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Research Paper

# MULTIDRUG RESISTANCE OF ISOLATES OF METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) IN PAPER CURRENCY NOTES FROM MEAT SELLERS IN TANGA, TANZANIA

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A total of 128 Paper currency notes of Tanzania Shilling (500,1000,2000,5000 and 10,000Tshs) were randomly collected from Meat sellers in market place and analyzed for bacterial contamination. Swab samples were analyzed in microbiology lab. 36(28.125%) *Staphylococcus aureus* (MRSA) was isolated from 128 currencies. All *Staphylococcus aureus* (*S. aureus*) isolates showed multidrug resistance. *S. aureus* isolates resistant to Vancomycin also resistant to Methicillin. The incidence of *S. aureus* was more in lower denomination paper currency notes than higher denominations. The older currency notes carried lot of pathogenic bacteria. Currency notes may be the source of diseases.

**Keywords:** Antibacterial activity, Paper currency notes, meat sellers, *S.aureus* isolates

## INTRODUCTION

Paper currency, can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placement on dirty surface. Paper currency is commonly handled by various categories of people during transaction (Oyero and Emikpe, 2007). Items that are passed from hand to hand are of considerable likelihood to be contaminated with disease-causing micro-organisms especially if handled with unclean hands or kept in dirty or contaminated surroundings. Microorganisms are known to spread via air, water, food, etc. An important mechanism of the spread of pathogens

by for mites. Paper currency notes which are transferred from one individual to other are known to carry bacteria on their surface and are responsible for transmitting them (Hosen, 2006). Such practices transfer bacteria from currency notes to humans through food (Lamichhane et al., 2009, Ministry of Health, 2007). Dirty notes are usually moist and thus provide a good surface for bacterial growth. They provide favourable conditions such as substrate acquired from human body and due to handling as well as dust from the environment (Haque, 2003). The survival of various microorganisms on money and their transmission via the hands of food, vendors are

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often overlooked as enteric disease reservoir (Michaels, 2002).

*Staphylococcus aureus* is ubiquitous in nature and a known colonizer in humans. Community acquired soft tissue infections due to *S. aureus* is quite common. During the past four decades, Methicillin-resistant *Staphylococcus aureus*, or MRSA, has evolved from a controllable nuisance into a serious public concern (Neel and Ragini Deshpande, 2012).

*S. aureus* is a notable nosocomial pathogen to watch out for as it is found as skin or nasal flora (Adegoke and Komolafe, 2009, 2008). So, when this bacterium gets transferred to an immunocompromised individual with breached skin, any superficial and even systemic infection may result. Research has shown that contaminated fomites or surfaces play a key role in the spread of bacterial infections with antimicrobial resistance (Hota, 2004). Antimicrobial resistance is a global phenomenon that has resulted in high morbidity and mortality as a result of treatment failures and increased health care costs (Laxminarayan, 2010).

CA-MRSA is caused by newly emerging strains unlike those responsible for HA-MRSA and can cause infections in otherwise healthy persons with no links to healthcare systems. CA-MRSA infections typically occur as skin or soft tissue infections, but can develop into more invasive, life-threatening infections. CA-MRSA is occurring with increasing frequency in the United States and around the world and tends to occur in conditions where people are in close physical contact, such as athletes involved in football and wrestling, soldiers kept in close quarters, inmates, childcare workers, and residents of long-term care facilities (Media availability, 2012).

The aim of this study was to isolation and determine antibacterial activity of *S. aureus* isolated from Tanzanian currency. This is the first kind of work in Tanzania.

## MATERIALS AND METHODS

### Collection of Samples

128 notes of different denominations paper currency notes of 500, 1000, 2000, 5000 and 10,000 Tsh were collected from fish sellers, instant food sellers, fruits and vegetable sellers in market place from Tanga District place in Tanzania. The study was conducted from February to March 2012. We did not collect coin currency. Simultaneously we collected new paper currency notes from Bank as reference for bacteriological analysis.

Samples were randomly obtained by using large-denomination notes to smaller denominations by respective group. Each currency note was collected directly into a sterile plastic bag and transported to the laboratory of the Department of Science, Sebastian Kolowa University College, Lushoto soon after collection and examined for bacterial contamination. Swab samples were dipped in 1% peptone water. The swab samples were carried to lab for further examined for microbiological analysis.

### Bacteriological Analysis

Isolation of various bacterial contaminants from the currency notes were performed via standard techniques described previously (Gilchrist, 1993; Singh *et al.*, 2002). Briefly, a sterile, cotton-tipped swab moistened with sterile physiological saline was used to swab both sides of the currency note. The swabs were directly inoculated on blood agar and MacConkey agar. The pairs of inoculated media were incubated aerobically at

35-37°C for 24 hours and then examined for bacterial growth according to standard protocol described previously (Cheesbrough, 2000). The author was isolated bacteria by assessing colony characteristics and Gram reaction, and by conducting catalase and coagulase tests; hemolysis, sugar fermentation, and other biochemical tests, including tests for indole production, citrate utilization, and urase activity; triple sugar iron (TSI) agar tests (for glucose, sucrose, and lactose fermentation); gas and hydrogen sulfide production tests; and oxidase tests, according to protocols described previously (Cheesbrough, 2000). Bacteria were identified but were not quantified.

### Antibiotic Susceptibility Test (AST)

Antibiotic susceptibility was determined by the agar diffusion technique on Mueller-Hinton agar (Kirby-Bauer NCCLS modified disc diffusion technique) using 8 antibiotic discs (Biotec Lab. UK) corresponding to the drugs most commonly used in the treatment of human and animal infections caused by bacteria; Penicillin (PEN) (10 units), Erythromycin (ERY) (15 µg), Methicillin (M) (30 µg), Cefaclor (CL) (30 µg), Ciprofloxacin (CP) (30 µg), Vancomycin (V) (30 µg), Gentamycin (GEN) (30 µg), Linezolid(L)(30 µg),

amoxicillin (AM) (30 µg) and ampicillin (AMP) (30 µg) (Hi Media, India) (Kirby-Bauer, 2009).

## RESULTS AND DISCUSSION

From the analysis of the 128 paper currency notes collected from meat sellers in market places of Tanga city of Tanzania (Table 1).

After bacteriological analysis we did not find single bacterium from unused new paper currency notes obtained from Bank. *S. aureus* which had highest occurrence has been recognized for cross implication in various types of infections. High level of antibiotic resistance was observed by the *S. aureus* isolates (enter my data). The *S. aureus* obviously exhibited resistance to multiple antibiotics and 76.9% resistance to vancomycin that was often considered as last line of defense was isolated.

But in lower denominations were more dirty and microbial load than higher denominations. 500 Tshs showed highest incidence of different bacteria includes *S. aureus* 13(48.14%) out of 27 paper currency. All 13 *S. aureus* isolates from 500Tsh were resistant to Penicillium, 92.30% were resistant to Methicillin, 23.07% were resistant to Vancomycin, 4(38.76%) for Ciprofloxacin, 6(46.15%)for Erythromycin,

**Table 1: Expression Of Antibiotic Resistance Patterns By *S. Aureus* Strains Isolated from Paper Currency from Meat Sellers In Market Place Of Tanga In Tanzania**

| S. No. | Tanzania Currency Notes With Number Total 128 | Number of <i>S. aureus</i> Isolates and Percentage | Percentage of <i>S. aureus</i> isolates resistance to erythromycin (15 µg) | Percentage of <i>S. aureus</i> isolates resistance to gentamycin | Percentage of <i>S. aureus</i> isolates resistance to Linezolid(30 µg) | Percentage of <i>S. aureus</i> isolates resistance to ampicillin(30 µg) |
|--------|---|--|--|--|--|---|
| 1      | 500Tsh(27)                                    | 13(48.14%)   | 100  | 12(92.30%)   | 3(23.07%)  | 4(38.76%)   |
| 2      | 1000 Tsh(26)                                  | 10(38.46%)   | 100  | 9(90%)   | 2(20%)   | 4(40%)  |
| 3      | 2000Tsh(28)                                   | 8(28.57%)  | 100  | 100  | nil  | 3(37.5%)  |
| 4      | 5000Tsh(23)                                   | 4(17.39%)  | 100  | 100  | nil  | 1(25%)  |
| 5      | 10000Tsh(24)                                  | 1(4.16%)   | 100  | 100  | nil  | nil   |

6(46.15%) for Gentamycin, 0 % for Linezolid, 9(69.23%) for Amphotericin, 12(92.30%) for Cefaclor and 6(46%) for Amoxicillin (Table 2).

Percentage of resistance of *S. aureus* isolated from 1000Tsh. All 10 coagulase positive *S. aureus* isolates from 1000Tsh (total 26) were resistant to Penicillium, 9(90%) were resistant to Methicillin, 2(20%) were resistant to Vancomycin, 4(40%) for Ciprofloxacin, 5(50%) for Erythromycin, 6(46.15%) for Gentamycin, 0 % for Linezolid, 7(70%) for Amphotericin, 7(70%) for Cefaclor and 5(50%) for Amoxicillin.

From 2000Tsh (28 paper currency) 8(28.57%) coagulase positive *S. aureus* were isolated. All were resistant to Penicillium, 9(90%) were resistant to Methicillin. All 8 *S. aureus* were sensitive to Vancomycin, 3(37.5%) were resistant to Ciprofloxacin, 6(75%) for Erythromycin, 4(50%) for Gentamycin, all *S. aureus* were sensitive to Linezolid, 5(62.5%) for Amphotericin, 5(62.5%) for Cefaclor and 3(37%) for Amoxicillin.

From 5000Tsh (23 paper currency) 4(17.39%) coagulase positive *S. aureus* were isolated. All were resistant to Penicillium and Methicillin. All 4 *S. aureus* were sensitive to Vancomycin, 1(25%) is resistant to Ciprofloxacin, 2(50%) for

**Table 2: Expression Of Antibiotic Resistance Patterns By *S. aureus* Strains Isolated From Paper Currency From Meat Sellers In Market Place Of Tanga In Tanzania.**

| S. No. | Tanzania Currency Notes With Number Total 128 | Number of <i>S. aureus</i> Isolates and Percentage | Percentage of <i>S. aureus</i> isolates resistance to erythromycin (15 µg) | Percentage of <i>S. aureus</i> isolates resistance to gentamycin | Percentage of <i>S. aureus</i> isolates resistance to Linezolid(30 µg) | Percentage of <i>S. aureus</i> isolates resistance to ampicillin(30 µg) |
|--------|---|--|--|--|--|---|
| 1      | 500Tsh(27)                                    | 13(48.14%)   | 6(46.15%)  | 6(46.15%)  | nil  | 9(69.23%)   |
| 2      | 1000 Tsh(26)                                  | 10(38.46%)   | 5(50%)   | 6(46.15%)  | nil  | 7(70%)  |
| 3      | 2000Tsh(28)                                   | 8(28.57%)  | 6(75%)   | 4(50%)   | nil  | 5(62.5%)  |
| 4      | 5000Tsh(23)                                   | 4(17.39%)  | 2(50%)   | 2(50%)   | nil  | 2(50%)  |
| 5      | 10000Tsh(24)                                  | 1(4.16%)   | 100  | 100  | nil  | 100   |

**Table 3: Expression of Antibiotic Resistance Patterns by *S. Aureus* Strains Isolated from Paper Currency from Meat Sellers In Market Place of Tanga In Tanzania**

| S. No. | Tanzania currency notes with number. Total 128 | Number of <i>S. aureus</i> isolates and Percentage | Percentage of <i>S. aureus</i> isolates resistance to Cefaclor(30µg) | Percentage of <i>S. aureus</i> isolates resistance to amoxicillin(30 µg) |
|--------|--|--|--|--|
| 1      | 500Tsh(27)                                     | 13(48.14%)   | 12(92.30%)   | 6(46%)   |
| 2      | 1000 Tsh(26)                                   | 10(38.46%)   | 7(70%)   | 5(50%)   |
| 3      | 2000Tsh(28)                                    | 8(28.57%)  | 5(62.5%)   | 3(37%)   |
| 4      | 5000Tsh(23)                                    | 4(17.39%)  | 3(75%)   | 2(50%)   |
| 5      | 10000Tsh(24)                                   | 1(4.16%)   | 1(100%)  | 1(100%)  |

Erythromycin, 2(50%) for Gentamycin, all *S. aureus* were sensitive to Linezolid, 2(50%) for Amphotericin, 3(75%) for Cefaclor and 2(50%) for Amoxicillin.

From 10,000Tsh (24 paper currency) 1(4.16%) coagulase positive *S.aureus* were isolated. All were resistant to Penicillium, Methicillin, Erythromycin, Amphotericin, gentamycin, Cefaclor and Amoxicillin. One *S.aureus* were sensitive to Vancomycin, Linezolid and Ciprofloxacin. 1(100%) *S.aureus* resistance for 3.91% of Vancomycin resistance was found from 128 paper currency notes.

Over the past 50 years, the use of antimicrobial drugs to treat infections has become increasingly widespread. In response, microbes have been evolving to develop defences, and as a result, those drugs are no longer effective in killing them. Although MRSA is one of the most prevalent drug-resistant infections, other diseases, like TB and malaria, are also becoming increasingly difficult to treat because of drug resistance (NIH Scientists, 2012). 28.125% of *S.aureus* were isolated from 128 currencies. The percentage of *S.aureus* incidences were more in lower currency denominations and less in higher denominations. Every day currencies notes circulate in all profile people in the society get contaminated. The multidrug resistance was found in all *S.aureus* isolated. Multidrug resistance in isolates is increasing may be because of Changes in/on the antimicrobial target, inactivation by enzymes, changes in cellular permeability, antimicrobial active efflux, over production of target enzymes and by pass of the antimicrobial resistance have been the common mechanisms of antimicrobial resistance (McKeegan, 2002) One of the reasons in the

development of resistance to chemotherapeutic agents is due to abuse of these drugs (Reuters, 2005).

All 36(28.125%) *S.aureus* isolates were multidrug resistant isolated from 128 currencies. Similar reports were found with Bacterial contamination of *Staphylococcus aureus* (38%) in Saudi 'one' Riyal paper notes (Al-Ghamdi, 2011) and antibiotic resistant bacterial contamination of the Ghanaian currency note (Tagoe, 2011). Similar reports were found in Nigerian currency notes (Awe, 2010).

Vancomycin was choice of drug to treat MRSA. 3.91% of Vancomycin resistance was found from 128 paper currency notes. In society the currency pass from patients, especially immunocompromised patients and are on chemotherapeutic agents get Vancomycin resistance.

From this study, the bacterial isolates that were isolated were associated with oral, nasal, skin and faecal contamination. This is an indication that money contamination is associated to unhygienic practice of people. These practices include indiscriminate sneezing, coughing and defecation with indecent handling of currency notes (Singh *et al.*, 2002; Emikpe, 2007).

Patients infected with resistant strains are more likely to be sicker, to be hospitalized for longer periods of time, and to die of the infection (Carmeli *et al.*, 2002). Both the duration of hospitalization and the attributable cost of treating methicillin-resistant *Staphylococcus aureus* were found to be nearly three times as large as those for a susceptible infection (Abramson and Sexton 1999).

*Staphylococcus aureus* can cause disease of the skin usually results in a localized collection of pus, known as an abscess, boil, food poisoning and diarrhea, urinary tract infections (UTIs), and bacteremia (Prescott et al., 2008; and WHO, 1984a).

30.75% of *Staphylococcus aureus* were found from 136 currency notes, similar reports were found Ghanaian currencies (7.14%) (Patrick Feglo, 2010).

## CONCLUSION

Currency notes could be a source of Source of contamination and infection. Public education on proper handling and care of currency is advocated, in order to reduce currency contamination. Dirty and mutilated notes should be withdrawn from circulation from time to time. The practice of keeping money in brassieres, handkerchiefs and in shoes should be discouraged.

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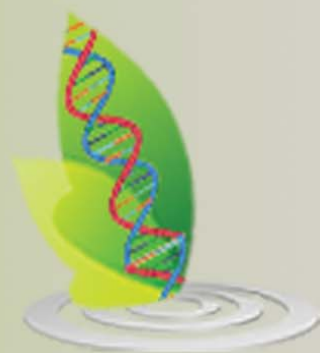
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