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Prevalence of Microbial pathogens on Currency Notes Circulating in some Hospitals of Kano Metropolis, Kano State, Nigeria.

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Abstract
The study probe on the prevalence of microorganisms isolated from currency notes in three different hospitals of Kano metropolis. A total of three hundred and eighty-four (384) pieces of Nigerian currency notes were randomly collected from 3 different hospitals within Kano metropolis. The loads as well as type of nosocomial pathogens present were examined using standard microbiological techniques. The mean bacterial and fungal counts of currency notes were recorded and One hundred naira (₦100) was found to have the highest bacterial and fungal counts of $7.55x10^4$±22.89 cfu/ml and $6.14x10^4$±33.34 cfu/ml respectively. The lowest bacterial and fungal counts ($3.74x10^4$±30.09 cfu/ml and $2.35x10^4$±29.44 cfu/ml) were found to be in one-thousand-naira denomination (₦1000). Ten microbial species of nosocomial pathogens were isolated, eight of which are bacterial species and two are fungal species, they are; *S. aureus*, *Streptococcus* spp., *E. coli, Klebsiella* spp., *Proteus* spp., *Salmonella* spp., *P. aeruginosa*, Coagulase Negative Staphylococci, *Aspergillus* spp. and *Candida* spp. The total number of nosocomial pathogens isolated from the three hospitals was 482. The most dominant nosocomial isolates from the three hospitals was *S. aureus*135(28%) and the least dominant was *Salmonella* spp 2(0.4%). Hasiya Bayero Paediatric Hospital (HBPH) had the highest number of nosocomial pathogens to be 176 (36.51%) with *Aspergillus* spp 64(36.4%) being the most dominant and *Salmonella* spp 2(1.1%) being the least dominant, followed by Murtala Muhammad Specialist Hospital (MMSH) having a total of 161(33.40%) nosocomial pathogens with *S. aureus* 51(31.7%) having the highest number and *P. aeruginosa* 3(1.9%) having the least number of nosocomial pathogens. The hospital with the least number of nosocomial pathogens was Aminu Kano Teaching Hospital (AKTH), *Candida* spp 65(100%) was the most dominant pathogen isolated from AKTH and *E. coli* 10(6.9%) was the least dominant. The result further suggests that it is important to employ protective measures to ensure the safety of individuals attending hospitals, including the patients on admission as well as the cashiers of the hospitals.

Keywords: Prevalence, Pathogens, Currency note, Hospital

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Introduction

Nosocomial infections are infections acquired in hospitals and other health care facilities usually transmitted through equipment; there is no evidence that the infection was present or incubating at the

time of hospital admission. To be classified as infection, the condition must be manifested as a clinical disease and not a colonization, which means the microorganisms are present but have no adverse effect on the host (Emori and Gaynes, 1993). Many serious human diseases are caused by bacteria, some of them responsible for millions of deaths each year, these includes cholera, leprosy, tetanus, bacterial pneumonia, whooping cough, diphtheria and Lyme disease (Agersew, 2014). Therefore, it is important to investigate the link between Naira notes circulating in hospitals and prevalence of nosocomial infections. An improved understanding of nosocomial infections from currency will help us further understand the roles of formites in the spread of infections. Formites are inanimate objects that are capable of absorbing, harboring and transmitting infectious microorganisms. Dust and dirt that commonly accumulate on such objects contain spores of infectious agents (Oyero and Emikpe, 2007). Contamination of objects by pathogenic microorganisms is of much public health concern as contaminated materials can be sources of transmitting pathogens (Xu *et al.*, 2005; Lalonde, 2007). Items that are passed from hand to hand are likely to be contaminated with disease causing microorganisms especially if handled with unclean hands or kept on dirty surroundings (Umeh *et al*., 2007). Currency notes therefore present a particular risk to public health since communicable disease can spread through contact with formites (Michaels *et al*., 2003).

Materials and method

Sampling Sites

Samples were collected within Kano metropolis from three different hospitals (Hasiya Bayero Paediatric Hospital (HBPH), Murtala Muhammad Specialist Hospital (MMSH) and Aminu Kano Teaching Hospital (AKTH) Kano State, Nigeria. Mints were collected from the bank to serve as control.

Sample Size

Sample size was calculated to be 384 using Open Epi Statistical Software version 2.3. A total of 384 samples were collected, forty-eight (48) pieces from each naira denomination (₦5 - 1000 notes). The samples were collected using simple random sampling from different cash unit, within the hospitals premises usually by exchanging the notes with new notes.

Collection of Samples

The notes were carefully collected and then gently inserted in sterile leather bags using disposable sterile hand gloves to avoid contamination from the cashiers of each cash unit usually after exchanging the notes with mints. The samples were then labeled in order to avoid mix up and transported immediately to the laboratory for analysis.

Sample Analysis

The procedure was performed via standard microbiological techniques and spread plate method (Singh *et al*., 2002; Yakubu, *et al.*, 2014). The working bench and environment were swabbed with 70% ethanol. A sterile, cotton-tipped swab stick moistened with sterile physiological saline was used to swab both sides of the currency notes. The swab of each sample was placed in a test tube containing 9ml sterile peptone and was shaken vigorously to dislodge the swabbed content into the solution. The solution was then mixed uniformly and a 10-fold serial dilution from 10^{-1} to 10^{-3} was made. A 1.0ml portion of the 10^{-3} serially diluted sample was inoculated using spread-plate method on sterile plates of nutrient agar medium for bacteria and potato dextrose agar medium for fungi in pairs and the inoculated plates were incubated in an inverted position at 37°C for 24hours for bacterial counts while those for fungal counts were incubated at room temperature for 72hours. The isolates were purified and identified to genus level on the basis of cultural, morphological and biochemical characteristics (Cheesebrough, 2002).

Excel and Statistical Package for Social Sciences (SPSS) version 21 were used to analyze the data obtained from the result. The values were expressed as mean ± standard (Gosa *et al*., 2014).

Results

The mean aerobic bacterial and fungal count of currency notes from three different

hospitals were presented in Table 1. One hundred naira (₦100) was found to have the highest bacterial and fungal counts of $7.55x10^4$±22.89 cfu/ml and $6.14x10^4$±33.34 cfu/ml respectively. The lowest bacterial and fungal counts ($3.74x10^4$±30.09 cfu/ml and $2.35x10^4$±29.44 cfu/ml) were found to be in one-thousand-naira denomination (₦1000).

The frequency of different microbial pathogens detected from currency notes from three different hospitals was presented in Table 2. Ten microbial pathogens were isolated, eight of which are bacterial species and two are fungal species, they are; *S. aureus*, *Streptococcus* spp., *E. coli*, *Klebsiella* spp., *Proteus* spp., *Salmonella* spp., *P. aeruginosa*, Coagulase Negative Staphylococci, *Aspergillus* spp. and *Candida* spp. The total number of microbial pathogens isolated from the three hospitals was 482. The most dominant isolates from the three hospitals was *S. aureus*135(28%) and the least dominant was *Salmonella* spp 2(0.4%). Hasiya Bayero Paediatric Hospital (HBPH) is having the highest number of pathogens to be 176 (36.51%) with *Aspergillus* spp 64(36.4%) being the most dominant and *Salmonella* spp 2(1.1%) being the least dominant, followed by Murtala Muhammad Specialist Hospital (MMSH) having a total of 161(33.40%) pathogens with *S. aureus* 51(31.7%) having the highest number and *P. aeruginosa* 3(1.9%) having the least number of pathogens. The hospital with the least number of nosocomial pathogens was Aminu Kano Teaching Hospital (AKTH), *Candida* spp 65(100%) was the most dominant pathogen isolated from AKTH and *E. coli* 10(6.9%) was the least dominant.

Table 1: Mean Aerobic Bacterial and Fungal counts (cfu/ml) of currency notes collected from Three Different Hospitals based on Denominations

Denomination(₦)	Number screened	Mean value of bacteria count (cfu/ml)	Mean value of fungal count (cfu/ml)
1000	48	$3.74x10^4$±30.09	$2.35x10^4$±29.44
500	48	$5.08x10^4$±37.93	$2.75x10^4$±30.65
200	48	$7.01x10^4$±24.59	$3.89x10^4$±28.36
100	48	$7.55x10^4$±22.89	$6.14x10^4$±33.34
50	48	$5.32x10^4$±36.85	$3.49x10^4$±31.24
20	48	$4.23x10^4$±25.71	$3.61x10^4$±34.68
10	48	$4.09x10^4$±42.28	$2.86x10^4$±32.18
5	48	$3.96x10^4$±26.99	$3.06x10^4$±34.79
Total	384	$5.12x10^4$±35.33	$3.51x10^4$±31.84

Key: ± = Mean ± standard deviation

Table 2: Prevalence of Microbial pathogens isolated base on the Three Hospitals

Isolates	Number of Isolates per Hospital			
	HBPH No (%)	MMSH No (%)	AKTH No (%)	TOTAL No (%)
S. aureus	47(26.7)	51(31.7)	37(25.5)	135(28.0)
Streptococcus spp	0(0)	21(13)	0(0)	21(4.4)
E. coli	40(22.7)	38(23.6)	10(6.9)	88(18.3)
*Klebsiella s*pp	5(2.8)	4(2.5)	12(8.3)	21(4.4)
Proteus spp	10(5.7)	7(4.3)	0(0)	17(3.5)
Salmonella spp	2(1.1)	0(0)	0(0)	2(0.4)
P. aeruginosa	0(0)	3(1.9)	0(0)	3(0.6)
CNS	8(4.5)	0(0)	21(14.5)	29(6.0)
Aspergillus spp	64(36.4)	37 (22.9)	0(0)	101(20.9)
Candida spp	0(0)	0(0)	65(44.8)	65(13.5)
TOTAL	176(36.51)	161(33.40)	145(30.08)	482

Key: CNS- coagulase negative Staphylococcal spp. HBPH = Hasiya Bayero Paediatric Hospital, MMSH = Murtala Muhammad Specialist HospitalAKTH = Aminu Kano Teaching Hospital

Discussion

The mean bacterial and fungal count of currency notes from three different hospitals were presented in Table 1 above, One hundred naira (₦100) was found to have the highest bacterial and fungal counts of $7.55x10^4$±22.89 cfu/ml and $6.14x10^4$±33.34 cfu/ml respectively. The lowest bacterial and fungal counts ($3.74x10^4$±30.09 cfu/ml and $2.35x10^4$±29.44 cfu/ml) were found to be in one-thousand-naira denomination (₦1000).

This result shows that all the denominations were found to be contaminated since growth were found on all the denominations examined. The study revealed that medium denominations (₦100 and ₦200) circulated in the three hospitals (Hasiya Bayero Paediatric Hospital (HBPH), Murtala Muhammad Specialist Hospital (MMSH) and Aminu Kano Teaching Hospital (AKTH)) were the most contaminated currency notes for both bacteria and fungi. The bacterial loads ranges from $3.74x10^4$±30.09 cfu/ml to $7.55x10^4$±22.89cfu/ml, and the fungal loads ranges from $2.35x10^4$±29.44 cfu/ml to $6.14x10^4$±33.34 cfu/ml respectively. This disagrees with other studies carried out on currency notes circulating in the environmental settings which reported that, lowest currency denominations are more contaminated than the highest denominations (Moosavy *et a l*., 2013).It can be assumed that lower denominations circulating within community are more contaminated than the higher denominations due to the frequent exchange between buyers and sellers in the market and small shops. The fact that higher currency denominations (₦500 and ₦1000) were found to be more contaminated in this study may be due to the less movement or circulations of the lower currencies (₦5, ₦10, ₦20 and ₦50) in the hospital settings due to the cost of hospital services which involve the use of higher denomination of currencies. The medium denomination (₦100 and ₦200) were found to have the highest load, this could be due to the fact that out of the different denominations screened, they are the dirtiest and tattered ones.

The frequency of different pathogens detected from currency notes from three different hospitals was revealed in Table 2 above, in which ten microbial pathogens were isolated, eight of which are bacterial species and two are fungal species, they are; *S. aureus*, *Streptococcus* spp., *E. coli*, *Klebsiella* spp., *Proteus* spp., *Salmonella* spp., *P. aeruginosa*, Coagulase Negative Staphylococci, *Aspergillus* spp. and *Candida* spp. The total number of nosocomial pathogens isolated from the three hospitals was 482. The most dominant nosocomial isolates from the three hospitals was *S. aureus* 135(28%) and the least dominant was *Salmonella* spp 2(0.4%). Hasiya Bayero Paediatric Hospital (HBPH) had the highest number of nosocomial pathogens to be 176 (36.51%) with *Aspergillus* spp 64 (36.4%) being the most dominant and *Salmonella* spp 2(1.1%) being the least dominant, followed by Murtala Muhammad Specialist Hospital (MMSH) having a total of 161(33.40%) nosocomial pathogens with *S. aureus* 51(31.7%) having the highest number and *P. aeruginosa* 3(1.9%) having the least number of nosocomial pathogens. The hospital with the least number of nosocomial pathogens was Aminu Kano Teaching Hospital (AKTH), *Candida* spp 65(100%) was the most dominant nosocomial pathogen isolated from AKTH and *E. coli* 10(6.9%) was the least dominant.

From the three hospitals, HBPH recorded the highest percentage of nosocomial pathogens (36.51%), followed by MMSH 33.40% and lastly AKTH 30.08%. The high prevalence of the organisms in HBPH could be attributed to poor sanitation standards of the hospital environment and it could be due to the fact that it is the only stand-alone paediatric hospital in the state with highest cliental load and paediatric cases, as such, it is congested. The lowest prevalence of organisms observed in AKTH could be related to its high standard of sanitation among the three hospitals studied. It's a reference and a teaching Hospital .The prevalence of nosocomial pathogens isolated

from this study varies compared to the one isolated by Umeh *et al.,* (2007) in their study which reported the prevalence of *Streptococcus faecalis (31.8%), Staphylococcus aureus* (27.3%), coagulase-negative staphylococci (18.2 %).

The most frequently reported nosocomial pathogens were *S. aureus, E. coli*, *P. aeruginosa* and *enterococci* (Teresa *et al*., 2008) which is in line with the findings of this study. The rate of occurrence of *E. coli* in this study were 18.25% which is against the report of Shakir*et al.* (2010), in which the rate of occurrence of *E. coli* were 58% followed by *Klebsiella* with the rate of 50% among others. The prevalence of nosocomial pathogens in this study contradict the report of Pal *et al.* (2013) who reported *Enterococcus* spp (25%) as the most frequently isolated bacteria followed by Coagulase Negative Staphylococcus (20.68%), *Staphylococcus aureus* (12.06%), *Bacillus* spp (12.06%), *Escherichia coli* (9.48%), *Klebsiella* spp (5.17%), *Micrococcus* spp (5.17%), and *Diphtheroids* (4.31%). *S. aureus* is the leading cause of nosocomial infections. It's the primary cause of lower respiratory tracts infections and surgical sites infections. *E. coli* is the second leading cause of nosocomial infections causing meningitis in neonates and diarrheal. *P. aeruginosa* is a nosocomial pathogen that is associated with urinary tracts infections and wound infections. It is also associated with systemic disease (Wahington *et al*, 2006, Brooks *et al*., 2007 and Contreras *et al*., 2008). *Klebsiella* spp. is a virulent organism that may cause both community and hospital acquired infections such as pneumonia typically along with urinary tract and wound infections particularly in immune-compromised individuals (Janardan *et al.,* 2009). Coagulase-negative Staphylococci (CNS) causes infections that are usually associated with indwelling foreign bodies. These infections are usually indolent but resistance to antibiotics can make them difficult to treat (Adamu*et al.,* 2012).

Conclusion

Aerobic mesophilic bacterial and fungal count from different hospitals was enumerated with the medium denominations having more counts, this shows that they are more contaminated than the higher and lower denominations. The isolation of microbial pathogens from currency notes circulating in the hospitals confirm that currency notes plays an important role in the transmission of hospital-acquired infections. Measures should therefore be employed to avoid the risk of transmitting nosocomial pathogens to patients and to ensure the safety of currency handlers in the hospital. There is also a need for determining the aerobic mesophilic count from other sources of contact in the hospital apart from currency notes.

Recommendation

A similar study should be conducted on clinical isolates from the patients on admission in the hospitals where this study is conducted. Poor hygienic standard should strictly be dealt with in hospital environment.

References

Adamu. J. Y., Jairus, Y. and Ameh J. A. (2012). Bacterial Contaminants of Nigerian Currency Notes and Associated Risk Factors. *Research journal of Medical Sciences.*6(1):1-6

Agersew, A. (2014). Microbial Contamination of Currency Notes and Coins in Circulation: A Potential Public Health Hazard. *Biomedicine and Biotechnology*, 2(3): 46-53

Brooks, G. F., Butel, J. S., Morse, S. A. and Carrol, K. C. (2007).*Jawetz, Melnics and Adelbergs.Medical Microbiology.* 24th Edition., U.S.A.: Lange books/McGraw-Hill, 248-261.

Cheesbrough, M. (2002).*District Laboratory practice in Tropical Africa countries, Part 2*. London: Press Sunicate of the University of Cambridge, 157-234.

Contreras, G. A., Diaz, C. A., Cortes, L. and Arias, C. A. (2008). Nosocomial outbreak of *Enteroccocusgallinarum:* ntaming of rare species of

enterococci. *Journal of Hospital Infections* 70:346-532.

Emori, T.G. and Gaynes, R. P. (1993). An overview of nosocomial infections,

Gosa, G., Tsige, K. and Ketema, B. (2014).Microbial load and safety of paper currencies from some food vendors in Jimma Town, Southwest Ethiopia. *BMC Research Notes* 7:843

Janardan, L., Satish, A., Pison, G., Rajani, M. and Bishal, D. (2009).Risk of handling paper currency in circulation chances of potential bacterial transmittance.*Nepal Journal of Science and Technology*. 10:161-166

Lalonde, M. (2007).Time for antibacterial wallets-germ fester on paper money. The Gazette, 1-2.

Michaels, B., Gangar, V., Lin, C. and Doyle, M. (2003). Use limitations of alcoholic instant hand sanitizer as part of a food service hand hygiene program. *Food Service Technology*, 3:71-80.

Moosavy, M. H., Shavisi. N., Warriner, K. and Mostafavi, E. (2013).Bacterial contamination of Iranian Paper Currency.*Iranian Journal of Health*, 42:1067–1070.

Oyero, O. G. and Emikpe, B. O.(2007).Preliminary Investigation on the Microbial Contamination of Nigerian Currency.*International Journal of Tropical Medicine*, 2(2):29-32.

Shakiruddin, A., Sahana, P., Tania, N. and Badrunessa, F. (2010).Evaluation of the Microbial Contamination of Bangladesh Paper Currency Notes (Taka) in Circulation.*Advances in Biological Research* 4 (5): 266-271

including the role of the microbiology laboratory. *Clinical Microbiology Rev* 6: 428-442.

Singh, D. V., Thakur, K. and Goel, A. (2002). Microbiological Surveillance of Currency.*Indian Journal of Medical Microbiology*. 20(1): 53.

Teresa, C. H., Andrus, M. and Dudeck, M. A. (2008).CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting.*American Journal of International Care*. 36:301-308.

Umeh, E. D., Juluku, J. D. and Ichor, T. (2007).Microbial Contamination of *'Naira'*(Nigerian Currency) Notes in Circulation.*Research JournalEnvironmental Science*.1(6): 336-339.

Wahington, C. W., Allen, S. D., Janda, W. M., Koneman, E. W. and Rocop, G. W. (2006). Koneman'scolour atlas and textbook of diagnostic microbiology. 6th edition: Lippincott.

Xu, J., Moore, J. E. and Millar, B. C. (2005).Ribosomal DNA (rDNA) identification of the culturable bacterial flora on monetary coinage from 17th currencies.*Journal of Environmental Health* 67(7): 51-55.

Yakubu, J. M. Ehiowemwenguan, G. and Inetianbor, J.E. (2014). Microorganisms Associated With Mutilated Naira Notes In Benin-City, Nigeria. *International Journal of Basic and Applied Science*; 03(1): 9-15