# INCIDENCE AND SPREAD OF FUNGI-ASSOCIATED RESPIRATORYINFECTIONS AMONG COMMERCIAL BANK TELLERS,SOUTH-EASTHERN NIGERIA.


## ABSTRACT

**INTRODUCTION:** Fungi - associated respiratory Infections are serious health challenges that have become inextricably linked with handling of paper currencies in some countries of the world. Given the quantity of Old-worn-out and mutilated Naira notes in circulation, and other prevailing circumstances in Nigerian banking halls, Study was undertaken to evaluate the incidence and spread of fungi -associated respiratory infections among tellers from selected commercial Banks in South-Eastern Nigeria.

**METHODS:** A total of 504 Cash Bank Tellers; 196 Males and 308 females aged 25 – 48years (mean age 32.4 years) were evaluated for Fungi-associated infections using Sputum and Nasal secretions-smear Microscopy and Culture simultaneously. Twenty-Seven bacterial strains from *Staphylococcus aureus* (12), *Streptococcus Pneumonia* (7) and *Klebsiella pneumoniae* (8) were tested for their antibiogram

**RESULTS:** One hundred and fifty-nine (31.5%) of the 504 Bank Cash Tellers were diagnosed of respiratory infections due to *Aspergillus* Sp. (13.5%), *Candida albicans* (5.8%), *Candida tropicalis* 6(.4%), *Staphylococcus aureus* (2.4*%), Streptococcus pneumoniae* (1.4%), *Klebsiella pneumoniae* (1.6%), and *Nocardia* Sp. (0.6%). The yield of micro-pathogens appeared to rise from 18.8% to 55.6% as duration of currency note handling increased from ≤ 6months to 43 – 48 months respectively. Analysis of the differences of the Micro-Pathogens isolated among tellers from Bulk Rooms (42.9%) and those from open Halls (20.2%) was statistically significant ($X^2$cal=68.3) $P < 0.05$. Forty-eight (88.9%), 26(123.8%), 41(44.6%) and 43(113.2%) Strains of micro-pathogens were isolated from Tellers who indicated with

history of respiratory infections, smoking only, alcohol consumption only and smoking/alcohol consumption respectively. The proportions of the micro-pathogens isolated are shown in the Table1, with *Aspergillus* sp. yield appearing highest. The antibiogram of the 27 strains of bacteria isolated in the study appeared relatively high; 92.6% for Ofloxacin and 66.7% for Gentamycin, while Streptomycin, Erythromycin, Cephalexin, Ampiclox, and Chloramphenicol responded poorly.

**CONCLUSION:** The micro-pathogens isolated from this study are important agents of respiratory infections. The relatively high proportions (31.6%) of micro-pathogens isolated may serve as relevant indication that most Nigerian Currency notes in circulation are old, worn-out, mutilated, and are contaminated with micro-pathogens commonly linked with serious public health problems.

**Keywords**: Bank Tellers, fungi and bacteria-associated Respiratory Infection, Contaminated Currency Notes, Nigeria.



## INTRODUCTION

The wide spread use and the relatively high rate of exchange of paper currencies in any economy (particularly in Nigeria), make bulk handling of the paper currencies a serious public health challenge. The materials from which the Naira Currencies (#100, #200, #500 and #1000) are produced constitute a mixture of cotton and linen. These currency notes made from cotton/linen mixtures become easily contaminated with micro – pathogens as they rapidly absorb and retain moisture. They are widely used and circulated than the polymer-based paper currencies (#5, #10, #20 and #50). El – Dars and Hassan (2005), in Egypt noted that those paper currencies that are made of mixture of cotton and linen usually offer surface

area for microorganisms to reside on both sides [1]. Meanwhile, it was also reported that polymer-based paper currencies presented lower bacterial counts than cotton/linen-based paper currencies [2]. The later investigators showed that the longer the paper currencies remain in circulation, the more chances that there are for them to become contaminated, and that lower denomination currency notes receive the most handling because they are exchanged more frequently.

In Nigeria, the higher denomination currency notes (#100, #200, #500 and #1000) are more in circulation as they receive the most handling and are also made of cotton/linen mixture. A number of old, warn-out and mutilated ones are increasingly in circulation because they are exchanged more frequently. There is a high likelihood that these old,worn-out and mutilated paper currency notes would harbour more microorganisms than the polymer- based neat intact new ones.

Current studies have confirmed the presence of various microbial pathogens on paper currencies in Nigeria and other countries of the world [3. 4, 5, 6, 7]. It was noted in these studies that fungal pathogens like *Aspergillus niger, Aspergillus flavas, Rhizopus Spp, Penicillium Spp, Candida spp, Trichoderma Viride, Altenariatenius* and *Alternairaparaticus* were among the notable fungal pathogens frequently isolated from paper currencies, and they linked them with serious respiratory infections.

Compared to other articles in circulation, paper currency notes perhaps, are the most widely handled by people of varying trade and vocation worldwide. Cash Tellers, whose primary job is to handle and disburse them stand the highest risk of acquiring infections commonly associated with contaminated currency notes. Currency counting machines and currency count rooms in banks also showed high level of the presence of various bacterial and fungal pathogens [8].

It therefore implies that cash tellers particularly those in bulk rooms may have the highest risk of currency note - associated infections. Of all the reported infections, respiratory infections appear the most frequently encountered as the causative agents are often airborne [9]. Although most reported fungal associated respiratory infections appear commonly among farmers and wig-and rug cleaners, another study noted that new episodes seem to involve people of even higher social-economic status [10]. Considering the volume of old-worn-out and mutilated currency notes in circulation in Nigeria, bank cash tellers either in the bulk rooms or in the open banking halls qualify to be enlisted among higher social economic group with the highest predisposition for fungal associated respiratory infections.

It was therefore on account of these considerations that the investigations reported here were carried out among bank cash tellers from selected commercial banks, South-Eastern Nigeria.

## MATERIALS AND METHODS

**SUBJECTS:** The subjects were 504; I96 males and 308 females, aged 25 – 48 years (mean age 32.9 years), who work in commercial banks, South – Eastern Nigeria. The cash tellers were of two categories; those at the bulk room and those at the counter in the banking hall. Both categories of cash tellers are exposed to currency notes for about 8 hours a day and 40hours a week. Individual characteristics/life styles of the subjects like history of smoking, alcohol consumption, history of respiratory diseases, were sought using structured questionnaire. Those already diagnosed of persistent respiratory infections, who were on medication from the banks reference hospitals/clinics were excluded from the study. A total of 504 Bank cash tellers were investigated; constituting 84 subjects from the six selected banks (Diamond, Zennith, Unite Banks for Africa, Union Bank, First Bank and Eco Banks) from South – Eastern Nigeria.

## SAMPLE, SAMPLE COLLECTION AND EXAMINATION

Nasal secretions and sputum samples from the 504 cash tellers were obtained using sterile swab stick and wide mouth sterile containers respectively. The nasal secretions were inoculated directly onto Brain- Heart infusion Agar (BHIA), antibiotic-free Sabouraud Dextrose Agar (SDA), Chocolate Agar and Blood Agar, for the bacteriological examination of the sputum samples, equal volume of M-acetyl-L-Cysteine was added to each sample and allowed to digest for 30 minutes with occasional shaking using a vertex mixer. The digested sputum was centrifuged at 3000rpm for 5 minutes and the supernatant discarded. A wet smear of the deposit was prepared on a clean glass slide and microscopically (x40 objective) viewed for the presence of fungal hyphae or budded yeast cells. Other smears were stained either with Indian ink for capsules, lactophenol-blue for fungal spores, and Gram stain for yeast and bacterial cells. About 60ul portion of the deposit was inoculated each onto Chocolate Agar, Brain-Heart Infusion Agar, antibiotic – free Sabouraud Dextrose Agar and Blood agar. All the cultures were incubated aerobically incubated at $37^{oc}$ and examined daily for growth for 30days, except chocolate and Blood agars plates, which were incubated for only 48hours.

The resultant colonies from all the cultures were characterized according to cowan (1993). Isolates obtained from the SDA were identified by their colonial and morphologic appearances. Also, the ability of the isolates to hydrolyse Casein, Xanthine, Tyrosine, was used to characterize Nocardia species. Isolate of Candida albicans were confirmed using Germ-tube formation test.

Antibiotic susceptibility testing of bacterial isolates was done using the disc diffusion technique (Stokes, 1980). The bacterial isolates along with Staphylococcus aureus Strain ATCC 25923 (positive control) were inoculated onto oxford Sensitest agar plates and incubated aerobically for 24 hours at $37^{oc}$. Thereafter, cultures were examined for zones of inhibition. The antibiotics used were Cephalexin (CE,30mg/disc) Ofloxacin (OXF; 5mg/disc), Chloramphenicol (CHL; 30mg/disc), Streptomycin (ST; 10mg/disc) Gentamycin (CN; 10mg/disc), Erythromycin (E;15mg/disc) and Ampiclox (Amp; 10mg/disc).

The study was carried out with the permission of the Banks and the Abia State University Teaching Hospital Research board/ ethics committee.

The data collated were analyzed with Epi-info-60 computer programme, applying the Chi-square and Correlation tests. For all the measurement, the ranges for the duration of exposure with paper currencies were used to summarize the data in tables. The statistical tests were performed to assess the significance of association of infections with the duration of the subject's exposure to currency notes, using a 95% confidence interval at a p-value of $< 0.05$ or $x= 0.05$.

## RESULT

One hundred and fifty-nine (31.5%) of the 504 Bank Cash Tellers investigated had infections due to fungi and bacteria: 68(13.5%) *Aspergillus*Spp; 29 (5.8%) *Candida albicans*, 32 (6.4%) *Candida tropicalis*, 12 (2.4%) *Staphylococcus aureus*, 7(104%) *Streptococcus pneumoniae*, 8 (1.6%) *Klebsiella pneumoniae* and 3(0.6%) *Nocardia* Sp. (Table 1)**.** Distributions of fungal and bacterial isolates according to duration of cash handling by the tellers are shown in Table 1. The range in months of exposure to cash handling by the tellers was from ≤ 6 months to 48 months and the mean duration was 27months. Among the 504 cash tellers with ≤ 6 months of exposure to Naira currencies had the lowest 13 (18. 8%) proportion of fungal and bacterial infections diagnosed, and the highest proportion 20(55.6%) came from among those who had handled cash between 43 – 48months, followed by 46(40.5%) for those of 31 – 36months duration. The differences in the distribution of both fungal and bacterial isolates by duration of exposure to cash appeared statistically significant($X^2$cal = 1630.3: $p< 0.05$).

The pattern of antibiotic susceptible of the three bacterial isolates; *Staphylococcus aureus* 12 (2.4%), *Streptococcus pneumoniae* 7(1.4%) and *Klebsiella pneumoniae* 8(1.6%) is shown in

Table2. Out of 27 bacterial strains tested for antibiotic susceptibility 25 (92.6%) were susceptible to Ofloxacin (5mg), 18 (66. 7%) to Gentamycin (10mg), 10 (37.0%) to Streptomycin (10mg), 5(18.5%) to Erythromycin (15.mg) 5 (18. 5%), to Cephalexin (30ug), 3(11.1%) Ampiclox (10ng), and 8 (29.6%) to Chloramphenicol (30ng). All the strains of *Streptococcus pneumoniae* were resistant to 30ng Cephalexin, 10ng Ampiclox and 10ng Erythromycin.



**Table 1: Characteristics Of Bank Tellers and Number Of Microbial Isolates**

| Characteristics | No (%) positive for microbial isolates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. Examined | *Aspergillus* Sp. | *Candida albicans* | *Candida tropicalis* | *Staphylococcus aureus* | Streptococcus pneumoniae | *Klebsiella pneumoniae* | *Nocardia* Sp. | Total |
| **Duration of Handling Cash (Months)** | | | | | | | | | |
| ≤ 6 | 69 | 5(7.2) | 2(2.9) | 3(4.5) | 2(2.9) | 0.00 | 1(1.5) | 0.00 | 13(18.8) |
| 7 – 12 | 87 | 7(8.0) | 3(3.5) | 5(5.8) | 1(1.2) | 1(1.2) | 1(1.2) | 0.00 | 18(20.7) |
| 13 – 18 | 36 | 8(22.2) | 1(2.8) | 1(2.8) | 0.00 | 0.00 | 0.00 | 0.00 | 10(27.8) |
| 19 – 24 | 60 | 14(23.3) | 1(1.7) | 2(3.3) | 0.00 | 0.00 | 0.00 | 0.00 | 17(28.3) |
| 25 – 30 | 15 | 1(6.7) | 1(6.7) | 1(6.7) | 0.00 | 0.00 | 0.00 | 0.00 | 3(20.0) |
| 31 – 36 | 111 | 10(9.0) | 11(9.9) | 12(10.8) | 6(5.4) | 2(1.8) | 3(2.7) | 2(1.8) | 46(40.5) |
| 37 – 42 | 21 | 0.00 | 0.00 | 4(19.0) | 0.00 | 0.00 | 1(4.8) | 0.00 | 5(23.8) |
| 43 – 48 | 36 | 8(22.2) | 4(11.1) | 5(13.9) | 2(5.6) | 1(2.8) | 0.00 | 0.00 | 20(55.6) |
| ≥ 49 | 69 | 15(21.7) | 2(2.9) | 3(4.3) | 1(1.5) | 2(2.9) | 3(4.3) | 1(1.5) | 27(39.1) |
| **Total** | 504 | 68(13.5) | 29(5.8) | 32(6.4) | 12(2.4) | 7(1.4) | 8(1.6) | 3(0.6) | 159(31.6) |
| **Tellers in Bulk rooms** | 252 | 47(18.7) | 21(15.7) | 19(7.5) | 9(3.4) | 4(1.9) | 5(2.0) | 3(1.2) | 108(42.9) |
| **Tellers in open Halls** | 252 | 21(15.7) | 8(3.2) | 13(5.2) | 3(1.2) | 3(1.2) | 3(1.2) | 0.00 | 51(20.2) |
| **History of Respiratory infection** | 54 | 23(15.7) | 3(5.6) | 5(9.3) | 7(13.9) | 5(9.3) | 5(9.3) | 0.00 | 48(88.9) |
| **Smokers** | 21 | 13(61.9) | 0. 0 | 0.00 | 7(33.3) | 3(14.3) | 3(14.3) | 0.00 | 26(123.8) |
| **Alcohol Consumers** | 92 | 17(18.5) | 7(7.6) | 9(9.8) | 5(5.4) | 3(3.3) | 3(3.3) | 0.00 | 41(44.6) |
| **Smokers/Alcohol Consumers** | 38 | 22(57.9) | 9(23.7) | 9(23.7) | 7(18.4) | 3(7.9) | 0.00 | 0.00 | 43(113.2) |



**Table 2: Pattern Of Antibiotic Susceptibility of Bacterial Strains Isolated from Nasal Secretions and Sputum of Bank Cash Tellers**

| Isolates Tested | No. Tested | OXF | CN | ST | E | CEP | AMP | CHL |
|---|---|---|---|---|---|---|---|---|
| **Staphylo- coccus aurers** | **12** | **10(83.3)** | **7(58.3)** | **7(58.3)** | **5.(41.7)** | **5(41.7)** | **3(25.0)** | **2(16.7)** |
| **Streptococcus Pneumonia** | **7** | **7(100.0)** | **6(85.7)** | **3(42.9)** | **0.00** | **0.00** | **0.00** | **2(28.6)** |
| **Klebsiella Pneumonia** | **8** | **8(100.0)** | **5(62.5)** | **0.00** | **0.00** | **0.00** | **0.00** | **4(50.00)** |
| **Total** | **27** | **25(92.6)** | **18(66.7)** | **10(37.0)** | **5(18.5)** | **5(18.5)** | **5(18.5)** | **3(11.1)** |

OXF= Ofloxacin, CN=Gentamycin, ST=Streptomycin, E=Erythromycin, CEP= Cephalexin, AMP=Ampiclox



## DISCUSSION

Reports on the role of paper currencies as agents of common infectious diseases, particularly those of the respiratory tract all over the globe, is on the increase [3, 11, 12]. The one hundred and fifty-nine (31.5%) of the 504 Bank cash tellers with respiratory infections; 13.5% *Aspergillus* Spp; 5.8% *Candida albicans*, 6.4% *Candida tropicalis*, 2.4% *Staphylococcus aureus*, 1.4% *Staphylococcus pneumoniae*, 1.6% *Klebsiella pneumoniae* and 0.6% *Nocardia* Sp; encountered in this study, have serious public health complications. Pneumonia due to most of these organisms; Nocardiosis, and Aspergillosis confound Tuberculosis (TB) diagnosis and management.

The highest proportion of Bank tellers with respiratory infections (55.6%), which came among these who had handled cash between 43-48months, and which difference from other

categories was statistically significant ($x^2$ea = 1630.3: $p<0.05$) may still reflect relative exposure to contaminated old, worn-out and mutilated currency notes in circulation.

Analysis of the differences in the microbial isolates from cash tellers operating in the bulk room (42.9%) and those from open Halls (20.2%) which was statistically significant ($x^2$ea = 68.3: $p<0.05$), also expresses the relatively high risk of infection associated with handling of bulk old, worn-out, mutilated and contaminated currency notes in circulation. It has also been reported that currency counting machines and currency counting rooms in banks revealed high level of the presence of various fungal and bacterial pathogens [8].

Although any type of microbial infection is possible to be acquired and spread in such banking compartment, respiratory infections, particularly those of fungal and some airborne bacterial agents seem to present high proportion of public health problems among bank Tellers in Nigeria.

Antibiotic resistance as a global phenomenon has resulted in high morbidity and mortality as a result of treatments failures. It has also given rise to increased health care cost [12].
Antibiotic susceptibility testing analysis indicated that the three bacterial isolates encountered in this study showed highest level of susceptibility (92.6%) for ofloxacin, 66.7% for Gentamycin, 37.0% for Streptomycin, and 18.5% each for Erythromycin and Ampiclox, and the least 11.1% for Chloramphenicol. These are commonly used antibiotics, and the relatively high susceptibility of the bacterial isolates to ofloxacin is expected as the drug is most expensive, and is very rarely prescribed. Therefore, it is not subject to much abuse. Gentamycin, Streptomycin, Erythromycin, Cephalexin, Ampiclox and Chloramphenicol with relatively reduced susceptibility, are commonly used antibiotics that have been observed in some studies to present with multiple resistance [11].

## CONCLUSION

Most Microbial isolates reported from contaminated paper currencies constitute a great chunk of fungal agents. These pathogens are often inhaled as dust particles or a aerosols from paper currencies and they are important causes of respiratory infections. The relatively high proportion of Bank Cash Tellers in the study whose nasal secretion and Sputum yielded pathogens commonly associated with respiratory infections may serve as relevant evidence that most paper currencies in circulation is South- Eastern Nigeria, and probably other regions of the country are old, worn-out, and mutilated, and therefore prone to contamination with microbial pathogens.

In order to eliminate the health risks linked with bulk handling of mutilated and old worn-out paper currencies, the government of Nigeria should introduce washable plastic based currency notes like those found in Australia and New-Zealand, which do not support much contamination. Even when contaminated, cleaning of such currency notes may become possible without compromising their life spans.



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