherichia coli*. Ceporex showed the highest susceptible % response profile among all the antibiotics tested against *Escherichia coli*, followed by peflacine and ciprofloxacine, while cotrimaxole, tetracycline, penicillin, erythromycin, nalidixic acid, ofloxacine, augmentine and ampicillin showed the lowest susceptible % response profile among all the antibiotics tested against *Escherichia coli*. Ofloxacine showed the highest intermediate % response profile among the entire antibiotics test against *Escherichia coli*, while cloxacillin, tetracycline and penicillin showed the lowest intermediate % response profile among all the antibiotics tested against *Escherichia coli* (**Fig. 3**).

Table 4. Antibiotic sensitivity pattern of isolates measure in millimeter

Isolates Code	AMP	CXM	CXC	COT	TET	PEN	GEN	ERY	N	OF	PF	CIP	C	AU
S. aureus 1	R	16	R	22	R	R	17	13	R	R	R	R	R	R
S. aureus 2	R	12	10	15	R	R	2	1	R	17	18	2	R	R
S. aureus 3	17	2	18	24	11	10	14	19	20	12	1	20	20	18
S. aureus 4	R	R	R	12	10	5	10	10	R	R	R	7	R	R
S. aureus 5	12	10	13	R	R	10	14	12	R	R	15	22	18	22
S. aureus 6	R	16	10	11	R	17	15	16	10	17	15	19	10	R
S. aureus 7	R	20	18	20	19	18	20	25	20	20	R	17	R	R
S. aureus 8	10	10	14	15	17	5	12	R	10	18	14	R	14	12
S. aureus 9	10	R	1	17	15	R	R	R	R	R	1	5	10	15
Klebsiella 3	12	R	R	17	R	R	22	R	15	15	18	22	15	10
Klebsiella 4	10	16	R	10	R	R	R	R	17	12	15	16	17	19
Klebsiella 5	10	21	19	22	22	22	R	R	R	R	R	19	21	20
Klebsiella 6	R	15	15	20	R	R	R	R	R	15	21	19	R	20
E. coli 1	R	10	R	14	R	R	15	R	12	15	20	22	R	R
E. coli 2	R	15	R	15	R	R	15	R	15	15	13	15	15	10
E. coli 3	R	R	22	R	R	R	25	14	12	10	15	18	21	10

Key: E. coli = *Escherichia coli*, R = Resistance, AMP = Ampicillin, CXM = Cefixime, CXC = Cloxacillin, COT = Cotrimoxazole, TET = Teteracycline = PEN = Penicillin, GEN = Gentamycin, ERY = Erythromycin, N = Nalidixic acid, OF = Tarivid, PF = Peflacine, CIP

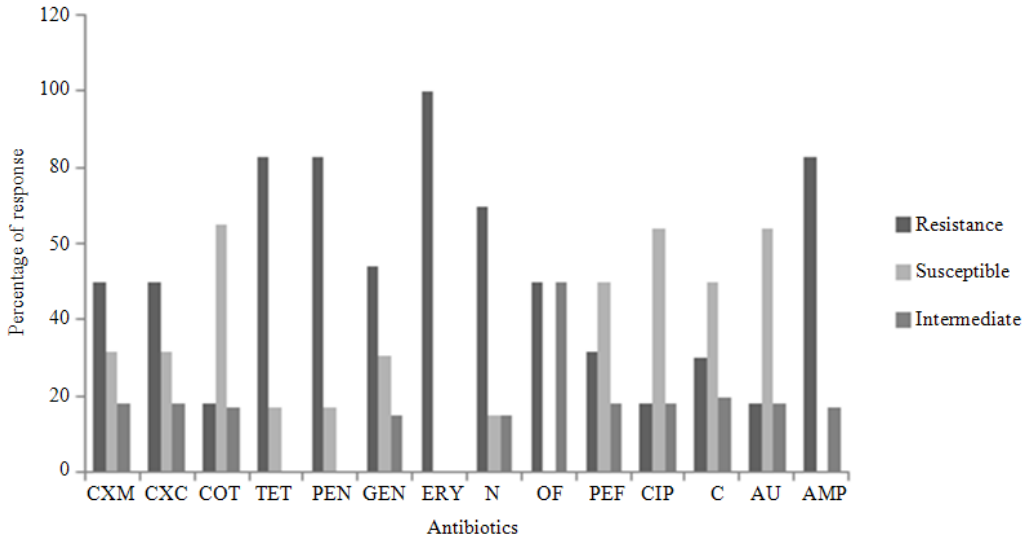

Fig. 2. Antibiotic sensitivity pattern of *Klebsiella* species in percentage

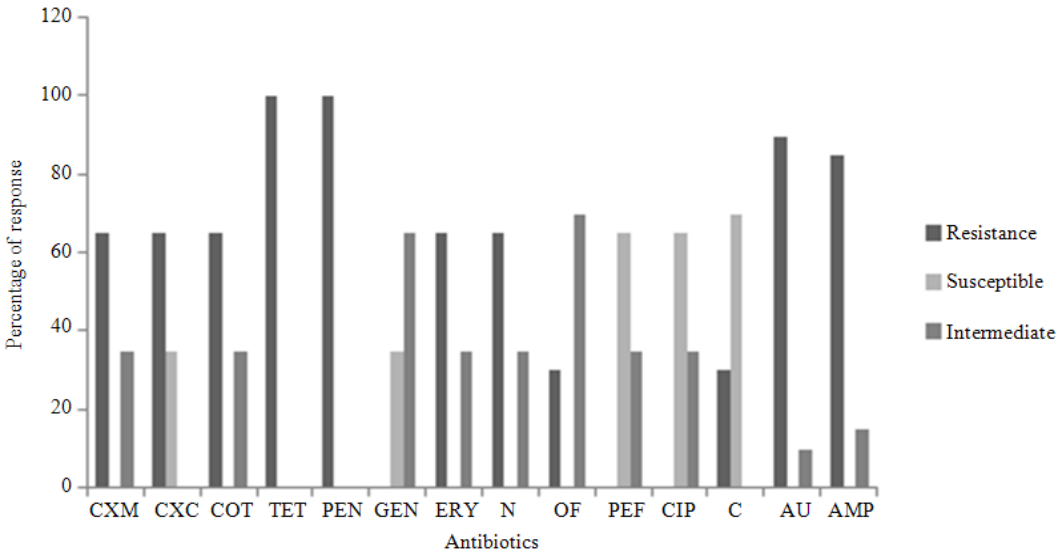

Fig. 3. Antibiotic sensitivity pattern of *Escherichia coli* species in percentage

4. DISCUSSION

The results of this study showed high level of bacterial contaminations of the surfaces of the metallic keypads of ATMs with *Staphylococcus aureus*, *Klebsiella* species and *Escherichia coli.* The number of microorganisms present on a surface is amongst the microbe-associated factors that determine whether an infection will occur or not (Neely and Sittig, 2002). Apart from the quantity of bacteria, the type and quality of microorganism present on a surface is also an important determinant of whether an infection will occur or not (Oluduro *et al*., 2011).

The high level of bacterial contamination seen in this study is in line with the study of Oluduro *et al*. (2011), who reported that keypads of ATMs haboured more bacteria than computer keyboards and this may be due to the fact that ATMs are usually located in the open, exposed to wind and rain. This study is also in agreement with the study of Abban and Tano-Debrah (2011) who reported the presence of *Staphylococcus* species, *Escherichia* species and *Klebsiella* species on the keypads of ATM machines. In the same vein, Anastasiades *et al*. (2009) reported that *Staphylococcus aureus* are prevalent on computer keyboards and mouse.

The result of this study is of public health concern especially for expatriates residing in Abakaliki Metropolis; Rusin *et al*. (2002) reported that even low levels of *Salmonella* spp. and some *Escherichia coli* strains can easily be transferred from the fingers to food surfaces.

It has been observed that antibiotic susceptibility of bacterial isolates is not constant but dynamic and varies with time and environment (Hassan, 1995). This therefore demands the need for periodic screening of common bacterial pathogens for their antibiotic susceptibility profiles in different communities (Rahman *et al*., 2007). The antibiogram result of this study showed that *Staphylococcus aureus* was 89% resistant to ampicillin, followed by penicillin (78%), nalidixic acid (78%), augmentine (70%), cefixime (68%), tetracycline (68%), erythromycin (68%), ceporex (65%), gentamycine (60%), ciprofloxacin (60%), peflacin (57%), cloxacilline (55%) and tarivid (55%), while 33% and 30% were susceptible to peflacine and gentamycin respectively. This is an indication that the *S. aureus* isolated were multiple drug resistance. All most all the antibiotics tested were resistance to *S. aureus*. This result agrees with the result of the study carried out at Cape Town, Ghana by Tagoe and Kumi-Ansah (2011) where *Staphylococcus aureus* was 83% resistant to ampicillin, penicillin and nalidixic. In the same vein Oluduro *et al*. (2011) reported that *S. aureus* resistance to 2 antibiotics was the commonest multiple antibiotic resistance patterns observed, while resistance to a combination of 3 antibiotics was also prevalent. *Klebsiella* species were 100% resistant to erythromycin, followed by tetracycline (83%), penicillin (83%), ampicillin (83%), nalidixic acid (70%), gentamycine (54%) cefixime (50%), cloxacilline (50%) and tarivid

(50), but showed high level susceptibility to cotrimoxazole (65%), followed by ciproflocacin (64%), augmentine (64%), peflacine (50%) and ceporex (50%). *Escherichia coli* were 100% resistant to tetracycline and penicillin, followed by augmentine (90%), ampicilin (85%), cefixime (65%), cloxacilline (65%), cotrimoxazole (65%), erythromycin (65%) and nalidixic acid (65%), but 70% susceptible to ceporex, followed by peflacine (65%) and ciprofloxacin (65%). This study is similar to the study of Issmat *et al*. (2007) who isolated multi-drug resistant bacteria from public interfaces (computer surfaces). Occurrence of resistance in pathogens may reduce the effectiveness of previously useful antibiotics (Toroglu and Dincer, 2008). This study disagrees with the result of the antibiogram data obtained by Oluduro *et al*. (2011) where the susceptibility of *Escherichia coli* to erythromycin and ciproflox was 93% and 35% respectively. The variation in the result might be because of variation in geographical locations, environmental conditions and genetic background of the organism and the abuse of drugs in a location which leads to drug resistance (Anupurba *et al*., 2006).

5. CONCLUSION

This study confirmed the presence of bacterial contamination on ATM metallic keypads. The organism isolated were *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species and a coagulase negative *Staphylococcus aureus*. The result of the antibiotic test showed that cotrimoxazole, ciprofloxacin and augmentine are drugs of choice for *Klebsiella*. Also, ceporex, peflacine and ciprofloxacin showed to be the drugs of choice for *Escherichia coli*. Indeed, has demonstrated that microbial contamination of ATM keypads may be a common mechanism of transfer of potentially pathogenic bacteria, among users.

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