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Microbes Associated with Some Selected Banks 'automated Teller Machines in Ilaro, Ogun State

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Abstract*: Different people from different socio-economic levels and hygiene status use the ATMs daily and increase the chances of hand-borne transmission of microorganisms to the machines' surfaces. A total of 72 colonies and 56 colonies of four fungi belonging to three genera were repeatedly isolated from the surfaces of the banks' ATMs' touch-screens and keyboards. They are; Fusarium moniliforme, Malassezia globosa, Phanaerochate carnosa and Fusarium oxysporum. A total of 217 colonies and 158 colonies of three bacteria belonging to two genera were repeatedly isolated and they were identified based on standard tests for the identification of bacteria. They include; Escherichia coli, Staphylococcus aureus and Staphylococcus epidermidis. The microbial load of the banks' ATMs' touch-screens is fairly higher than that of the banks' ATMs' keyboards. UBA bank recorded the highest microbial load. All the selected banks' ATMs were contaminated with varied fungi and bacteria, though with disparity. The public should be sensitized to avoid direct hand-to-mouth contact after an ATM use to avoid potential inadvertent inoculation by the users.*

Keywords: People, surfaces, sensitized, inadvertent, inoculation

Introduction

Different people from different socio-economic levels and hygiene status use the ATMs daily and increase the chances of hand-borne transmission of microorganisms to the machines' surfaces. One of the most important routes for the spread of many infectious agents in the community is hand-borne transmission (Tekerekoglu *et al*., 2013). Hand transmission is a critical factor in the spread of pathogens, although, viruses cannot live or reproduce on their own. These cells may require magnification to be seen but when cultured on solid media that allow their growth and multiplication; they form visible colonies consisting of millions of cells. Microorganisms may be beneficial or disease-causing (pathogenic) and may need to be controlled in the latter case. Microorganisms are everywhere in the environment, in high populations in soil, in the air we breathe, the water we drink, the food we eat, on our skin, in our noses, throats, mouths and intestinal cavities (W.H.O., 2012).

One of the most commonly touched surfaces is computer keyboard, so it should not be surprising that studies have shown that typically, 25% of keyboards in ATMs carry pathogens at any given time more than double that of other commonly touched surfaces (Bures, 2000). Automated teller machines (ATMs) are the longest standing and most widely used form of computer-driven public technology, working as a data terminal by communicating through a host processor which links all others. Such machines operate by a bank across a wide area network. It makes cash withdrawal and other services available to the account holders more conveniently (Miller, 2006).

The presence of conveyed pathogenic bacteria on inanimate objects has been reported by earlier investigators. Furthermore, micro-organisms found to contaminate fomites have also being shown to persist on environmental surfaces in varying periods of time ranging from hours to months. Bacteria that can cause severe gastroenteritis have been found on ATMs' key pads and cross infection of microorganisms between environment's surface and a

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host has equally been established. Chains of infection occur when the agent leaves its reservoir or host through a portal of exit, conveyed by some mode of transmission and enters through an appropriate portal of entry to infect a susceptible host (Marbel *et al*., 2014).

With the advent of ATMs, banks are able to serve customers outside the banking hall. ATM is designed to perform the most important function of bank such as withdrawal of cash, deposit, printing of mini statement, settlement of bills. Different people from different social economic levels and hygiene statuses use ATMs daily and increase the chances of hand-borne transmissions of microorganism to the machines' surfaces. As a result of this, ATMs are potential areas for pathogenic accumulation or reservoirs and they might have a role in microbial transmissions within a community. The frequent use of ATMs in Ilaro by ATM users poses a potential public health concern because of the possibility of the easy transmission of highly infectious diseases by ATM users that could be potential carriers of these highly infections pathogens from them. Most ATMs are exposed to dust and the hands of ATM users and these potentially harbour diverse microbes with a possibility of high microbial load (Nagajothi, 2015).
The significant health and adverse effects of microbes associated with ATMs cannot be over emphasized. Hence, there is a need to study and evaluate the prevalence of microbes associated with ATMs in Ilaro. The possibility of a disease outbreak or transmission emanating from ATMs, by ATMs being potential reservoirs of infectious pathogens, calls for caution because of the attendant and indiscriminate hand-to-mouth activity that could follow. The era of credit and debit cards, ease of payment of utility bills and other advantages of using a modern ATM have increased the burden on ATMs and the unintentional transfer of potential pathogens from the users during a transaction particularly on the ATMs' keyboard and touch screens.

The aim of this study is to determine the pathogenic microbes associated with Automated Teller Machines in Ilaro, Ogun State.

Materials and methods

Sample Collection
The investigation was carried out in the Microbiology Laboratory of The Federal Polytechnic, Ilaro, Ogun State, Nigeria. The samples used were the swab sticks used on the five selected ATMs within Ilaro at intermittent intervals at different locations on different days, once. The samples were all engaged within the month of October, 2022, kept in clean dispensable sachets, carefully labeled appropriately and stored until when needed. Sterile swab sticks were moistened by separately dipping them into distilled water and then gently used to randomly swipe the keyboards of the selected ATMs of banks at different locations within Ilaro town to collect microbial strains. The selected bank's ATMs are Polaris bank ATM (main branch), Access bank ATM, Union bank ATM, Wema bank ATM and UBA bank ATM. The swab sticks were carefully kept in the clean dispensable sachets for onward transportation to the laboratory. The appropriate precautionary measures were adopted such as the use of a pair of hand gloves and a nose mask, during the course of the investigation.

Isolation
The isolation of the microbes was by streak plate method. Nutrient agar and mannitol salt agar, potato dextrose agar and Sabouraud's dextrose agar were employed for the isolation of bacteria and yeast respectively. The swab sticks were aseptically used to streak already prepared bacteriological agar and mycological agar respectively. The plates were then incubated for 24hrs at 35^{o}C ± 2^{o}C and 28 ± 2^{o}C respectively. Sub-culturing was carried out to obtain pure culture of the isolates. The pure isolates were maintained on agar slants and stored in a refrigerator.

Cultural Identification
The fungal isolates were identified on the basis of their morphological and cellular characteristics, as described by Barnett and Hunter (1999). The bacteria isolated were identified based on their Gram's status, colonial characteristics and biochemical tests such as urease, catalase, citrate, indole, methyl red, coagulase, oxidase etc., according to Cheesbrough (2000) and Silverton and Pallister (2001).

Occurrence of the Isolates
The fungal and bacterial load was determined respectively using the plate count technique and expressed in cfu/a. The colonies were counted by using a colony counter to determine the colonies forming unit/area (cfu/a) of the isolates from the two

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substrates and then subsequently recorded. The frequencies of occurrence for the isolated and identified fungal and bacterial isolates were determined and expressed in percentage accordingly and respectively.

Results

Tables 1 and 2 show the probable identities of the fungi and bacteria isolated from the selected ATMs after aseptically collecting them from the surfaces of their ATMs' screens and keyboards for microbial analyses, respectively. Four fungi belonging to three genera were repeatedly isolated and were conspicuously differentiated by the variation in their colonial appearance, colour and microscopic evaluation. They include *Fusarium moniliforme*, *Malassezia globosa*, *Phanaerochate carnosa* and *Fusarium oxysporum*. Three bacteria belonging to two genera were isolated and were identified based on standard tests for the identification of bacteria. They are *Escherichia coli*, *Staphylococcus aureus* and *Staphylococcus epidermidis*.

Table 1: Cultural and Microscopic Characteristics of the Fungal Isolates

Isolates	Colonial appearance	Microscopy
1	White mould	Multicellular distinctive sickle-shaped macroconidia, aseptate, floccose with sparse mycelia
2	White rot mould	Monolithic hyphal, simple septae, clavate basidia, lamprocystidia, thin – walled
3	Beige mould	Mono-polar budding, cream to yellowish to brown colonies, smooth and hypha absent
4	Green mould	Macroconidia with septation

Table 2: Bacterial Strains Isolated from the Banks'ATMs

Characteristic test	Probable organism		
	S. aureus	***S. epidermidis***	***E. coli***
Gram stain	+	+	-
Morphology/shape	Coccus	Coccus	Rod
Motility	-	-	+
Indole	-	+	+
Citrate	-	-	-
H_2S	+	-	-
Urease	-	-	-
Spore	-	-	-
Catalase	+	-	+
Oxidase	-	-	-
Methyl red	+	+	+
Voges-Proskauer	-	-	-
Capsule	-	-	-
Coagulase	+	-	-
Starch hydrolysis	+	-	+
Nitrate reduction	-	-	+
Glucose	+	-	+
Fructose	+	+	-
Lactose	+	-	+
Sucrose	+	-	+
Raffinose	-	+	+
Maltose	+	+	-
Mannose	+	+	-
Xylose	-	-	-
Mannitol	+	+	+
Sorbitol	+	+	+
Inositol	+	-	-

Keys: + = Positive, - = Negative

Table 3: The Fungal Load of the Banks' ATMs' Touch-screens and Keyboards

Isolate	Polaris	Access	Union	Wema	UBA
Fusarium oxysporum	14; 10	-; -	17; 15	ND	21; 18
Phanaerochate carnosa	-; -	8; 5	-; -	ND	-; -
Malassezia globosa	-; -	-; -	1; -	ND	-; -
Fusarium moniliforme	5; 4	2; 2	4; 2	ND	-; -
Total	19; 14	10; 7	22; 17	-	21; 18

Key: ND = Not Done

Table 4: The Bacterial Load of the Banks' ATMs' Touch-screens and Keyboards

Isolate	Polaris	Access	Union	Wema	UBA

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Staphylococcus aureus	14; 11	9; 5	22; 18	5; 2	24; 20
Staphylococcus epidermidis	8; 1	3; 2	10; 6	1; -	18; 11
Escherichia coli	23; 19	15; 12	29; 22	8; 8	28; 21
Total	45; 31	27; 19	61; 46	14; 10	70; 52

From the investigation, as shown in table 3, Access bank recorded the least fungal load of 10 colonies from its touch-screen and 7 colonies from its keyboard from two different types of fungi. Polaris Bank recorded a fungal load of 19 colonies from its touch-screen and 14 colonies from its keyboard, also from two different types of fungi. There is neither a report nor datum for Wema bank as there was a seemingly-perceived breach of security and misconceived security threat during an attempt to collect swab samples from the bank's ATM at the time. Table 4 shows the bacterial load of the banks' ATMs' touch-screens being fairly higher than that of the banks' ATMs' keyboards. UBA bank recorded the highest bacterial load of 70 colonies from its touch-screen and 52 colonies from its keyboard from three different types of bacteria. This was very closely followed by the bacterial load of Union bank with 61 colonies from its touch-screen and 46 colonies from its keyboard also from three types of bacteria. Surprisingly, Wema bank recorded the least bacterial load of only 14 colonies from its touch-screen and 10 colonies from its keyboard but from two different types of bacteria for the latter. Polaris Bank recorded a bacterial load of 45 colonies from its touch-screen and 31 colonies from its keyboard, also from three different types of bacteria. Access bank recorded the 4th highest bacterial load value after Polaris bank's 3rd place with 27 colonies isolated from its touch-screen and 19 colonies from its keyboard from three types of bacteria.

Table 5 shows the frequency of occurrence of the fungal isolates from the banks' ATMs' touch-screens of which *Fusarium oxysporum* recorded the highest value of 72.22% (52 colonies) while *Malassezia globosa* recorded the lowest value of 1.38% (1 colony). *Fusarium moniliforme* was the second most prevalent fungus with a value of 15.28% (11 colonies) and this was followed by *Phanaerochate carnosa* as the third most prevalent fungus with a value of 11.11% (8 colonies). The frequency of occurrence of the fungal isolates from the banks' ATMs' keyboards is as follows; *Fusarium oxysporum* recorded the highest value of 76.79% (43 colonies) while *Malassezia globosa* recorded the lowest value as it is non-existent. *Fusarium moniliforme* was the second most prevalent fungus with a value of 14.23% (8 colonies) and this was followed by *Phanaerochate carnosa* as the third most prevalent fungus with a value of 8.93% (5 colonies).

Table 5: The Frequency of Occurrence of the Fungal Isolates from the Banks' ATMs' Touch-screens and Keyboards

Isolate	No. of Colony	% Occurrence
Fusarium oxysporum	52; 43	72.22; 76.79
Phanaerochate carnosa	8; 5	11.11; 8.93
Malassezia globosa	1; -	1.38; 0
Fusarium moniliforme	11; 8	15.28; 14.23
Total	72; 56	100; 100

Table 6: The Frequency of Occurrence of the Bacterial Isolates from the Banks' ATMs' Touch-screens and Keyboards

Isolate	No. of Colony	% Occurrence
Staphylococcus aureus	74; 56	34.10; 35.44
Staphylococcus epidermidis	40; 20	18.43; 12.66
Escherichia coli	103; 82	47.47; 51.90
Total	217; 158	100; 100

As shown in table 6, the frequency of occurrence of the bacterial isolates from the banks' ATMs' touch-screens reveals that *Escherichia coli* recorded the highest value of 47.47% (103 colonies) while *Staphylococcus epidermidis* recorded the lowest value of 18.43% (40 colonies). *Staphylococcus aureus* was the second most prevalent bacterium with a value of 34.10% (74 colonies). The frequency of occurrence of the bacterial isolates from the banks' ATMs' keyboards is as follows; *Escherichia coli*

recorded the highest value of 51.90% (82 colonies) while *Staphylococcus epidermidis* recorded the lowest value as it was lowly-existent with a value of 12.66% (20 colonies). *Staphylococcus aureus* was the second most prevalent bacterium with a value of 35.44% (56 colonies).

Discussion

The results of this investigation show that banks' ATMs are potential reservoirs of fungi and bacteria, particularly those that are air-borne and those transmitted by touch through physical contact by humans. The banks' ATMs varied in the types and quantities of micro-organisms on them. While the ATMs' screens appeared to have a higher microbial load, the ATMs' keyboards recorded a lower one. That is presumably expected as most users frequently use those two buttons than any other on the ATMs' screens and the keyboards' buttons, more so, the keyboards are usually fairly guarded by shields for privacy. Some bacteria are known to be capable of causing infections and one of the commonest is gastroenteritis. ATMs are used by dozens of people daily in Ilaro, as they are public utility devices needed for cash withdrawal but when contaminated, they could become sources of infections and may pose a risk to public health. UBA bank recorded the highest bacterial load, presumably because it is frequently used by a large population of students, particularly when the school; The Federal Polytechnic, Ilaro, is in session and also some indigenes patronize the bank's ATMs, perhaps because of its perceived 24-hour service delivery's reliability.

The ATM is likely to be contaminated with many different kinds of microorganisms both pathogenic and non-pathogenic due to their vast usage and dermal contact by many people in a day especially in an overcrowded environment (Marbel *et al*., 2014). ATMs, once contaminated, become vehicles for the transmission of infections, such that the users 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 (Onuoha and Kayode, 2014).

The ATMs may not only be cash providers but dispensers of diseases considering the population of pathogenic micro-organisms that may be present as large number of persons assess them on a daily basis. Users usually stop over at ATMs without the knowledge that the keypad they touch contains a blend of pathogenic micro-organisms which can eventually be transferred between individuals.

Conclusion

The result of this study shows that banks' ATMs are typical inanimate reservoirs as they are always exposed to bacterial infestation since they are mostly situated in open spaces. All the selected banks' ATMs were contaminated with micro-organisms such as *Escherichia coli*, *Staphylococcus aureus* and *Staphylococcus epidermidis*, *Fusarium moniliforme*, *Malassezia globosa*, *Phanaerochate carnosa* and *Fusarium oxysporum*, though with disparity. UBA bank had the highest microbial load while Wema bank had the lowest bacterial load from the data obtained from both their ATMs' screens and keyboards, Access bank had the lowest fungal load and there is no datum for the fungal load of Wema bank.

Recommendations

Judging by the outcome of this investigation, it is therefore recommended that;

- The public, particularly the end-users of banks' ATMs, should be enlightened by way of displayed images pasted on the ATMs on the cautions to be adopted and the potential risk of contracting microbial pathogens at every time they use the ATMs especially with bare hands.
- The public should be sensitized to avoid direct hand-to-mouth contact after an ATM use to avoid potential inadvertent inoculation by the users.
- Wearing of hand glove(s) should be encouraged and emphasized before ATM use or hands are to be washed using hand sanitizer after every ATM use.
- The ATMs could be fumigated daily to reduce or eliminate pathogenic micro-organisms, where practicable.

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