

# Transmission of antibiotic-resistant *Enterococcus faecalis* through currency notes

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## To cite this article

Olawale A. K., Akinro E. B., Olawale A. O., Olakunle T. P. Transmission of Antibiotic-Resistant *Enterococcus faecalis* through Currency Notes. *American Journal of Biology and Life Sciences*. Vol. 2, No. 6, 2014, pp. 162-165.

## Abstract

Enterococci have continued to attract considerable attention as emerging pathogen of public health concern. The present study therefore investigates the roles of Nigeria currency in the spread of drug resistant *Enterococcus faecalis* strains in the community. Of 130 currency samples collected from three locations including; food-markets, motor-garage, and hospital premises, 69 (53%) were positive for *Enterococcus faecalis*. Higher percentage (62.69) of currency notes from food marketers were positive for *Enterococcus faecalis*, followed by currency notes from motor-garage (47.22%) and the least (37.04) from hospital arena. Antibiograms of 246 *E. faecalis* strains recovered from the total samples reveal 113 (45.93%) resistant to cloxacilin, 101 (41.06%) resistant to erythromycin, 123 (50%) to cotrimoxazole, 131(53.25%) to amoxicillin, 59(23.98%) to chloramphenicol, 87(35.37%) to tetracycline, 119(48.37%) to augmentin, 52(21.14%) to gentamicin and 10(4.07%) to vancomycin. Resistance to the fluoroquinolones tested was in the order; levofloxacin 35(14.23%), ciprofloxacin 39(15.85%), norfloxacin 45(18.29%), spafloxacin, 48(19.51%), and perfloxacin 48(19.51%). This study has revealed that Naira currencies in circulation in the study area are highly contaminated by potential pathogens that can lead to spread of infection. Hence, the need for vigorous enlightenment of the populace on regular hand-washing exercise and other hygiene practices. The habit of applying saliva on fingers for counting currency notes should be totally discouraged.

## Keywords

Currency, Pathogen, Antibiotics, Hygiene

## 1. Introduction

The possibility that currency notes might act as environmental vehicles or fomites for the transmission of potential microorganism was suggested in the 1970s (Abrams & Waterman, 1972). Confirmation of contamination of money by drugs has been detected in the United States and United Kingdom (Ritter, 1997; Jenkins, 2001, Thompson, 2002). Contamination from the skin, anal region, wounds, nasal secretions and aerosols generated by sneezing and coughing are potential sources of transfer of microorganisms to currency notes during handling (Mackintosh and Hoffman, 1984).

Currency might also be playing an important role in the

transmission of microorganisms and also in the spread of drug resistant strains in the community. During the past decades, enterococci have emerged as important nosocomial pathogens (Moellering, 1992; Papanicolaou *et al.*, 1996). Enterococci are also important human pathogens being frequently implicated in human infections. These microorganisms present a high capacity of acquisition of antibiotic resistance mechanisms through horizontal gene transfer (Hammerum and others 2010). *Enterococcus faecalis* is responsible for most infections in the community, long-term care and hospital settings (Patterson *et al.*, 1995). *Enterococcus faecalis* with high level resistance to gentamicin and aminoglycosides emerged in the United States in the 1980s, creating therapeutic problems for patients with serious infections, such as endocarditis (Zervos *et al.*,

1987). The number of antibiotic-resistant enterococci, especially vancomycin-resistant enterococci (VRE), is increasing (Hsueh *et al.*, 2012; Rybaka *et al.*, 2012) which is of great public health concern as this may lead to treatment failure and increased hospital costs with attendant complications. The finding of Hayakawa *et al.* (2012) suggests the presence of a nonhospital pool of VR *E. faecalis*, which is of great concern. Enterococci are ubiquitous, found virtually everywhere in nature, they are adaptable to different substrates and growth conditions such as low and high temperature, extreme pH, and salinity (Abriouel *et al.*, 2008).

Numerous researches on currency in several countries indicated bacterial contaminations. A study by Hosen *et al.*, (2002) in Bangladesh revealed coliform contamination of 80% of thirty old two-taka notes, Pope *et al.*, 2002, isolated pathogenic or potentially pathogenic organisms from 94% of one-dollar bills. Nigerian currency like any other being used in the world is exposed to the potential of bacterial contamination. There is possibility of acquiring infection while applying saliva on fingers for counting currency notes. The possibility of getting infected by improper handling of currency is a potential hazard especially among children, who are known to torch money with their mouth while playing. The surprising levels of contamination found on everyday objects is a sign that people are forgetting to wash their hands after the toilet, one of the key moments for infection prevention (Cutler and Curtis, 2012).

Although there is no direct evidence that presence of microorganisms on currency results in infection, but still strategies must be adopted to reduce the contamination of currency, therefore this present study investigates the roles of Nigeria currency in the spread of drug resistant *Enterococcus faecalis* strains in the community.

## 2. Materials and Methods

### 2.1. Samples Collection

Nigeria currencies notes of different denominations and levels of usage were collected at random from various individuals at three locations (raw and ready-to-eat food market, motor-park and hospital premises) in Boripe Local Government Area, Osun State, Nigeria.

130 Naira notes were collected into separate sterile paper bags between August, 2012 to September, 2012 and transported to the Laboratory of the Department of Applied Sciences, Osun State Polytechnic, Iree, Nigeria, for bacteriological analysis on the same day. Not in circulation currency notes obtained from the Central Bank, were used as control samples.

*Culture and Isolation of Bacteria:* Each currency note was aseptically transferred into individual universal bottles containing 10 ml of sterile buffered peptone water and the bottle vigorously shaken for 2 minutes. The currency was removed and the resulting peptone water solution served as a test sample and incubated for 24 hours at of 37°C. The incubated test sample was then cultured onto Bile esculin

agar. The plates were incubated aerobically overnight in an incubator at 37°C. Pure cultures were obtained by sub-culturing distinct colonies. Control samples underwent the same processes.

*Identification of Isolates:* Pure isolated colonies were identified using their Morphology, Gram reaction as well as biochemical techniques using standard methods of Olutiola *et al.* (2000) and Fawole and Oso (2001).

### 2.2. Antibiotics Susceptibility Testing

Susceptibility testing was carried out on Mueller-Hinton agar using the disc diffusion method as described by Clinical and Laboratory Standard Institute (CLSI) (2008). The following commercial antibiotic disks (Abtek Biologicals, and Oxoid Ltd, Basingstoke, Hampshire, UK) with their concentrations (in µg) were used: amoxicillin (25), gentamicin (10), cotrimoxazole (25), augmentin (30) and tetracycline (30), erythromycin (5), chloramphenicol (30), cloxacillin (5), perfloxacin (5), norfloxacin (10), ciprofloxacin (10), levofloxacin (5), sparfloxacin (10) and vancomycin (5).

### 2.3. Statistical Analysis

Data from study was analyzed descriptively using SPSS 16.0 version software.

## 3. Results and Discussion

Table 1 shows the distribution of *Enterococcus faecalis* among currencies handled by different groups of people. Of 130 currency samples collected from three locations (food-markets, motor-park, and hospital premises), 69 (53%) were positive for *E. faecalis* contamination. Higher percentage (62.69) of currency notes from food marketers were positive for *Enterococcus faecalis*, followed by currency notes from motor-park (47.22%) and the least (37.04) from hospital arena. This finding confirms other research findings about bacterial contamination of currencies in circulation as well as introduces a new level of contamination although other researchers have detected contamination levels of 80% (Hosen *et al.*, (2002), 90% (Bosh and Steyn (1997) and 94% (Pope *et al.*, (2002). Basavarajappa *et al.*, (2005) found 96 out of 100 currencies contaminated with bacteria, fungal and protozoa. Also, Umeh *et al.*, 2007, revealed that 89.8% of Nigerian currency notes in circulation within the University of Agriculture, Makurdi Campus have microbial contamination.

Poor hygiene practices among food sellers compare to the hospital workers could be responsible for the higher occurrence of faecal contamination among them. The widely accepted Nigerian marketers attitude of applying saliva to fingers while counting the currency notes, biting off corners of banknotes, sticking banknotes in braziers and even squeezing all serves as potential routes of exposure to these bacteria.

Folding or crumpling of banknotes creates pouches or

crevices which could harbour dust particles and microorganisms some of which may grow or remain in a quiescent stage for long periods until they find suitable environments to grow and multiply (Bank of Ghana, 2007).

Studies however have shown that there is no statistically significant association between physical condition and the bacterial contamination of currency notes (Zarei *et al.*, in 2009) which places all currencies in circulation as potential public health hazards and immunocompromised persons stand the risk of acquiring opportunistic infections through handling of contaminated currency (Igumbor *et al.*, 2007).

Washing hands with soap when necessary such as before eating, after touching dirty objects or using the toilet can reduce pathogenic infections by up to 42% but only 69% of people reported doing this whenever possible (Cutler and Curtis, 2012).

**Table 1.** Distribution of *Enterococcus faecalis* among currencies handled by different groups of people.

Currency sources	Number of currency screened	Number of currency positive for <i>E. faecalis</i> (%)
Food marketers:		
Meat sellers	21	17 (80.95)
Fish sellers	15	6 (40.00)
Chicken sellers	18	13 (72.22)
Canteen Workers	13	6 (46.15)
TOTAL	67	42 (62.69)
Transporters:		
Drivers	11	5 (45.45)
Conductors	14	8 (57.14)
Passengers	11	4 (36.36)
TOTAL	36	17 (47.22)
Hospital Workers:		
Doctors	7	2 (28.57)
Nurses	12	4 (33.33)
Patients	8	4 (50.00)
TOTAL	27	10 (37.04)

**Table 2.** Antimicrobial susceptibility pattern of *E. faecalis* isolates from Currencies handled by different groups of people.

Antibiotics	Number of isolates resistant (%)
Amoxicillin	131 (53.25)
Cotrimoxazole	123 (50)
Augmentin	119 (48.37)
Cloxacillin	113 (45.93)
Erythromycin	101 (41.06)
Tetracyclin	87 (35.37)
Chloramphenicol	59 (23.98)
Gentamycin	52 (21.14)
Vancomycin	10 (4.07)
Perfloxacin	48(19.51)
Sperfloxacin	48(19.51)
Norfloxacin	45 (18.29)
Ciprofloxacin	39 (15.85)
Levofloxacin	35 (14.23)

Antibiograms of 246 *E. faecalis* strains recovered from the currency samples reveal 113 (45.93%) resistant to cloxacilin, 101 (41.06%) resistant to erythromycin, 123 (50%) to cotrimoxazole, 131(53.25%) to amoxicillin, 59(23.98%) to chloramphenicol, 87(35.37%) to tetracycline, 119(48.37%) to augmentin, 52(21.14%) to gentamicin and 10(4.07%) to vancomycin. Resistance to the fluoroquinolones tested was in the order; levofloxacin 35(14.23%), ciprofloxacin 39(15.85%), norfloxacin 45(18.29%), spafloxacin, 48(19.51%), and perfloxacin 48(19.51%) (Table 2). The extensive use of antibiotics has obviously led to a rapid development of resistance among both clinical and environmental isolates (Prakash *et al.*, 2005). Lack of proper hand hygiene may facilitate the spread of the antibiotic resistant organisms.

## 4. Conclusion

This study has revealed that Naira currencies in circulation in the study area are highly contaminated by potential pathogens that can lead to spread of infections. Hence, the need for vigorous enlightenment of the populace on regular hand-washing exercise and other hygiene practices.

## Recommendation

Strategies must be adopted to reduce the contamination of currency. These could be in the form of cashless transaction practices (i.e. use of ATM). Other recommendation is the regular disinfection of currency deposited in banks by ultraviolet light or formalin vapors. The general awareness about the possibility of acquiring infection while applying saliva on fingers for counting currency notes and good personal hygiene must be created in the public. The possibility of getting infected by improper handling of currency is a potential hazard especially among children, who are known to swallow coins accidentally or just keep them in mouth while playing. Therefore, health awareness must be directed towards children in the school through cartoons, stickers and other audio visual aids. Lastly, there is need for vigorous enlightenment of the populace on regular hand-washing exercise and other hygiene practices.

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