BAJOPAS Volume 17 Number 1, June, 2024

http://dx.doi.org/10.4314/bajopas.v17i1.8

Bayero Journal of Pure and Applied Sciences, 17(1): 43 - 50
Received: 13/04/2024
Accepted: 11/06/2024
ISSN 2006 – 6996

INVESTIGATING THE CONTAMINATION LEVELS, BACTERIAL DIVERSITY AND SUSCEPTIBILITY PATTERN OF BACTERIA ISOLATED FROM POINT OF SALE (P.O.S) DEVICES IN KANO METROPOLIS

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ABSTRACT

Point of Sale (POS) devices are frequently handled surfaces that may serve as reservoirs for bacterial contamination, posing potential public health risks. This study investigated the bacterial load on POS devices in Kano Metropolis, analyzing contamination levels, bacterial diversity, and antibiotic susceptibility patterns. A total of 30 samples were collected from Supermarkets, School Markets, Car Parks, Neighborhood markets and Cash Withdrawal Kiosks. Samples were collected using swab stick moistened in sterile normal saline and processed using standard Microbiological procedures. The lowest and highest aerobic mesophilic bacterial counts (AMBC) ranged from 1.84 × 10^3 CFU/cm² in neighborhood shops to 6.68 × 10^3 CFU/cm² in school markets, with contamination levels influenced by location and hygiene practices. Bacterial isolates identified included Staphylococcus aureus (26.56%), Escherichia coli (18.75%), Bacillus subtilis (17.19%), Streptococcus spp. (15.63%), Klebsiella spp. (14.07%), Salmonella spp. (4.69%), and Pseudomonas aeruginosa. (3.13%), with Gram-negative bacteria (57.14%) being more prevalent. Antibiotic susceptibility testing revealed high susceptibility to Ofloxacin (83%), Imipenem (83%), Ceftriaxone (79%) and Azithromycin (75%), while resistance was observed against Ampiclox (79%) and Cefuroxime (73%). These findings highlight the role of POS devices as fomites for bacterial transmission and the potential risk of antimicrobial resistance. Regular disinfection, improved hygiene practices, and antibiotic stewardship are recommended to mitigate contamination and prevent the spread of resistant strains.

Keywords: Point of Sale (POS), Bacteria, Contamination, Exploration

INTRODUCTION

The rise of high-touch devices, particularly Point of Sale (POS) terminals, has transformed financial transactions across Nigeria and other parts of the world. Traditionally, financial operations relied heavily on cash and banking institutions, but the introduction of POS devices, driven by technological advances and several other factors has made transactions faster and more accessible (Adekanmi *et al*., 2021)**.**

In recent years, Nigeria has experienced a significant shift in its financial landscape, driven by the introduction and widespread adoption of the cashless policy initiated by the Central Bank of Nigeria (CBN). The policy was launched to reduce reliance on physical cash, promote electronic payments, and improve efficiency within the financial system. This shift aimed to address the inefficiencies of a cash-based economy, leading to the growing adoption of electronic payment systems, with Point of Sale (POS) devices playing a critical role in transforming financial transactions across the country (Adekanmi *et al*., 2021).

The COVID-19 pandemic further accelerated the adoption of POS devices. The pandemic disrupted the circulation of physical cash due to movement restrictions, supply chain disruptions, and reduced cash availability. As banks limited operations to curb the spread of the virus, POS operators filled the gap, offering essential financial services, including withdrawals and transfers. This surge in demand led to an increase in POS usage across Nigeria, especially in markets, neighborhoods, and informal business sectors (Blessing, 2024). Consequently, cash withdrawal via POS terminals became more popular, reducing the need for people to visit banks or ATMs. Today, POS devices are ubiquitous in Nigeria, not only in formal retail settings but also as standalone businesses. Many Nigerians, especially in urban areas like Kano, now run POS services as their primary source of income. These POS operators facilitate cash withdrawals and deposits, serving as an alternative to ATMs and bank branches. Customers can visit these POS kiosks, where they use their bank cards to withdraw cash for a small service fee (Odetokun *et al.,* 2021).

The expansion of POS services in diverse environments such as local markets, supermarkets, filling stations, retail shops, hospitals, restaurants and academic institutions introduced new challenges, including bacterial contamination risks associated with these devices (Adekanmi *et al.*, 2021). The public health risks posed by these contaminated surfaces are significant, especially in densely populated urban centers like Kano Metropolis.

Kano, as one of Nigeria's major commercial hubs, sees high volumes of POS transactions in its markets, businesses, and academic institutions. Given the sheer number of transactions conducted daily, the potential for POS devices to serve as vectors for disease transmission is a growing concern. The lack of regular cleaning protocols for these devices, combined with their frequent use, creates an environment conducive to the accumulation and transfer of microbial contaminants (Adekanmi *et al.*, 2021). This raises critical questions about the safety of POS devices as they become integral to daily economic activities. The increased handling of POS devices has underscored the need for studies examining their role as fomites in the transmission of infectious agents, with public health implications extending beyond the pandemic.

The increased reliance on POS devices for financial transactions in Kano Metropolis raises concerns about the potential health risks associated with bacterial contamination. While POS devices are essential for both retailers and consumers, they are frequently used without adequate cleaning between transactions. This increases the risk of spreading pathogenic bacteria that may cause infections, particularly antibiotic-resistant strains such as MRSA and VRE (Yusha'u *et al.*, 2010).

This study is justified by the widespread use of POS devices and their growing role in financial transactions across Nigeria. In Kano, POS terminals are prevalent almost everywhere in markets, supermarkets, schools and on the streets, where they are used by both customers and operators with minimal or no cleaning. Understanding the bacterial contaminants on these devices is essential for improving public health, as contaminated devices may serve as vectors for the spread of infectious agents.

In light of the rise in antibiotic-resistant bacteria, including MRSA and VRE, this research becomes even more critical. Evaluating the antibiotic susceptibility of bacteria isolated from POS devices will provide useful data to healthcare practitioners and policymakers in developing effective strategies to combat the spread of resistant strains. The aim of this study is to evaluate the bacterial contaminants on POS devices used in local markets, supermarkets, and academic institutions in Kano Metropolis.

Hypothesis

This study is based on the following hypotheses:

- Null Hypothesis (H_0): There is no significant bacterial contamination on POS devices found in Kano Metropolis.
- Alternative Hypothesis (H_1): POS devices in Kano Metropolis harbor significant bacterial contamination.

MATERIALS AND METHODS

Sampling Locations

The study was conducted in various commercial establishments in Kano Metropolis, including supermarkets, Neighborhood shops, school market, Motor parks and Cash withdrawal kiosks. These locations were selected due to their high traffic and frequent use of POS devices, making them ideal for assessing bacterial contamination.

Sample Size

A total of 30 swab samples were collected from different POS devices across the selected locations. Each location was visited twice, with a two-week interval between visits, allowing for comparative analysis over time.

Sample Collection Techniques

Samples were collected using sterile swabs moistened with sterile saline. Each POS device was swabbed on the surface where contact with customers was most frequent. Care was taken to ensure that each swab was applied uniformly to avoid cross-contamination. The surface area of each device was measured and calculated using a sterile ruler. The swab stick container was then transported back to the laboratory for further analysis.

Sample Inoculation

- A 1 mL aliquot of normal saline was added to the swab stick container and thoroughly mixed to prepare the stock solution. From this stock solution, serial dilutions were prepared using aseptic techniques. Each dilution was plated onto petri dishes containing nutrient agar. The inoculum was mixed with the agar by swirly it around gently to ensure uniform distribution before allowing the plates to solidify. The plates were then incubated under optimal conditions to promote bacterial growth (Cheesbrough, 2006).

Observation and Sub-Culturing

- **Observation**: After incubation, the plates were examined for bacterial growth. The distinct colonies formed were noted, counted, recorded and expressed as colony forming unit per centimeter square (CFU/cm2).
- **Sub-Culturing**: Distinct colonies were carefully picked and streaked onto fresh Nutrient Agar plates to obtain pure cultures. These plates were incubated at 37°C for 24 hours. Pure isolates were then stored for further testing (Dawodu & Akanbi, 2021).

Gram Staining

Gram staining was performed to classify bacteria into Gram-positive or Gram-negative groups (Tripathi & Sapra, 2023).

Biochemical Tests

Biochemical test is crucial for the identification and differentiation of bacterial isolates based on their metabolic characteristics. This section outlines the specific biochemical tests performed in this study to characterize the aerobic mesophilic bacteria isolated from Point of Sale (POS) devices. The tests include; catalase, oxidase, indole, coagulase (Cheesbrough, 2006), methyl resd, Voges Proskuer (MacFaddin, 2000).

Antibiotic Susceptibility Testing

Antibiotic susceptibility testing was conducted to evaluate the sensitivity or resistance of bacterial isolates to a selection of antibiotics. The Kirby-Bauer disk diffusion method was employed, adhering to the guidelines established by the Clinical and Laboratory Standards Institute (CLSI, 2023). A bacterial suspension was prepared and adjusted to match the turbidity of the 0.5 McFarland standard, ensuring a uniform concentration of bacterial cells. Sterile cotton swabs were used to evenly spread the standardized bacterial suspension over the entire surface of nutrient agar plates, creating a uniform bacterial lawn. Commercially available antibiotic discs were aseptically placed onto the inoculated agar surface using sterile forceps. The antibiotics tested included Amoxicillin Clavulanate (30 µg), Cefotaxime (25 µg), Ceftriaxone Sulbactam (45 µg), Imipenem (10/10 µg), Cefuroxime (30 µg), Ofloxacin (5 µg), Cefixime (5 µg), Levofloxacin (5 µg), Ciprofloxacin (5 µg), Erythromycin (15 µg), Gentamycin (10 µg), Azithromycin (15 µg), Nitrofurantoin (300 µg), Nalidixic Acid (30 µg), and Ampiclox (10 µg). The inoculated plates with antibiotic discs were incubated at 35°C for 18 to 24 hours to allow for optimal bacterial growth and interaction with the antibiotics. After incubation, the plates were examined for zones of inhibition around the antibiotic discs. The diameters of these zones were measured in millimeters and interpreted according to CLSI guidelines to classify the bacterial isolates as susceptible, intermediate, or resistant to each antibiotic (Bauer *et al.*, 1966; CLSI, 2023).

RESULTS

The Aerobic Mesophilic Bacterial Count (AMBC) of POS device samples shows that school markets (SM) and car parks (CP) have the highest bacterial contamination ranging from 6.68×10^3 CFU/cm² and 5.57×10^3 CFU/cm², respectively,, likely due to high human traffic and frequent handling. Cash withdrawal kiosks (CW) showed moderate contamination, (3.99×10^3 CFU/cm²), while supermarkets and neighborhood shops have the lowest bacterial loads (2.27×10^3 and 1.84×10^3 CFU/cm², respectively) (Table 1).

The percentage frequency distribution of bacterial isolates from POS device samples, indicated that *Staphylococcus aureus* (26.56%) is the most prevalent species, followed by *Escherichia coli* (18.75%) and *Bacillus subtilis* (17.19%), suggesting significant human and environmental contamination. *Streptococcus spp.* (15.63%) and *Klebsiella spp.* (14.07%) also show considerable presence, indicating potential pathogenic risks, while *Salmonella spp.* (4.69%) and *Pseudomonas aeruginosa* (3.13%) had the least percentage frequency of occurrence (Table 2).

The distribution of the bacterial isolates across different sampling sites showed *Staphylococcus aureus* as the most widely distributed species, with the highest occurrence in school markets (5), car parks (4), and cash withdrawal kiosks (3) (Table 3). *Escherichia coli* and *Bacillus subtilis* were also prevalent, particularly in school markets, car parks, and supermarkets, suggesting environmental and fecal contamination. *Klebsiella spp.* and *Streptococcus spp.* are moderately distributed, while *Salmonella spp.* and *Pseudomonas aeruginosa* appear only in school markets, car parks, and cash withdrawal kiosks.

The antibiotic susceptibility profile of the Gram-positive bacterial isolates shows that most isolates were sensitive to a broad range of antibiotics, including Levofloxacin, Ofloxacin, Cefotaxime, Ceftriaxone, Erythromycin, Imipenem, Azithromycin, Gentamicin, and Cefixime, indicating their effectiveness in inhibiting bacterial growth (Table 4). However, resistance was observed for Cefuroxime and Amoxicillin-Clavulanate in *Staphylococcus aureus* and *Streptococcus spp.*, suggesting their ineffectiveness against these strains. Additionally, Ciprofloxacin showed intermediate susceptibility in *Streptococcus spp.* and *Staphylococcus aureus*, while Amoxicillin-Clavulanate showed intermediate resistance in *Bacillus subtilis*, indicating reduced efficacy.

The Gram-negative bacterial isolates' antibiotic susceptibility profile reveals that most isolates are highly sensitive to Levofloxacin, Ofloxacin, Ceftriaxone, Cefixime, Gentamicin, and Imipenem**,** indicating their effectiveness in treating infections caused by these bacteria. Nalidixic Acid also demonstrated strong activity, particularly against *Salmonella spp.***,** while Cefotaxime showed intermediate susceptibility in *E. coli* and *Salmonella spp.***,** suggesting variable effectiveness. However, resistance was observed for Cefuroxime and Amoxicillin-Clavulanate across all isolates, as well as Ampliclox in *E. coli*, *Salmonella spp.*, and *P. aeruginosa*, suggesting limited efficacy of these drugs against Gram-negative bacteria**.** Additionally, Nitrofurantoin exhibited intermediate activity across all isolates, indicating potential but reduced effectiveness (Table 5).

Table 1: Mean Aerobic Mesophilic Bacterial Count of POS Device Samples

SAMPLING SITE			**Mean AMBC (CFU/cm²)**
SM1	6.78×10^3	6.52×10^3	6.65×10^3
SM2	7.18×10^3	6.82×10^3	7.03×10^3
SM3	5.98×10^3	6.78×10^3	6.38×10^3
CP1	6.23×10^3	5.92×10^3	6.07×10^3
CP2	6.73×10^3	3.34×10^3	4.54×10^3
CP3	5.63×10^3	6.60×10^3	6.11×10^3
CW1	4.10×10^3	4.15×10^3	4.13×10^3
CW2	4.31×10^3	3.76×10^3	4.04×10^3
CW3	3.93×10^3	3.48×10^3	3.71×10^3
SPM1	2.39×10^3	2.49×10^3	2.44×10^3
SPM2	2.16×10^3	2.74×10^3	2.45×10^3
SPM3	2.05×10^3	1.83×10^3	1.94×10^3
NS1	1.39×10^3	2.28×10^3	1.84×10^3
NS2	2.76×10^3	1.94×10^3	2.35×10^3
NS3	1.65×10^3	1.03×10^3	1.34×10^3

Key: SM= School Market, CP= Car Park, CW= Cash Withdrawal Kiosk, SPM= Super Market, NS= Neighborhood Shops. AMBC= Aerobic mesophilic Bacterial count.

Table 2: Percentage Distribution of Identified Bacterial Isolates

Bacterial Species	**Percentage Occurrence (%)**
Staphylococcus aureus	26.56
Escherichia coli	18.75
Bacillus subtilis	17.19
Streptococcus spp.	15.63
Klebsiella spp.	14.07
Salmonella spp.	4.69
Pseudomonas aeruginosa	3.13

Table 3: Distribution of Bacterial Isolates by sampling site

Bacterial Species	Neighborhood Shops	Supermarkets	School Markets	Cash Withdrawal Kiosks	Car Park/Motor Parks	Total
Streptococcus spp.	1	2	2	3	2	10
Bacillus subtilis	1	3	2	2	3	11
Staphylococcus aureus	2	3	5	3	4	17
Escherichia coli	2	2	3	2	3	12
Klebsiella spp.	2	1	2	2	2	9
Salmonella spp.	0	0	2	0	1	3
Pseudomonas aeruginosa	0	0	1	1	0	2

Table 4: Antibiotic susceptibility profile of isolated Gram-positive Bacteria

Antibiotics	**Streptococcus spp. (n=10)**	***B. subtilis* (n=11)**	***Stap. aureus* (n=17)**
Lbc	10 (S)	9 (S)	11 (S)
Cxm	5 (I)	9 (R)	2 (I)
Ofx	9 (S)	8 (S)	15 (S)
Ctx	8 (S)	6 (S)	14 (S)
Cro	3 (S)	6 (S)	10 (S)
Ery	8 (S)	6 (S)	10 (S)
Imp	10 (S)	8 (S)	10 (S)
Aug	8 (R)	10 (I)	15 (R)
Azn	7 (S)	8 (S)	14 (S)
Gn	8 (S)	6 (S)	12 (S)
Zem	9 (S)	10 (S)	11 (S)
Cip	10 (I)	11 (S)	16(I)

Table 5: Antibiotic Susceptibility Profile of Isolated Gram-negative Bacteria

Antibiotics	***E. coli* (n=12)**	**Klebsiella spp. (n=9)**	**Salmonella spp. (n=3)**	***P. aeruginosa* (n=2)**
Lbc	10 (S)	7 (S)	3 (S)	1 (S)
Cxm	1 (S)	2 (S)	1 (R)	1 (R)
Ofx	8 (S)	9 (S)	3 (S)	1 (S)
Ctx	9 (S)	8 (S)	2 (S)	2 (S)
Cro	6 (S)	6 (S)	3 (S)	2 (S)
Na	8 (S)	7 (S)	2 (S)	2 (S)
Acx	6 (R)	7 (I)	2 (R)	2 (R)
Imp	10 (S)	8 (S)	3 (S)	1 (S)
Nf	11 (I)	6 (I)	2 (I)	1 (I)
Aug	8 (R)	7 (I)	1 (R)	1 (R)
Gn	10 (S)	8 (S)	3 (S)	2 (S)
Zem	10 (S)	31 (S)	32 (S)	2 (S)

Key:

S (Sensitive): Effective inhibition of bacterial growth.

R (Resistant): Ineffective inhibition of bacterial growth.

I (Intermediate): Partial inhibition; may require higher doses or specific conditions for effectiveness.

Lbc (5ug) – Levofloxacin, Cxm (30ug) – Cefuroxime, Ofx (5ug) – Ofloxacin, Ctx (25ug) – Cefotaxime, Cro (45ug) – Ceftriaxone sulbactam, Na (30ug) – Nalidixic Acid, Acx (10ug) – Ampliclox, Imp (10/10ug) – Imipenem, Nf (300ug) – Nitrofurantoin, Aug – Amoxicillin clavulanate, Zem (5ug)

– Cefixime, Gn (10ug) – Gentamicin, Cip (5ug) – Ciprofloxacin, Ery (15ug) – Erythromycin, Azn (15ug) – Azithromycin.

DISCUSSION

The point-of-sale (POS) devices examined in this study exhibited significant bacterial contamination, with aerobic mesophilic bacterial counts (AMBC) across the sampled locations ranging from 1.84 × 10^3 CFU/cm² in neighbourhood shops to 6.68 × 10^3 CFU/cm² in school markets. The higher bacterial load observed in school markets is likely due to increased foot traffic and potentially insufficient hygiene practices, which are common in environments with frequent interaction between individuals (Firesbhati *et al*., 20201). In contrast, neighbourhood shops, which experience fewer user interactions, showed lower contamination, possibly reflecting better sanitation practices. This variation in bacterial contamination suggests the influence of both location and the frequency of device usage, alongside hygienic practices. The findings align with previous study by Odetokun *et al.* (2021), who also noted the significant presence of bacterial species on surfaces with frequent human contact, especially in high-traffic areas such as markets, shops, and transportation hubs. Additionally, similar studies conducted in Nigeria and other developing countries have reported high bacterial loads on frequently touched surfaces like ATMs and mobile phones. POS devices are emerging as new fomites, particularly with the increasing adoption of cashless transactions, highlighting the importance of hygiene in mitigating bacterial transmission in public spaces (Rajasekar *et al*., 2011).

The Bacterial species identified include *Staphylococcus aureus* (26.56%), *Escherichia coli* (18.75%), *Bacillus subtilis* (17.19%), *Streptococcus* spp*.* (15.63%), *Klebsiella* spp*.* (14.07%), *Salmonella* spp*.* (4.69%), and *Pseudomonas aeruginosa.* (3.13%). Among these, *Staphylococcus aureus* was the most prevalent, a finding consistent with previous studies on frequently touched surfaces (Anibijuwon *et al*., 2014). The isolation of *E. coli* and Klebsiella spp*.* is of particular concern, as these bacteria are commonly associated with fecal contamination and poor hygiene practices (Ifeadike *et al*., 2012). Notably, the presence of *Salmonella spp.* and *Pseudomonas aeruginosa,* highlights the potential risk of pathogenic transmission via POS devices. Both genera are known for their ability to cause severe infections, particularly in immunocompromised individuals. The identification of pathogens on POS devices has significant public health implications. POS devices, being frequently touched, act as fomites, facilitating the indirect transmission of bacteria between users. In particular, *S. aureus* and *E. coli* are known to survive on surfaces for extended periods, increasing the risk of contamination (Boye *et al*., 2020).

Gram-negative bacteria (57.14%) were more prevalent than Gram-positive bacteria (42.86%). The predominance of Gram-negative bacteria in this study may be attributed to their structural resilience and adaptability, enabling them to survive on frequently touched surfaces for extended periods (Sharma *et al*, 2019). This persistence poses significant public health concerns, as Gram-negative bacteria are often associated with healthcare-associated infections (HAIs) and exhibit substantial resistance to antibiotics, complicating treatment strategies (Al-Ghamdi *et al*., 2011). Notably, the findings align with those of Kawo and Musa (2021), who reported a higher prevalence of Gram-negative bacteria on mobile phones used by healthcare workers in Kano, Nigeria. Similarly, Sharma *et al.* (2019) found that ATMs from different locations were predominantly contaminated with Gram-negative bacteria. These studies collectively underscore the necessity for rigorous hygiene practices and regular disinfection protocols to mitigate the transmission of these resilient pathogens.

The antibiotic susceptibility test results reveal patterns in bacterial sensitivity and resistance across various antibiotics for both Gram-positive and Gram-negative bacteria.

The results indicate that most bacteria tested showed significant susceptibility to antibiotics such as Ofloxacin (Ofx), Ceftriaxone (Ctx), Gentamicin (Gn), Imipenem (Imp), Azithromycin (Azn) And Ceftriaxone Sulbactam (Cxm). These findings suggest that these antibiotics most likely retain their effectiveness against a broad range of bacterial species, including Gram-positive bacteria like as well as Gram-negative bacteria.

On the other hand, resistance was noted against antibiotics like cefuroxime (Cro), Augmentin (Aug), Ampiclox (Acx) and amoxicillin-clavulanate (Acx) across both groups of Bacteria. These findings align with previous studies conducted in Nigeria and globally, which report an increasing prevalence of resistance to older-generation antibiotics. For instance, Olowo-Okere *et al*. (2020) highlighted rising resistance rates among Gram-negative bacteria particularly against fluoroquinolones and β-lactam antibiotics.

Intermediate susceptibility observed for ciprofloxacin (Cip) and nitrofurantoin (Nf) in some cases indicates that while these antibiotics may still be partially effective, there is a potential risk of emerging resistance. This aligns with findings by Oliseh *et al*. (2018), where multidrug-resistant bacteria, including fluoroquinolone-resistant *E. coli* and *Salmonella* isolates. This trend necessitates a cautious approach to prescribing such drugs, emphasizing stewardship programs to prevent further resistance.

P. aeruginosa demonstrated resistance to several antibiotics, aligning with trends noted by John *et al*. (2021) regarding multidrug-resistant strains on ATM and POS surfaces. On the other hand, the susceptibility of *P. aeruginosa* and *Klebsiella* spp. to imipenem and gentamicin is encouraging, given that these bacteria may be notorious for their multidrug resistance potential. Similar trends were reported by Onyeajuwa *et al.* (2018), who demonstrated that carbapenems like imipenem remain potent against multidrug-resistant Gram-negative pathogens.

Hypothesis Evaluation

The results showed high bacterial counts (2.27 × 10^4 to 7.63 × 10^4 CFU/cm²) and the presence of pathogenic bacteria (*S. aureus, E. coli, Klebsiella spp., Salmonella spp*.), confirming POS devices as potential fomites. Therefore, the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted, indicating significant bacterial contamination on POS devices.

CONCLUSION

This study has highlighted the significant bacterial load present on POS devices, emphasizing their potential role as fomites in microbial transmission. The findings suggest that frequent handling of these devices by multiple users throughout the day, combined with inadequate sanitization, creates an environment conducive for accumulation and persistence of various bacterial species. The diversity of bacterial species identified in this study further suggests that these devices could be a medium for transmitting both harmless and potentially pathogenic microorganisms. Furthermore, the finding is particularly concerning, as it indicates the potential for antimicrobial-resistant strains to spread through commonly used POS devices. The presence of antibiotic-resistant bacteria on these surfaces underscores the growing public health challenge posed by antimicrobial resistance (AMR) and highlights the need for continuous monitoring of microbial contamination in such environments.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to reduce bacterial contamination and limit the spread of antibiotic-resistant bacteria:

1. Regular Disinfection of POS Devices:
   - Businesses should implement routine disinfection of POS devices using alcohol-based disinfectants or antimicrobial wipes.
   - Cleaning should be done multiple times a day, especially in high-traffic areas, to reduce bacterial accumulation.
2. Public Awareness and Hygiene Practices:
   - POS operators and customers should be educated on proper hand hygiene, encouraging the use of hand sanitizers before and after handling POS devices.
   - Awareness campaigns should emphasize the importance of regular handwashing, especially for individuals frequently handling cash and POS machines.
3. Health and Safety Regulations for POS Device Handling:
   - Health authorities and regulatory bodies should enforce strict hygiene guidelines for businesses that rely on POS transactions.
   - Business owners should be required to provide hand sanitizers at POS terminals for customers and operators to use.

By implementing these recommendations, the risks associated with bacterial contamination and antibiotic resistance on POS devices can be significantly reduced, thereby improving public health safety in commercial environments.

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