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Enumeration of Pathogenic Bacteria from Automatic Teller Machine (ATMs) Keyboard, a Case Study of ATM Machine of Branch 448 Unity Bank Plc Jahun, Jahun Local Government, Jigawa State

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ABSTRACT

This study investigated the pathogenic bacteria from automatic teller machine (ATMs) keyboards, a case study of ATM machine of branch 448 Unity Bank PLC Jahun, Jahun Local Government, Jigawa state. ATM is used by hundreds of people in a day in the world (including Nigeria). The grab sampling techniques were used to obtain the sample. The cultural, Gram stained and biochemically tests were conducted. A total of 100 samples were collected from the ATM keyboard in the study area in April 2022, *Staphylococcus aureus* has the highest prevalence of 48%, *E. coli* 43% and *P. aeruginosa* has the lowest prevalence of 9% in this study. Pathogenic bacteria such as *E. coli*; *P. aeruginosa* and *S. aureus* on the ATMs were isolated. The research work revealed that there is a relationship between the Automatic Teller Machines (ATMs) and the isolated pathogenic bacteria. A bowl containing sanitiser should be provided by the bank management at every ATM location so that users can disinfect their hands after using the ATMs and also ATM Cleaners should be employed by the bank management so that they can disinfect the metallic buttons at intervals using compatible disinfectants.

INTRODUCTION

Pathogenic infections due to contact with contaminated environmental objects and surfaces are 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 microorganisms [1]. Atmospheric pollution is one of the most pressing problems of our age. This pollution has now reached an advanced level which poses a potential threat to the health and wellbeing of the population. Bacterial pathogens still play a considerable role in the environment making a potential reservoir for bacterial pathogens since diverse pathogenic microorganisms and a large number of susceptible bacterial pathogens are associated with a background rise in various types of indoor and outdoor environments [2]. The increased risk frequency has risen in spreading the pathogenicity from the 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 [3]. The pathogens live and or 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 [4].

Microorganisms such as bacteria are ubiquitous minute/microscopic organisms that make up a major part of every ecosystem and they exist either freely or as parasites. They are found all around us and within each one of us either as pathogens or commensals and can persist or even grow on any surface. These microorganisms live as transient contaminants in fomites/surfaces or hands where they constitute a major health hazard in the community [5]. Though a majority of these microorganisms are harmless to humans and animals, few are harmful and can lead to death of infected individuals, especially in immunocompromised individuals [6]. Fomites, when in constant contact with humans or natural habitats of pathogenic

organisms constitute a major source of the spread of infectious diseases [7]. Microorganisms are forms of life that require magnification to see and resolve their structure. They include bacteria, yeasts, moulds, protozoa, algae, and rickettsia. Viruses are also included, although they cannot live or reproduce on their own. These cells may require magnification to be seen but when cultured on solid media that allows their growth and multiplication; they form visible colonies consisting of millions of cells [8].

Microorganisms may be beneficial, or disease-causing (pathogenic) and need to be controlled in both cases. 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 [9].

Besides the day-to-day interaction of people, which constitutes one way of spreading disease, the major source of the spread of community-acquired infections is fomites [10]. The contamination of various fomites by potential pathogenic microorganisms is of public health significance as these items can be likely sources of transmission of such pathogens. Fomites serve as vehicles for cross-infections and recontamination of washed hands [11]. Several of the bio-contaminants can be pathogenic and can be transferred from one individual to the next or may bring about auto-inoculation [12]. Research has shown that certain objects in our homes carry more microbes than others. For instance, a study found that the dish sponge is one of the most contaminated items in the kitchen, followed by the toothbrush holder[1]. Additionally, cell phones and shoes also harbor thousands of different microbes, including some lesser-known ones

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, kitchen sinks, office desks, computer keyboards, escalator handrails, elevator buttons and with the spread of supermarkets and hypermarkets shopping cart handles [13].
ATM is used by hundreds of people in a day. It is meant to be a public utility device. Hence microorganisms play a major role in accommodating the safer place, ATM. Poor hygiene status could raise the risk of contamination, and this infection rate.

MATERIALS AND METHODS

Study Site
This study was conducted at Jahun Local Government, Jigawa State (Figure 3.1). Its headquarters are in the Jahun town. The study site lies on GPS coordinates: 12.078614 N 12°4'43.01112"(Latitude) and 9.626670 E 9°37'36.01164S" (Longitude). It has an area of 1,172 km^2 and a population of 229,094 at the 2006 census. The postal code of the area is 720.

Approval for the study and study design

Oral permission was obtained from the management of the bank used for the study. The study was descriptive and cross-sectional.

Sample collection
One hundred (100) samples were obtained between January and April of 2022 from various ATM keypad locations utilizing sterile swab sticks through the use of grab sampling techniques.
After moistening each sterile swab stick with sterile distilled water and rubbing it on the ATM keyboard's touch screen and buttons, it was put back into its casing, labelled appropriately, put inside an ice-bag-lined container, and sent straight away to Federal University, Dutse Microbiology Laboratory. This was done to make sure that the germs in the samples didn't proliferate in any way. Before being analysed, the samples were kept aseptically in the lab by adding 2 ml of Phosphate Buffer Solution (PBS) to each labelled swab stick. They were then kept in a refrigerator at -20 ºC.

Isolation of pathogenic bacteria

Culture media preparation
Selective media was used for the isolation of the pathogenic bacteria. Along this line, Cetrimide Agar (for *Pseudomonas aeruginosa*), Mannitol Salt Agar (for *Staphylococcus aureus*) and Macconkey agar (for *Escherichia coli*).The media were prepared according to the manufacturer's instructions.

Serial dilutions
Serial dilutions of 1:10, 1:100 and 1:1000 was prepared from each test tube containing the swabbed samples by taking 1ml into 9ml of sterilized buffer peptone using a sterile needle and syringe. This gave a dilution factor of 10-^{1} [14].

Inoculation and incubation of culture media
The sterilized culture media was inoculated with a loopful from the 10-^{1}dilution factor using a flamed wire inoculating loop and then incubated at 37ºC for 24-72 hours [15].

Enumeration of pathogenic bacteria
The enumeration of pathogenic bacteria was done by multiplying the number of viable, separated and distinct colonies with the reciprocal of the dilution factor and expressed as colony-forming unit per millilitre (cfu/mL) [15]. Selective media were used to confirm each bacteria obtained.

Gram staining isolated pathogenic bacteria
The Gram staining was carried out as stated by [15].

Biochemical tests to identify isolated pathogenic bacteria
Biochemical tests such as Catalase, Methyl Red and Indole Tests, were carried out to confirm the isolates as stated in the literature [15].

RESULTS

Prevalence of pathogenic bacteria in ATMs in the study area
A total of 100 samples were collected from the ATMs in the study area, *Staphylococcus aureus* has the highest prevalence of 48%, *E. coli 43%* and *P. aeruginosa* has the lowest prevalence of 9% in this study (**Table 1**).

Table 1. Prevalence of pathogenic bacteria in ATMs in the study area.

		No. of Isolates (%)		
ATMs	No of samples	*E. coli*	*S. aureus*	*P. aeruginosa*
1	48	22%	20%	6%
2	52	21%	28%	3%
Total	100 (100%)	43%	48%	9%

Gram staining of the isolated pathogenic bacteria-
Gram-staining reactions of the isolated pathogenic bacteria was shown in **Table 2** *Escherichia coli, Pseudomonas aeruginosa* were all appeared Gram-negative rods while *Staphylococcus aureus* appeared as Gram-positive *cocci* in clusters (**Table 2**).

Table 2. Gram staining of the isolated pathogenic bacteria.

Isolated Pathogenic Bacteria	Gram staining
Escherichia coli	Gram –ve rods
Pseudomonas aeruginosa	Gram –ve rods
Staphylococcus aureus	Gram +ve cocci with clusters

Characteristic colony appearance of the isolated pathogenic bacteria on different culture media

The characteristic colony appearance of the isolated pathogenic bacteria on different culture media is shown in **Table 3**. The colonies of *Escherichia coli* appeared yellowish on MacConkey agar while *Pseudomonas aeruginosa* appeared greenish on Cetrimide Agar on the other hand the colonies of *Staphylococcus aureus* appeared yellowish on Mannitol Salt Agar (**Table 3**).

Table 3. Characteristic colony appearance of the isolated pathogenic bacteria on different culture media.

Isolated pathogenic bacteria	Media used	Colony appearance
Escherichia coli	MacConkey Agar	Yellowish colonies
Pseudomonas aeruginosa	Cetrimide Agar	Greenish colonies
Staphylococcus aureus	Mannitol Salt Agar	Yellowish colonies

Biochemical tests conducted on the isolated pathogenic bacteria

The result of the biochemical tests conducted on the isolated pathogenic bacteria (that is, *E. coli*, *P. aeruginosa*, *S. aureus*) is presented in **Table 4** three (3) tests which include methyl red; indole; and catalase; were carried out on ten (10) isolates for each of the pathogenic bacteria isolated from the samples for confirmation and identification. **Table 4** revealed that *E. coli* was indole positive while *S. aureus* was indole negative. However, all the isolates were catalase-positive.

Table 4. Biochemical Tests were conducted on the isolated Pathogenic Bacteria (n = 10).

E. coli	*P. aeruginosa*	*S. aureus*	Test
+	-	+	Methyl red
+	-	-	Indole
+	+	+	Catalase

Key:
+ = Positive
- = Negative
n= No. of isolates tested

DISCUSSION

The result obtained in **Table 1** showed that pathogenic bacteria such as *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* were isolated from the Automated Teller Machines (ATMs) of Unity Bank plc located in Jahun local government. This result is in agreement with the results obtained by [16]. The isolated pathogenic bacteria which are members of the family *Enterobacteriaceae* can cause hand-to-mouth infections in men if hands are not sanitized after using ATM [17]. Furthermore, out of the 100 samples, *S. aureus;* had the highest number (percentage) of 48% followed by *E. coli* with 43% and the lowest percentage found in *P. aeruginosa* with 9% **Table 1**.

The finding of *E. coli* in this study was in contrast to that of [18] where the percentage is lower from their findings. The finding of *S. aureus* and *E. coli* was in line with that of [19] who observed that *S. aureus* (28.57%) was the commonest organism isolated followed by *E. coli* (21.43%). *E. coli* is one of the most frequent causes of many common bacterial infections including cholecystitis, bacteremia, cholangitis, urinary tract infection (UTI), traveler's diarrhea and other clinical infections such as neonatal meningitis and pneumonia [20]. The highest number (percentage) of 48% of *S. aureus* obtained from the ATMs located in Jahun might probably be due to a change of attitude of the users which must have contributed to the use of ATMs. Although *S. aureus* is not always pathogenic, it is a common cause of skin infections such as abscesses, respiratory infections such as sinusitis and food poisoning. *S. aureus* is responsible for many infections, but it may also occur as a commensal [21].

S. aureus can infect tissues when the skin or mucosal barriers have been breached. This can lead to many different types of infections, including boils and carbuncles (a collection of boils) [22]. *S. aureus* infections can spread through contact with pus from an infected wound, skin-to-skin contact with an infected person by producing hyaluronidase that destroys tissues, and contact with objects such as towels, sheets, clothing, or athletic equipment used by an infected person [21]. Deeply penetrating *S. aureus* infections can be severe. Prosthetic joints put a person at particular risk of septic arthritis, staphylococcal endocarditis (infection of the heart valves) and pneumonia. Strains of *S. aureus* can host phages, such as Φ-PVL (produces Panton-Valentine leukocidin), that increase virulence [23].

The result obtained for Gram's reactions of the isolated pathogenic bacteria in (**Table 4**) is in agreement with Bergey's Manual of Determinative Bacteriology [24]. The result in (**Table 2**) also suggests that the isolated pathogenic bacteria are associated with ATMs as stated in the work of [25]. This infers that users of ATMs should always maintain good hand-washing practices after visiting ATMs to prevent hands-to-mouth infections which may have serious health implications for the infected ATMs users.

The result obtained in (**Table 3**) confirmed the characteristic colony appearance of the isolated pathogenic bacteria on the different culture media they were cultured. This further authenticate the presence of pathogenic bacteria (such as *E. coli*; *P. aeruginosa* and *S. aureus*) on the ATMs as stated in the work of [7]. The confirmation of the presence of these pathogenic bacteria suggests that users should always key into good and frequent hand-washing practices after using the ATMs to prevent infections. The result in **Table 3** also indicates that ATMs are not sterile hence the need to maintain good hygienic practices by the users. The biochemical tests conducted on the isolates confirmed them to be *E. coli*; *P. aeruginosa* and *S. aureus* (**Table 4**). This result is in line with Bergey's Manual of Determinative Bacteriology [16]

CONCLUSION

Pathogenic bacteria such as *E. coli*; *P. aeruginosa* and *S. aureus* on the ATMs were isolated from the Automated Teller Machines (ATMs) located in Jahun local government. They were confirmed culturally, Gram-stained and biochemically tested. The research work established that there is a relationship between the Automated Teller Machines (ATMs) and the isolated pathogenic bacteria.

RECOMMENDATIONS

As a result of the relationship that exists between the Automated Teller Machines (ATMs) and the isolated pathogenic bacteria, the following recommendations will be made:
Good hand washing and other hygienic practices should be observed by the users of ATMs. A bowl containing sanitiser

should be provided by the bank management at every ATM location so that users can disinfect their hands after using the ATMs. ATM Cleaners should be employed by the bank management so that they can disinfect the metallic buttons at intervals using compatible disinfectants.

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