CODEN (USA): IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.377013

Available online at: http://www.iajps.com *Research Article*

COMPARATIVE STUDY OF THE ANTIBIOGRAM OF SOME BACTERIA ISOLATED FROM AUTOMATED TELLER MACHINE (ATM) KEYPADS FROM ABAKALIKI AND AFIKPO IN EBONYI STATE.

Nworie, Okoro[1],Udu Nkechinyere,[1] Orji Jerry O[2], Egwu Eze[3], Nnorom Mac-Anthony Ezennia[1],Ukpabi Nkechinyere Nwali[2] and Onu Euslar N[4]

[1]Department of Biology, Microbiology and Biotechnology, Faculty of Science, Federal University Ndufu Alike Ikwo, Ebonyi State, Nigeria.

[2]Department of Applied Microbiology, Faculty of Science, Ebonyi State University Abakaliki, Nigeria.

[3]Medical laboratory Department Federal Teaching Hospital Abakaliki, Ebonyi State, Nigeria.

[4]Ebonyi State School of Health Mgbo, Ohaukwu Local Government Area, Ebonyi State, Nigeria.

Received: 28 December 2016 **Accepted:** 28 January 2017 **Published:** 28 February 2017

Abstract:

Automated Teller Machine (ATM) is used by millions of people each day and it is likely to be contaminated with different microorganisms. The ATM keypads were examined to assess them as a potential source of bacterial contamination and to provide the antibiogram of the isolated bacteria. The study lasted from April, 2016 to June, 2016. The procedures involved culturing and identifying swabs from the keypads of 20 ATMs using biochemical tests and Kirby Bauer disc diffusion method for the antibiotic sensitivity tests. The result indicated contamination of the keypads with Staphylococcus aureus 15 (44 %), Escherichia coli 8 (24 %), Klebsiella species 10 (29 %) and Enterobacter species 1 (3 %). There was no significant difference among the bacteria isolated ($p > 0.05$). The result of the antibiogram showed variation in the susceptibility pattern of the isolates to the antibiotics. Stapphylococcus was 92% resistance to penicillin, followed by ampiclox 85 %, erythromycin 77 % and augmentine 62 %, and while 62 %, 46 % were susceptible to levofloxacine and streptomycine respectively. Escherichia coli was 100% resistance to norfloxacine, followed by penicillin and amoxyl 86%, while 71% of E. coli was susceptible to levofloxacine, followed by ciprofloxacine 57 % and gentamycine 43 %. Klebsiella species were 80 % resistance to penicillin and erythromycin, followed by ampiclox and nalidixic acid 60 %, but 80 % susceptible to levofloxacine, and 60 % susceptible to augmentine, ciprofloxacin and chloramphenicol. The variation of the isolates to the antibiotics demands the need for periodic screening of common bacterial pathogen.

Keywords: *Antibiogram, Bacteria, Automated teller machine (ATM), Abakaliki and Afikpo.*

Corresponding Author:
Nworie Okoro,
Department of Biology,
Microbiology and Biotechnology,
Faculty of Science, Federal University Ndufu Alike Ikwo,
Ebonyi State, Nigeria.

QR code

Please cite this article in press as Nworie Okoro et al, ***Comparative Study of The Antibiogram of Some Bacteria Isolated from Automated Teller Machine (ATM) Keypads from Abakaliki and Afikpo in Ebonyi State****, Indo Am. J. P. Sci, 2017; 4(02).*

INTRODUCTION:

Automated Teller Machine (ATM) is a device that provides the clients of financial institution with access to money transaction in a public space without the need of bank customer [1]. They are the longest standing and most widely used form of computer driven public technology with an estimated over 2.4 million units in use, since their invention and use in the late 1960's [2].

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 the kind of service one requires [3]. ATM machine is likely to be contaminated with various microorganisms due to their vast dermal contact by multiple users [4]. The presence of viable pathogenic bacteria on inanimate objects has been reported by earlier investigators [5]. *Salmonella* species and *Escherichia coli* has also been shown to be transferred from hands to raw processed and cooked foods, even at low levels on the fingers [6]. Furthermore, microorganisms found to contaminate fomites has also been shown to persist on environmental surfaces in varying periods of time ranging from hours to months [7]. In addition, bacteria that can cause severe gastroenteritis have been found on ATM keypad and cross infection of microorganisms between environmental surfaces and a host has equally been established [8]. 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.

Atmospheric pollution has become one of the most pressing challenges of our age. This pollution has now reached an advance level that possesses a potential threat to the health and well-being of the population. Bacterial pathogens still play a considerable role in environment making a potential reservoir for bacterial pathogens since diverse pathogenic microorganisms and a large number of susceptible bacterial pathogen associated with a background rise in various types of indoor and outdoor environments [9]. The increased risk frequency has risen in spreading the pathogenicity from atmosphere where aerosols play a role in adhesion towards the surfaces. The reservoir of any organism, which may be animate or inanimate objects, in the epidemiology of any bacterial disease is very important [10]. The pathogens live and multiply in the reservoir on which their survival depends. Pathogens live on fomites. Many epidemiological studies have confirmed that many contaminated surfaces played a major role in the spread of infectious diseases. Most people do not realize that microbes are found on many common objects outdoors, in their offices, and even in their homes. Such objects include; playground equipment, ATM keyboards, office desks, computer keyboards, escalator handrails, and elevator buttons [10].

Contamination of environmental objects and surfaces is a common phenomenon. 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. Reynold, *et al.* (2005), [11], used an invisible fluorescent tracer for artificial contamination of public surfaces, they found that contamination from outside surfaces was transferred to 86 % of exposed individual hands and 82 % tracked the tracer to their home or personal belongings hours later. Some microbes are infectious at very low doses and can survive for hours to weeks on non porous surfaces. Tekerekolu *et at*. (2011), [12], have also demonstrated that cell phones of patients, visitors and health care workers were contaminated with various type of microorganisms. But like all surfaces microbial colonization of these metallic keypads are eminent, particularly when there are no proper cleaning regimens in place for most of these facilities [13].

Many factors have been shown to influence the bacteria transfers between surfaces, including the source and destination surface features, bacterial species involved, moisture levels, pressure and friction between the contact surfaces and inoculums size on surfaces [14]. It has also been shown that snacks eaten with the fingers can easily be cross contaminated by bacteria from the hands after handling dirty currency notes. Furthermore, microbes once attached to hands and to some surfaces may survive for a while and may be difficult to remove [15].

Bank Automated Teller Machines are the essential requirements of our social life. They are frequently located in city areas, trade areas and around the hospitals. Hundreds of people whose socio-economic levels and hygiene status are quite different with each other use ATM daily [16].

People believe that microbes are only present in research laboratories or in hospitals and clinics and thus they have a misleading feeling of security in other places. Inadequate knowledge about where germs prowl could be the cause of health problems [10]. In fact 80% of infections are spread through hand contact with hands or other objects. ATM once contaminated becomes vehicles for transmission of infection, such that the user may succeed in picking these pathogens after making use of the Automated Teller Machine, since there is no restriction as to who has access to the facility, and no guidelines to ensure hygienic usage [1].

ATM with pathogenic bacteria is a serious challenge due to its ability to transmit diseases, the risk associated with these bacteria further increases with a corresponding increase in their resistance to antimicrobial therapy [17]. Antimicrobial resistance is a global phenomenon that has resulted

in high morbidity and mortality as a result of treatment failures and increased healthcare [18].

Justification of the Study

Since Automated Teller Machines (ATMs) are used by millions of people each day without restriction, and many works have been done on the microbial contamination of the machine [19]. There is a possibility that the machine might be contaminated with antibiotic resistance bacteria. Therefore there is need to create awareness to the public and users of ATM on the possible diseases that are likely to be contacted due to the present of bacterial pathogen at the ATM centres. Hence, this work was mapped out to determine the bacterial diversity and degree of contamination obtainable on the ATM buttons as money is being collected and the level of health risk to which the ATM users are subjected to. In this study, samples from different ATM from different banks in Afikpo and Abakaliki were examined. Bacterial colonies were isolated for identification to give an indication of bacteria present in the Automated Teller Machine keypads.

Aim

This study was aimed to assesse Automated Teller Machines (ATM) keypads and examined the machine as a potential source of bacterial contamination.

Objectives

- To isolate bacteria from Automated Teller Machine (ATM) keypads
- To identify, and characterize the bacteria isolated
- To provide information about the antibiotic resistant pattern of the bacterial isolates
- To recommend a guideline to ensure hygienic usage

MATERIALS AND METHODS:

Study Area

This work was conducted within Abakaliki and Afikpo metropolies. They are the two major towns in Ebonyi State. Ebonyi State is one of the states where low percentage of its population has access to good sanitation. Abakaliki is a big town in Ebonyi State, having about 134,102 inhabitants. The town is situated at 6.32° North latitude, 8.12° East longitude and 117 meters elevation above the sea level. Afikpo is situated at 5.89° North latitude, 7.94° East longitude and 115 meters elevation above the sea level. It has about 71,866 inhabitants. Geophysical survey of each of these banks was run using global positioning system (GPS) to get global information system (GIS) concerning the exert locations (latitude and longitudes). Map of Ebonyi State showing the sampling locations is shown in figure 1.

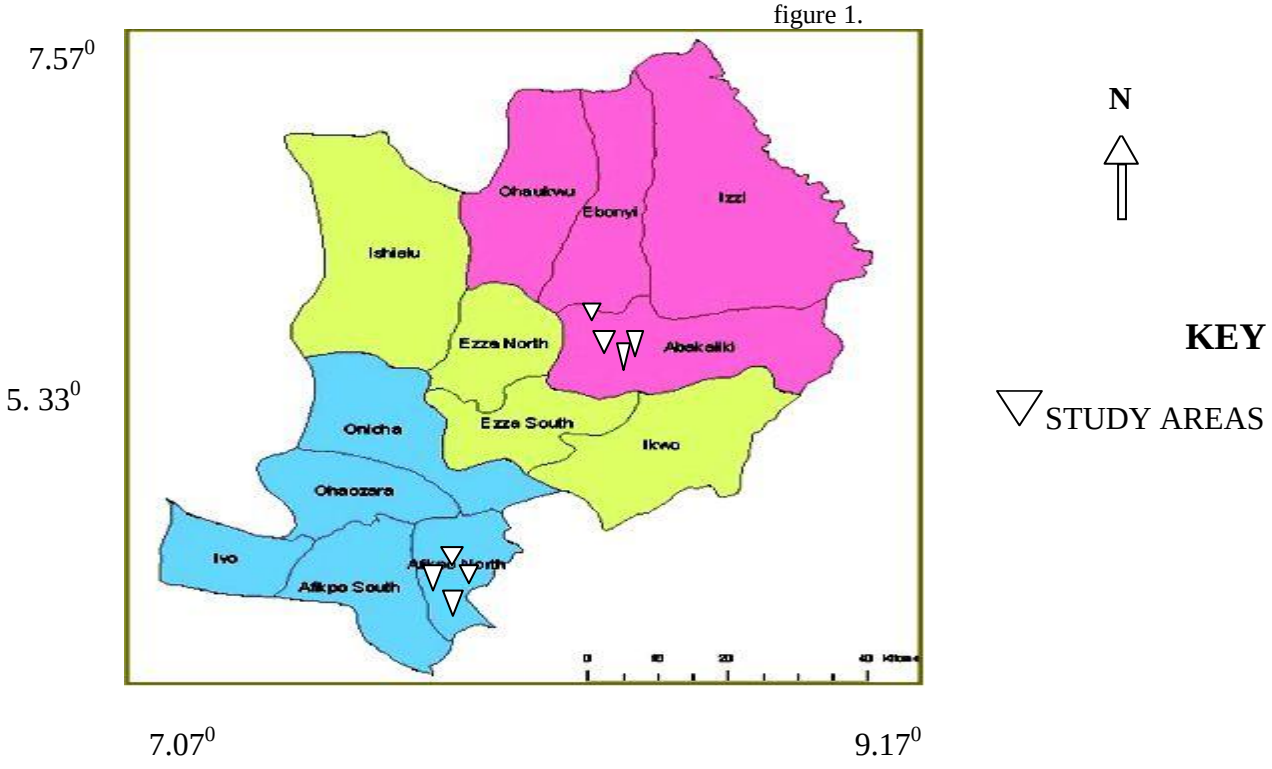

Fig 1: Map of Ebonyi showing sampling location

Sample Collection

Twenty Automated Teller Machines from 8 banks were used for the study. Permission was sought from the Management of all the Banks used in this study in order to use their Automated Teller Machine (ATMs) keypads. Samples were aseptically collected from each ATM keypad by using sterile moisten cotton swabs. The swabs were moved over the surface of the ATM keypads and were immediately taken to the laboratory for bacteriological examination.

Bacteriological Analysis

The swabs were inoculated into different media (nutrient, MacConkey, Eosin Methylene Blue agar) and incubated at 37°C and examined for growth after 24 hours. Bacterial colonies differing in size, shape and colour were further sub-cultured into a freshly prepared media. The pure isolates were then isolated by picking discrete colonies from each of the media plate and inoculated into the freshly prepared nutrient agar inside bijou bottles with wire loop. The bijou bottles were then incubated for 24 hours.

Identification of the Isolates

After obtaining pure colonies, further identifications were carried out on the isolate; they include cultural examination, microscopic examination (Gram staining) and biochemical tests.

Gram staining

This was carried out to differentiate between gram positive and gram negative bacteria. The principle is that Gram-positive bacteria absorb and retain purple colour of crystal violet which make them show purple coloration and this is possible by resisting decolouration by acetone while Gram-negative absorb and retained the red colour of safaranine, accounting for why they show red or pink colour under microscopic examination of the stain.

Procedures

A thin smear of the organism was made on a glass slide using sterilized wire loop. The smear was allowed to air-dry, fixed on a gentle heat of Bunsen flame. It was then kept on a staining rack and flooded with crystal violet (primary stain) and allowed for 60 seconds, and then washed with water. The smear was then covered with lugols iodine (a mordant), and was washed with water after 60 seconds. Again the smear was flooded with acetone for decolourisation and washed immediately with water. Lastly, it was flooded with safaranine (counter stain) and washed with water after 30 -60 seconds. The slides were kept in a slant position on a draining and allowed to air dry. It was then examined with ×100 oil immersion objective lens.

Biochemical Tests

The following biochemical tests were employed in this study to aid the identification of the isolates. A fresh 18-24 hour old culture was used for every biochemical test carried out and they include:

Catalase test

Most aerobic microorganisms possess the enzyme catalase which acts as a catalyst in the breakdown of hydrogen peroxide to oxygen and water.

Procedures

A drop of water was placed on a glass slide, using a wire loop, a colony of the cultured organism was transferred into the slide to make a thick smear of the culture. Then 1 to 2 drops of hydrogen peroxide was placed on the smear and was observed for bubbles.

Citrate utilization test

This was carried out to determine some of the isolates that have the ability to utilize citrate as its only source of carbon for its metabolism. The citrate permease produced by the citrate utilizing organisms facilitates the transport of the citrate into the cell, thereby enabling the organism to utilize it as the sole carbon source.

Procedures

The medium simmon citrate agar was prepared according to the manufacturer's instruction; 5 ml were dispensed into test tubes and sterilized at 121°C for 15 minutes. After autoclaving, the test tubes were kept in a slant position and allowed to solidify. Thereafter, the isolates were inoculated into slope of the test tubes; a positive result was indicated by a colour change from green to bright blue after 48 hours of incubation.

Urease test

Urease is an enzyme that hydrolyses urea to carbondioxide and ammonia. The test was carried out to identify some of the isolated organisms that were able to produce the enzyme urease. The test organism was cultured in a medium that contains urea and the indicator phenol red. When the strain is urea producing, the enzyme will break down the urea to give ammonia and carbondioxide.

Procedure

Urea agar base was prepared according to the manufacturer's instruction, urea was added and dispense in 5 ml into test tubes and sterilized by autoclaving at 121°C for 15 minutes. After autoclaving, it was slanted and allowed solidified, after which they were inoculated with isolates and incubated at 37°C for 18-24 hours.

Indole test

Testing for indole production is important in the identification of some *Enterobacteria* that break down the aminoacid tryptophan with the release of indole. Indole production is detected by Kovacs which contain 4(p)-dimethylaminobenzaldehyde.

Procedures

Peptone water was prepared according to the manufacturer's instruction; 5 ml were dispensed into test tubes sterilized in autoclave for 15 minutes for 121°C. After autoclaving, test organisms were inoculated into the test tubes and incubated at 37°C for 48 hours. About 2-4 drops of Kovac's reagent were added to each of the broth culture which

reacts with the indole to produce a red colouration at the surface of the test tubes.

Coagulase test

This test was carried out to identify pathogenic *Staphylococcus aureus* which produces the enzyme coagulase. Coagulase causes plasma to clot by converting fibrinogen to fibrin.

Procedures

Two loopful of normal saline were dropped on a glass slide using a sterilized wire loop, and then a thin smear of the isolate was made on the slide. Unused syringe was used to add 2 drops of plasma on the smear and mixed very well. Clumping which showed positive result was observed in about 10 seconds with most of the isolates.

Sugar fermentation test

This was carried out to identify some of the isolates that are able or unable to ferment each of the selected sugars to produce acid and gas or acid only. The sugar tested were; lactose, glucose, sucrose and mannitol.

Procedures

Peptone water (100 ml) was prepared in a labelled beaker for each sugar following the manufacturer's instruction; 1g of sugar was added and mixes thoroughly. Each mixture was dispensed in 5 ml into test tubes containing durham tubes turned upside down and labelled according to each sugar. The test tubes were autoclave at 121°C for 15 minutes. After sterilization, the tubes were allowed to cool, inoculated with the isolates and the incubated for 24-48 hours at 37°C.

After incubation, some test tubes turned yellow with gas bubbles inside durham tubes, some turned yellow but no gas bubbles were produced in durham tubes, while there was no colour change in some tubes.

Antibiotic Susceptibility Test

The standard method of CLSI (2015), [20], was employed in the Antibiotic susceptibility test. The test was determined by disk diffusion techniques on Mueller-Hinton agar. Pure colonies were taken and emulsify in sterile normal saline. The turbidity was compared with 0.5 Mac Farland standards. The suspension was inoculated in Mueller-Hinton agar according to modified kirby-Bauer disk diffusion techniques. The appropriate antibiotic disks were aseptically placed on the inoculated Mueller-Hinton agar using sterile forceps. The plates were then incubated at 37°C for18-24 hours.

The degree of susceptibility of the test isolates to each antibiotic was interpreted according to the principles established by the Clinical and Laboratory Standard Institute as susceptible, intermediate or resistance by measuring the inhibition zone diameter. This was measured in millimetre.

Statistical Analysis

Chi-square was used to compared the difference among the bacteria isolated from various bank ATM keypads, and there was no significance difference among them (P>0.05).study findings were explain in words, tables and histogram.

Occurrence of the Bacteria Isolates at various banks

A total of 34 isolates were obtained from the ATM keypads analysed. Out of which 18and 16 isolates were obtained from Afikpo and Abakaliki metropolis, respectively; of these, 15 were *Staphylococcus aureus*, 8 were *Escherichia coli*, 10 were *Klebsiella* species and 1 was *Enterobacter* species. There was no significant different among the bacteria isolated from the ATM keypads at different locations (p>0.05).

Table1a shows the presence of bacteria on the different ATM keypads which were screen from various banks at Abakaliki, while table1b showed the presence of bacteria on ATM keypads at Afikpo.Table2 shows the percentage occurrence of the isolates at the two locations.Table3 shows the cultural characteristics of the isolates, while table 4 shows the different biochemical tests that the isolates were subjected to.

Table 1a: bacteria present in ATM keypads of various banks at Abakaliki

Banks	*Staphylococcus aureus*	*Escherichia coli*	*Klebsiella* species	*Enterobacter* species
Firstbank	+	+	+	_
Zenith bank	+	+	+	_
Eco bank	+	_	+	_
Fidelity	+	_	_	_

Table 1b: bacteria present in ATM keypads of various banks at Afikpo

Banks	*Staphylococcus aureus*	*Escherichia coli*	*Klebsiella* species	*Enterobacter* species
Firstbank	+	+	+	_
Zenith bank	+	+	+	+
Eco bank	+	_	_	_
Fidelity	+	+	+	_

Table 2: totalpercentage occurrence of the isolates at the locations

Isolates	Afikpo No (%)	Abakaliki No (%)	Total	% Occurrence
Escherichia coli	6 (33)	2 (13)	8	24
Staphylococcus aureus	6 (33)	9 (56)	15	44
***Klebsiella*species**	5 (28)	5 (31)	10	29
***Enterobacter* species**	1 (6)	_	1	3
Total number of isolates	18 (53)	16 (47)	34	100

Table 3 colony morphology of the isolates

Isolates	Cultural characteristics	Microscopic characteristics	Gram stain
Staphylococcus Aureus	Small, golden yellow colonies on nutrient agar. Raised pinkish colonies on MacConkey agar	Cocci, arranged in clusters and non-motile	Positive
***Klebsiella* species**	Round, large mucoid colonies on MacConkey agar	Rod shaped organism, arranged in singly and non motile	Negative
Escherichia coli	Green metalli sheen on eosine methylene blue agar	Short rod and motile	Negative
***Enterobacter* species**	Firm pink colonies on MacConkey agar	Rod shaped organism	Negative

Table 4- Biochemical characterization of the isolates.

Isolates	Gram stainig	Indole	Citrate	Catalase	Coagulase	Lactose	Glucose	Sucrose	Urease
S. aureus	+	_	+	+	+	+ (AG)	+ (AG)	+ (A)	_
Escherichia coli	_	+	_	+	_	+ (AG)	+ (AG)	+ (A)	_
*Klebsiella*species	_	_	+	+	_	+ (AG)	+ (AG)	+ (AG)	+
Enterobacter species	_	_	+	+	_	+ (AG)	+ (AG)	+ (AG)	_

Antibiotic Susceptibility Testing

The result of the antibiotic test showed that all the bacteria isolates showed varied degree of susceptibility to the antibiotics tested.

Staphylococcus aureus were highly susceptible to levofloxacin. However, this organism was highly resistant to norfloxacin (100 %), followed by penicillin (92 %), ampiclox (84 %) and amoxyl (76 %).

E. coli were highly resistance to norfloxacin (100 %), followed by penicillin (86 %), amoxy (85 %) andampiclox (85 %). However, *E. coli* isolates were susceptible to levofloxacin (67 %), followed by ciprofloxacin (57 %), gentamycin (41 %) and streptomycin (41 %).

Klebsiella species showed high resistance to Erythromycin (80 %) and penicillin (80 %), but were susceptibility to Levofloxacin (75 %), followed by ciprofloxacin (60 %) and augumentin (60 %).

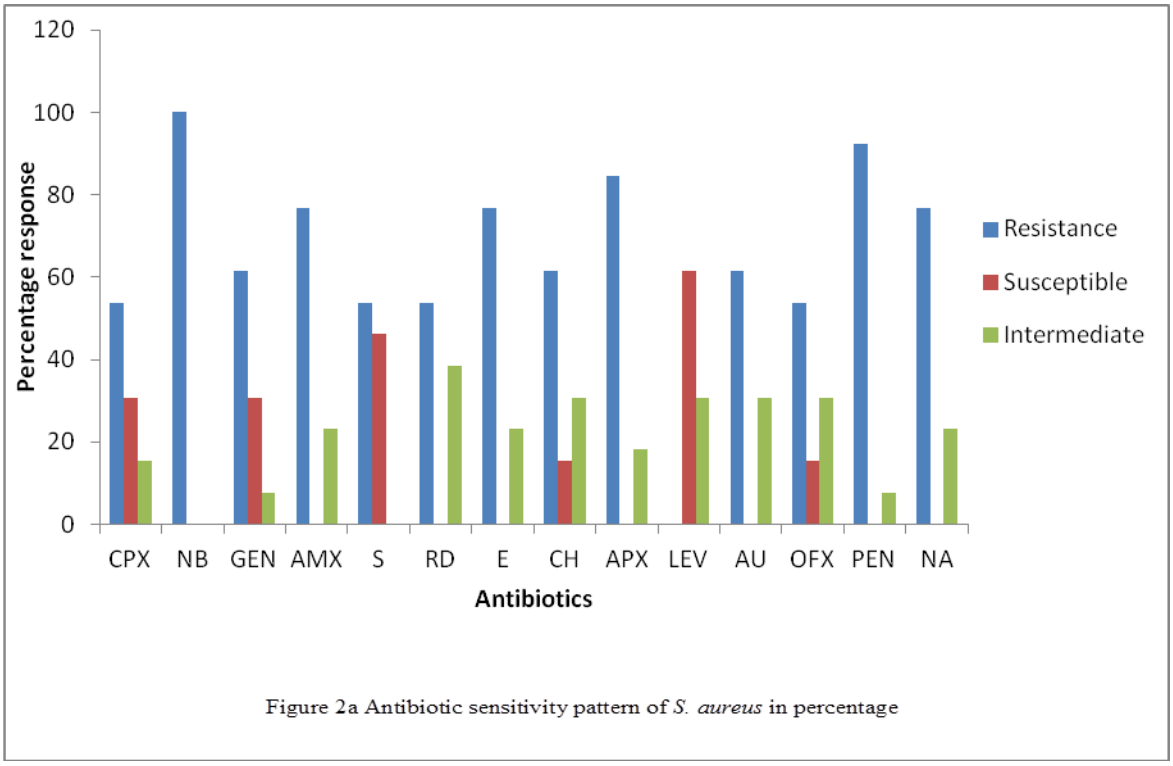

Figure 2a Antibiotic sensitivity pattern of *S. aureus* in percentage

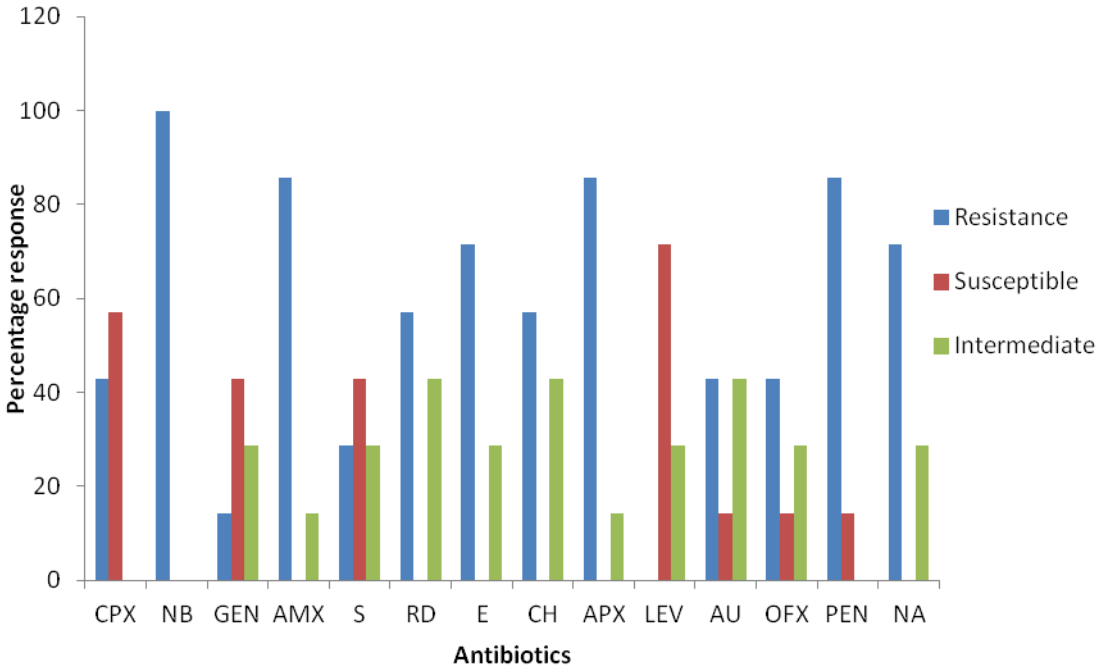

Figure 2b Antibiotic susceptibility pattern of *E. coli* in percentage

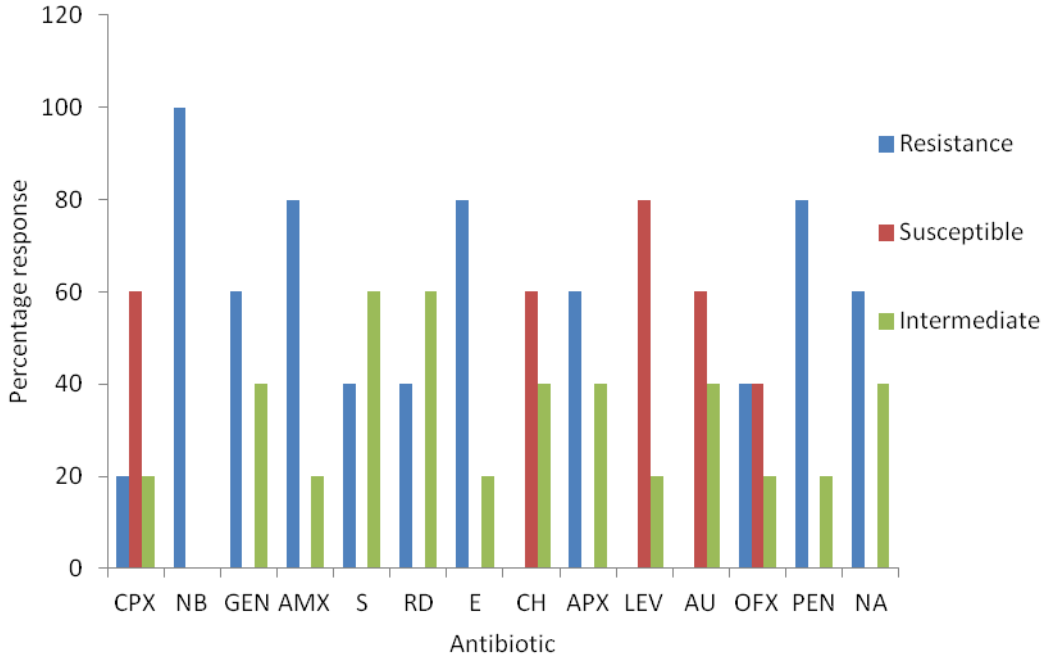

Figure 2c antibiotic susceptibility pattern of *Klebsiella* species in percentage

DISCUSSION:

The results of this study showed bacterial contamination of Automated Teller Machine keypads with *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species and *Enterobacte*r species. Sample collection from different ATM keypads showed prominent presence of *Staphylococcus aureus*. *Klebsiella* species and *E. coli* stood next to *S. aureus*. The isolation of bacteria from ATM in this study confirms that ATM might serve as a mediator playing an important role in the transmission of pathogenic bacteria in the environment. They provide favourable conditions such as substrate acquired from human body and due to handling as well as dust from the environment. Most of the bacteria encountered in this study are members of the human flora. This suggests that humans are the major source of bacteria contaminant on the ATM.

The high level of bacterial contamination observed in this study is in conformity with the study of Nwankwo and Offia (2015), [21], who reported bacterial contamination on the metallic interface of bank ATM due to multiple users. This study is also in line with the study of oluduro *et al*. (2011), [22], who reported that ATM keypads harboured more bacteria than computer keypads due to the fact that ATMs are located in the open and are exposed to wind and rain. In the same vein, Abban and Tano-Debrah (2011), [13], reported the presence of *Staphylococcus aureus*, *Escherichia coli* and *Klebsiella* species on ATM keypads. A similar study was carried out in England comparing the bacteria isolated from Automated Teller Machine keypads with those isolated from toilets seats and found out that ATM keypads had similar levels of bacteria described as heavily contaminated [23]. The result of this study also showed prevalence of *Staphylococcus aureus* (50 %) among other bacteria isolated. This is similar to the study of Nworie *et al*. (2012), [24], who reported higher occurrence of *S. aureus* (50 %) due to vast dermal contact with the ATM keypads. This is also in agreement with the study of Zhag *et al* (2011), [25], who stated that ATM can be contaminated with *S. aureus* frequently present on the fingers due to nose picking, sneezing or touching the nasal area and have previously reported a relatively high isolation rate of *S. aureus* from Automated Teller Machine than other commonly accessed items in the environment. In addition, Onuoha and Fatokun, (2014), [26], reported the abundance of *Staphylococcus aureus* on the metallic interface of ATM keypads in Abakaliki due to higher number of heterogeneous users in Abakaliki.

The findings from this study showed that the frequency occurrence of the bacterial species varied between the two locations. More bacterial species were found on the ATM keypads in Abakaliki, of which *S. aureus* was predominance. Enteric bacteria like *Escherichia coli*, *Enterobacter* species and *Klebsiella* species were found on the ATM keypads in Afikpo, which is an indication of recent faecal contaminant. These bacteria reside normally in the intestinal tracts of animals including humans and some are pathogenic, causing disease and food poisoning in humans. These findings is in line with that of Odebisi-Omokanya *et al*. (2014), [27], who stated that improper hand washing could be a reason why enteric organisms were isolated from ATM keypads. This study was also supported by Nwankwo and Offia, (2015), [21], who stated that *E. coli* can be easily picked up from toilet handles, in a society of poor sanitation due to improper hand washing. The pathogenicity of these bacteria are well documented. Some serovars of *E. coli* has been implicated in major food borne disease outbreaks. Other microbes isolated such as *Klebsiella* species and *Enterobacter* species are known opportunistic pathogens and their high pathogenicity are well documented, causing even death in some major outbreaks and infections [13].

The antibiogram result of this study showed that the overall range of resistance for the bacterial isolates were from 0 % to 100 %. In this study, *Staphylococcus aureus* was resistance to norfloxacin (100 %), penicillin (92 %), ampiclox (84 %), amoxil (76 %), nalidixic acid (76 %), erythromycin (76 %), gentamycin (61 %) and augmentin (61 %). This explains that the *S. aureus* isolated were multiple drug resistance. Most of the antibiotics tested were resistance against *S. aureus.* This result is in conformity with the study of Nworie *et al.* (2012), [24], who reported that *S. aureus* was resistance to penicillin (78 %), augumentin (70 %) and erythromycin (68 %). This study was also supported by a study carried out at Cape Town, Ghana by Tagoe and Kumi-Ansah (2011), [28], where *S. aureus* was 83 % resistance to ampicillin, penicillin and nalidixic acid. This is also in agreement with Alemu *et al.* (2015), [18], who reported high resistance of *S. aureus* isolated from computer keyboards and mice. In the same vein Oluduro *et al.* (2011), [22], reported that *S. aureus* resistance to 2 antibiotics was the commonest multiple antibiotic resistance patterns observed.

Escherichia coli showed high level of resistance to penicillin (86 %), ampiclox (85 %) and amoxyl (85 %). *Klebsiella* species was resistance to norfloxacin (100 %), penicillin (80%) and erythromycin (80%). *Enterobacter* species was 100% resistance to amoxyl, erythromycin and penicillin. All the bacterial isolates showed resistance for two or more antibiotics tested. A similar study was carried out by Ramesh *et al* (2015), [29], who reported on the prevalence of multidrug resistance strains on touch screen of Automated Teller Machine in the town of

Tami Nadu, India. This was supported by the findings of Alemu *et al* (2015), [18], who reported multi drug resistance of bacteria isolated from computer keypads and mice. This indicates that multidrug resistance was found to be very high to the commonly used antibiotics.

The degree of variation observed in the resistance pattern of the isolates might be attributed to the population of people using the ATM and the environment where the ATM is situated, genetic background of the organism and the misuse of drugs in a location which leads to drug resistance [27].

CONCLUSION:

This study revealed that Automated Teller Machine (ATMs) can be contaminated with bacteria that are capable of causing disease and infection. The organisms isolated were *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species and *Enterobacter* species which were found to be resistance to some commonly used antibiotics. The result of the antibiotic test showed that levofloxacin and ciproflozacin are drugs of choice for *Escherichia coli*. Also levofloxacin, augumentin, ciprofloxacin and chloroamphenicol showed to be the drug of choice for *Klebsiella* species.

This study also confirms previous reports of a relatively high prevalence of bacterial contamination of bank Automated Teller Machine keypads. These bacteria can be transported from the contaminated surface to the humans by direct contact and then they are transported to other people and items. Depending on environmental conditions, pathogens may remain active on surfaces for weeks after contamination. Furthermore, formation of biofilm by one bacterial agent can affect the survival of other pathogens on the same surface. The greater the concentration of the microbe, the longer it survive, also the longer the survival of a bacterium on surface like the ATM keypads, then the tendency of being picked by someone. People who do not pay attention to hygiene is an important factor as well as the atmospheric movements and other carriers in the spread of bacteria. Specifically, this study has revealed that people living in Afikpo and Abakaliki who live in an unhygienic condition are at risk of contacting the bacteria. In addition there is no indication that most bank owners' observe any form of guidelines or rule in the cleaning of their ATM.

REFERENCES:

1.Onuoha, S. C., & Kayode, F. Bacterial Contamination and Public Health Risk Associated with the user of Banks' Automated Teller Machines (ATMs) in Ebonyi State, Nigeria. *American Journal of Public Health*,2014; 2 (*2*): 46-50

2.Anonymous. (2011a). Global ATM attack clock. Automated teller machine industry Association(ATMIA). Accessed online. February, 2016.

3.Sharma, A., & Dhanashree, B. Screening of currency in circulation for bacteriological contamination. *Journal of Current Science*,2011; 100(*6*):822-5.

4.Nworie, O., Mercy, M., Chukwudi, A., Oko, I., Chukwudum, S.O., Agha, V.M., & Ekuma, U.O. Antibiogram of bacteria isolated from Automated Teller Machines within Abakaliki Metropolis. *American Journal of Infectious Diseases*, 2012;8(*4*): 168-174.

5.Oluduro, A. O., Ubani, A. O., & Ofoezie, I. E. Bacterial Assessment of Electronic hardware user interface in Ile-ife, Nigeria. *Journal of Basic Applied Pharmaceutical Science*, 2011;32: 323-334

6.Ashgar, S. S., & El-Said, H. M. Bacteria Associated with different public Environmental sites in Mecca city. *Open Journal of Medical Microbiology*,2012; 2: 133-137.

7.Deresse, D. Antibiotic-resistant *Staphylococcus aureus* isolated from mobile phones and hands of Health care workers in the Hawassa referral Hospital, South Ethiopia. *Journal of Microbiology and Antimicrobials*,2014; 6(*4*): 72-78

8.Jerkovic-mujkic, A., Besta, R., & Memisevic, S. Bacterial contamination of public telephones in the down town area of Sarajevo. *African Journal of Microbial Research*, 2013;7 (*17*):1664-7.

9.Adwan, G., Salama, Y., & Hasan, A. N. Microbial contamination of Environmental Surfaces in An-Najah National University setting. *Journal of Scientific Research and Reports*,2016; 10(*2*): 1-9

10.Mabel, J. C., Subathra, M., Shymala, M., Padmavathy, S., & Rekha. Automated Teller Machine (ATM). A "pathogen city"-A surveillance report in and around Madurai city, Tamil Nadu, India.*International Journal of Public Health Sciences*. 2014;3(*1*): 51-56.

11.Reynolds, K.A., Watt, P.M., Boone, S.A., & Gerba, C. P. Occurrence of Bacteria and Biochemical markers on public surface. *International Journal of Environmental Health Research*, 2005;15: 225-234.

12.Tekerekoglu, M. S., Yakupogullari, Y., Otlu, B., Duman, Y., & Gucluer, N. Bacteria found on banks' Automated Teller Machine (ATMs). *African Journal of Microbiology Research*. 2012;7(*16*): 1619-1621.

13.Abban, S., & Tano-Debra, K.. Automatic Teller Machines (ATMs) as potential Sources of food-borne pathogens-a case from Ghana. *Journal of Nature and Science*,2011; 9(*9*): 63-67.

14.Taylor, J., Davies, M., Canales, M., & Lia, K.M.. The persistence of flood borne pathogens on building surfaces under drying conditions. *International Journal of Hygienic Environmental Health*. 2013;216(*1*):91-99
15.Alemu, A. Microbial contamination of currency notes and coins in circulation: A potential public health hazard. *Journal of Biomedicine and Biotechnology*, 2014;2 (*3*):46-53.
16.Tekerekoglu, M. S., Yakupogullari, Y., Otlu, B., Duman, Y., & Gucluer, N. Bacteria found on banks' Automated Teller Machine (ATMs). *African Journal of Microbiology Research*.2012; 7(*16*): 1619-1621.
17.Da Silva, G. J., & Mendoca, N. (2012). Association between antimicrobial resistance and virulence in *Escherichia coli.* Virulence 3, 18-28
18.Alemu, A. Microbial contamination of currency notes and coins in circulation: A potential public health hazard. *Journal of Biomedicine and Biotechnology*, 2014;2 (*3*):46-53.
19.Nagajothi, J., Jeyakumari, D., Vigneshwaran, S., Kumar, R. P., Bharatwwaj, R .S., & Bagyalakshmi, R. Study of prevalence of microbial contamination with its antibiotic Resistance pattern in Automated Teller Machine in and around Puducherry, India.*Journal of Earth and Environmental Health Science*, 2015;1:27-31.
20.Clinical and Laboratory Standard Institute (2015). Performance Standards for Antimicrobial susceptibility Testing; Twenty-fifth information supplement. CLSI.M100-S25.
21.Nwankwo, E. O., & Offiah, J. C. Bacterial contamination of User Interface of Automated Teller Machines (ATM) of various Banks in Umuahia Metropolis, Abia State, Nigeria. *International Journal of Tropical Disease and Health.* 2015;13(*3*): 1-9.
22.Russotto, V., Cortegiani, A., Raineri, M. S., & Giarratano, A. Bacterial contamination of inanimate surfaces and equipment in the intensive care unit. *Journal of Intensive Care*, 2015;3: 54.
23.Al-Ghamdi, A. K., Abdelmalek, S. M.., Ashshi, A. M., Faidah, H., Shukiri, H., & Jiman-Fatani, A.A. Bacterial contamination of computer keyboards and mice, elevator buttons and shopping cart. *African Journal of Microbiology*, 2011;5: 3998-4003.
24.Nworie, O., Mercy, M., Chukwudi, A., Oko, I., Chukwudum, S.O., Agha, V.M., & Ekuma, U.O.Antibiogram of bacteria isolated from Automated Teller Machines within Abakaliki Metropolis. *American Journal of Infectious Diseases*, 202;8(*4*): 168-174.
25.Zhang, M., O'Dononghue, M., & Boost, M.V. Characterization of *Staphylococci* contaminating Automated Teller Machine (ATMs) in Hong Kong. *Journal of Epidemiology and Infection*, 2012;140: 1366-1371.
26.Oke, M. A., Bello, A. B., Odebisi, M. B., Ahmed, A. M., & Kazeem, M. O. Evaluation of antibacterial efficacy of some alcohol-based hand sanitizer sold in Ilorin (North –Central Nigeria). *Ife Journal of Science*, 203;15(*1*): 111-117.
27.Odebisi-Omokanye, M. B., Anibijuwon, L. L., Oke, M. A., Ahmed El-Imam, A. M., & Makinde, T. O. *Journal of Science*, 2014;1(*2*): 264-273.
28.Tagoe, D. N., Nyarko, H., Arthur, S. A., & Birikorang, E. A. Study of antibiotic susceptibility pattern of bacteria isolates in sachet drinking water sold in the Cape Coast metropolis of Ghana. *Resolution Journal of Microbiology*,2011; 6: 453-458.
29.Ramesh, N., Akshita, P. P., Nandini, R. B., Prasanth, M., Shanthini, T., Gothandan, K. M., &Karthikeyan, S. Prevalence of multi drug resistant strains on touch screen of Automated Teller Machine. *Asian Journal of Pharmaceutical and Clinical Research*, 2015;8 (*2*):1-3.