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ORIGINAL ARTICLE

Profiling urinary tract infections bacteria among elderly population in a Nigerian Teaching Hospital

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There have been conflicting reports about prevalence of Urinary Tract Infections (UTIs) causing bacteria in elderly in recent times. This study aims to evaluate the prevalence and resistance pattern of UTIs causing bacteria in elderly Nigerian patients. A prospective cross-sectional study was carried out among elderly patients attending the general and medical outpatients' clinics of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria. Patients aged 60 years and above with at least two signs of UTIs were purposefully selected for the study. Clean catch mid-stream urine specimens from 100 eligible patients were examined for significant bacteriuria. Identification and antibiotics susceptibility patterns of the isolates were determined using standard techniques. Data were analysed using descriptive statistics such as frequency and percentage. Association between variables was determined using Chi-squared test. P values<0.05 were considered significant. One hundred elderly outpatients were evaluated. Majority of the study participants were males (68, 68.0%) and (64, 64.0%) were married. More than half of the participants (59, 59.0%) had no significant bacteriuria. Among the participants with significant bacteriuria (41, 41.0%), males (29/41, 70.7%, p=0.001) were more than the females (12, 29.3%). *Klebsiella pneumoniae* (19/41, 46.3%) was the most isolated organism in the participants' urine specimens, (35/41, 85.4%) of the isolates were resistant to nitrofurantoin. *Klebsiella pneumoniae* was the most isolated UTIs-causing bacteria among the elderly evaluated. Physicians need to be aware of trends in profiles of UTIs-causing bacteria for effective diagnosis of the disease in elderly.

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INTRODUCTION

Uncomplicated urinary tract infections (UTIs) are a common cause of morbidity among the elderly worldwide (Beveridge *et al.,* 2011). The disease is medically diagnosed by the detection of pathogens in the urine of infected patients either through urine cultures or microscopy (Hooton *et al.,* 2010). However, in many remote areas of low and middle-income countries, facilities for determining bacteriuria are often not available, thus, the disease is commonly diagnosed in these areas based on non-definitive clinical features of the disease, resulting in over diagnosis (August &De-Rosa, 2012; Juthani-Mehta *et al.,* 2013). UTIs present with signs and symptoms such as fever, dysuria, change in urine colour and polyuria (Juthani-Mehta *et al.,* 2013).

There are evidences to show that uncomplicated UTIs are over-treated in the elderly. The unequivocal definition of UTIs by many treatment guidelines can be responsible for this phenomenon. Many treatment guidelines provide no clear dividing line between asymptomatic, uncomplicated and complicated UTIs (Rowe & Juthani-Mehta, 2013). While the use of antibiotics in asymptomatic UTIs has been proven to be of no clinical benefit, the choice of antibiotics for the treatment of uncomplicated UTIs continues to generate debate among clinicians (Nicolle, 2012, Ericksson *et al.,* 2010; Jarvis *et al.,* 2014).

Irrational use of antibiotics in UTIs can contribute to the increasing global antibiotics resistance and adverse drug reactions in patients (Rowe & Juthani-Mehta, 2013; Wagenlehner *et al.,* 2011; AUA, 2015).

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Although many guidelines for the treatment of UTIs advocate the use of antibiotics with little collateral damage such as trimethoprim and Nitrofurantoin to treat uncomplicated UTIs (AUA, 2015; Grabe *et al.,* 2010; SIGN, 2012), these guidelines are often not followed in many health care settings, and empirical treatment of UTIs continues unabated (Rowe & Juthani-Mehta, 2013; Dibua *et al.,* 2014).

UTIs have been shown to be more common among females and diabetic patients (Dibua *et al.,* 2014; Kebira *et al.,* 2009). However, the prevalence of UTIs-causing bacteria among elderly has been a subject of debate in recent times. Previous studies on UTIs among elderly have reported conflicting observations.

In a study conducted in a Teaching Hospital in south -south Nigeria *Klebsiella pneumoniae* was the most prevalent bacteria causing UTIs (Omoregie *et al.,* 2010; Osazuwa *et al.,* 2010). Similar observation was reported by researchers in South-west, Nigeria (Dada-Adegbola & Muili, 2010) in contrast to the observations of other researchers who found that *Escherichia coli* was the most prevalent UTIs-causing organisms among different populations (August & De-Rosa, 2012; Dibua *et al.,* 2014; Sule & Kumurya, 2016).

With the explosion in the global population of elderly, the burden of UTIs is expected to increase, making the need for evidence-based approach critical in the management of the disease (WHO, 2015). A guide which reflects local resistance patterns of UTIs -causing bacteria to the locally available antibiotics is therefore of utmost importance. This study, therefore, aimed to profile UTIS-causing bacteria, with a view to providing antibiotic treatment guides for the treatment of UTIs among Nigerian elderly.

MATERIALS AND METHODS

Study design and population

A two-phase prospective cross-sectional study involving elderly population aged 60 years and above was carried out. Phase 1 involves screening of systematically sampled elderly patients for study eligibility. Patients were eligible for the study if; aged 60 years and above and had at least two signs and symptoms of uncomplicated UTIs. Patients were excluded if; below 60 years, had catheter on, had exposure to antibiotics in the past one week, had hearing impairments and/or if referred to another level of care. Phase 2 involves prospective analytical study of the eligible patients' urine samples for the presence of UTIs

Ethical considerations

The study was approved by the Hospital Health Research Ethical Committee. Verbal consents of the patients were obtained before the initial screening for eligibility in the main study, while written consents were obtained from the main study participants.

Study setting

Ambulatory elderly patients were recruited from the general and medical outpatients' clinics of the Olabisi Onabanjo University Teaching Hospital Sagamu, South-west, Nigeria. The hospital is a referral centre for other health facilities in the region. Although, the hospital did not have a geriatric ward there were few clinicians with geriatric training working in the healthcare facility.

Selection procedure

One out of every three consenting elderly patients who attended the clinics, between November 2015 and June 2016 was screened for the study eligibility. Patients were approached at the consultation registration point. A researcher administered questionnaire was used to obtain information about patients' social-economic demographics and eligibility criteria. Only elderly patients who fulfilled the eligibility criteria were selected for the phase 2 study.

Data collection

A modified Indiana University–Purdue University Indianapolis (IUPUI) Health Services UTIs questionnaire which also incorporated the demographics of the patients was used to screen consenting patients for study eligibility. The questionnaire contained 8 questions which were used to evaluate the presence of certain signs and symptoms experienced by patients. Measurement of patients' vital

signs were however not included in the study. The questionnaire was administered before patients' consultation with physicians.

Responses of the participants were analysed to determine their eligibility for the main study. Eligible elderly patients were then approached again and the procedure for the phase 2 study was clearly explained to them. Elderly patients who agreed to participate were given consent form to sign. The medical records of the consented participants were then reviewed for history of some diseases such as hypertension, diabetes, osteoarthritis, congestive heart failure, peptic ulcers and Asthma.

Urinalysis and identification of the isolates
The external genitalia of the study participants were thoroughly cleaned. They were asked to void for a few seconds and then stopped. A well labelled sterile plastic disposable bottles was put on the path of the participant's urine stream to catch the midstream urine specimens. This was done after the participant's urine flow has been well established. The cap of the sterile bottle was then tightly screwed. The urine specimens were immediately refrigerated and examined within 2-4 hours of collection.

A loopful (0.001ml) of well- mixed urine was streaked on blood agar and cysteine lactose electrolyte deficient medium (M6; Plasmatec Laboratories, United Kingdom). The plates were incubated aerobically for 24 hours and the level of growth was assessed (Cheesbrough, 2006). UTIs was defined by the presence of organisms with colony forming units $\geq 10^5$cfu/mL (SIGN, 2012). Identification of the clinical isolates was done using a combination of cultural, morphological and biochemical characteristics of the organisms (Cowan & Steel, 2003).

Antibiotic susceptibility test
A sterile cotton swab was dipped into 0.5ml MacFarland standard. The swab was rotated several times and pressed firmly on the inside wall of the tube. Sterile Mueller-Hinton Agar plates were then inoculated by streaking the swab over the entire sterile agar surface. The procedure was repeated by streaking 2 times. The plates were rotated at 60^0 each time. The rim of the agar was then swabbed and the lid ajar was left for 10 minutes. The antibiotics discs were aseptically placed on the plates using sterile forceps and pressed down to ensure complete contact with the agar surface. The plates were then incubated for 16 hours at 37^0 C. The diameters of the zone of inhibition were measured and interpreted according to National Committee for Clinical Laboratory Standard approved guidelines (NCCLS, 2000).

The antibiotics were tested against all the isolated organisms. Antibiotics including co-trimoxazole (30ug), ofloxacin (10ug), gentamicins (10ug), nitrofurantoin (10ug), ceftriaxone (10ug), amoxycillin (10ug), nalidixic acid (30ug), amoxycillin+clavulanic acid (2ug+4ug) and ceftazidime (30ug) were used for the sensitivity test. Urine specimens were collected by a medical laboratory scientist who was subsequently excluded from the urine examination. Patients' responses to the IUPUI questionnaires were matched with the results of their urine specimens.

Statistical analysis
The statistical package for social sciences (SPSS Version 20) was used to analyse the data. Descriptive statistics were used in the presentation of the results. Associations between socio-demographic variables and bacteriuria were tested using Chi-square. $P<0.05$ was considered significant.

RESULTS
A total of 642 elderly patients were screened in the phase 1 of the study, only 126 (19.6%) met the inclusion criteria for the main study. Majority of the patients that met the inclusion criteria 102 (80.9%) initially gave consents to participate in the main study; 2 (2.0%) later withdrew from the study after initial consent. As shown in table 1, only 100 (79.4%) of the eligible elderly patients completed the study. The majority of the study participants were males 68 (68.0%); married 64 (64.0%) and unemployed 55 (55.0%).

The majority 35 (35.0%) had no medical history of chronic diseases, 23 (23.0%) had hypertension

Table 1: Socio-demographics of the participants

Variables	Frequency	Percentage (%)
Gender		
Male	68	68
Female	32	32
Age		
60-70 years	51	51
71-80 years	37	37
81-90 years	9	9
>90 years	3	3
Marital Status		
Single	36	36
Married	64	64
Occupation Status		
Unemployed	55	55
Employed	29	29
Retired	16	16
Educational Status		
No formal education	16	16
Primary	12	12
Secondary	44	44
Post-secondary	28	28

Data presented as frequency and percentage

Table 2: Prevalence of chronic diseases among evaluated elderly

Disease	Frequency	Percentage
Hypertension	23	23
Diabetes	14	14
Hypertension+ Diabetes	12	12
Osteoarthritis	6	6
Osteoarthritis+ Diabetes	3	3
Asthma	2	2
Congestive cardiac failure	2	2
Peptic Ulcer Disease	3	3

Data presented as frequency and percentage

alone, 14 (14.0%) had diabetes mellitus alone 12 (12.0%) had co-morbidities of hypertension and Type 2-diabetes (Table 2).

Significant bacteria growths were found in only (41/100, (41.0%) of the urine specimens, majority (29/41, 70.7%) being from the male patients, (21/28, 75.0%) of the elderly patients with diabetes alone or with other co-morbidities had significant bacteriuria (p=0.043). Gender was significantly associated with bacteriuria in this study (p=0.001). Diabetes was significantly associated with bacteriuria (p=0.04). Associations between the patients' socio-demographics and bacteriuria is presented in Table 3.

Table 3: Association of UTIs signs with bacteriuria

Question	Yes	No	p-value
Do you experience burning sensation or pain on urination	56	44	0.007
Do you feel back pain	53	47	
What about urgency to urinate	48	52	0.432
In the last one week did you notice any blood in urine	0	100	
Do you feel too hotness in your body	69	31	0.078
Do you perceive foul odour in your urine	24	76	0.062
Do you notice changes in the colour of urine	43	57	0.036
Do you share toilet with neighbours	58	42	

Categorical data presented as proportion and compared using chi-square.

The majority 69 (69.0%) from responses to the modified IUPUI questionnaire had fever; 56 (56.0%) had dysuria at the time of the study. No

Table 4: Association between socio-demographics of respondents and uncomplicated UTIs

Variable	Bacteriuria frequent	No bacteriuria	p-value
Age			
60 – 70	15 (36.6%)	36 (61.0%)	0.033
71 – 80	17(41.5%)	20(33.9%)	
81 – 90	7(17.0)	2(3.4%)	
above90	2(4.9%)	1(1.7%)	
Gender			
Male	29 (70.7%)	39 (66.1%)	0.036
Female	12 (29.3%)	20 (33.9%)	
Marital status			
Single	19 (46.3%)	17(28.8%)	
Married	22(53.7%)	42 (71.2%)	
Economic status			
Employed	11 (26.8%)	18(30.5%)	
Unemployed	22(53.7%)	33(55.9%)	
Retired	8(19.5%)	8(13.6%)	

Categorical data presented as proportion and compared using chi-square.

Table 5: Resistance patterns of the isolates to commonly prescribed antibiotics in the facility

Antibiotics	K. pneumoniae (n=19)	E. coli (n=11)	P. mirabilis (n=4)	S. aureus (n=4)	P. aeruginosa (n=3)
Amoxycillin	18(94.7%)	8(72.7%)	4(100%)	2(50%)	3(100%)
Amoxycillin+Clavulanic acid	17(89.5%)	5(45.5%)	4(100%)	2(50%)	3(100%)
Co-trimoxazole	18(94.7%)	7(63.6%)	4(100.0%)	3(75.0%)	3(100.0%)
Nitrofurantoin	12(63.2%)	8(72.7%)	3(75.0%)	2(50.0%)	3(100.0%)
Nalidixic acid	12 (63.2%)	9(81.8%)	2(50.0%)	3(75.0%)	3(100.0%)
Ofloxacin	10(52.6%)	5(45.5%)	1(25.0%)	0(0.0%)	2(66.7%)
Gentamicin	6(31.6%)	3(27.3%)	0(0.0%)	1(25.4%)	0(0.0%)
Ceftriaxone	7(36.8%)	3(27.3%)	1(25.0%)	0(0.0%)	2(50.0%)
Ceftazidime	7(36.8%)	1(9.1%)	0(0.0%)	0(0.0%)	0(0.0%)

Data presented as number (percentages); K. pneumoniae - Klebsiella pneumonia; E. coli - Escherichia coli; P. mirabilis - Proteus mirabilis; S. aureus - Staphylococcus aureus; P. aeruginosa - Pseudomonas aeruginosa

significant association was found between patients' claims of fever (p=0.078) and bacteriuria in this study. The relationship between patients' responses to IUPUI questionnaire and bacteriuria is presented in Table 4.

Klebsiella pneumoniae (19/41, 46.3%) and *Escherichia coli* (11/41, 26.8%) were the most isolated bacteria from the urine samples. Other isolated bacteria include *Staphylococcus aureus* (4/41, 9.8%), *Proteus mirabilis* (4/41, 9.8%) and *Pseudomonas aeruginosa* (3/41, 7.3%). Majority of the isolates (35/41, 85.4%) were resistant to cotrimoxazole, (29/41, 70.7%) to nalidixic acid, (28/41, 68.3%) to nitrofurantoin and (18/41, 43.9%) to ofloxacin (Table 5).

DISCUSSION

This study revealed that more male than female had uncomplicated UTIs in contradiction of many reports (Rowe & Juthani-Mehta, 2013; Dibua *et al.,* 2014; Kebira *et al.,* 2009). The elderly females have been reported to be more prone to uncomplicated UTIs than the male folks, due to hormonal change at menopause, and their anatomical structure which allows for easy colonisation of the urethra by the gastrointestinal flora (Salvatore *et al.,* 2011; Dielubanza & Schaeffer, 2011). The reason for our observation is, therefore, unknown.

However, a study that used similar identification and isolation method had previously reported the same finding among elderly Nigerians (Omoregie *et al.,* 2010). A higher prevalence of UTIs than previously reported among the elderly Nigerians was also observed (Dibua *et al.,* 2014; Omoregie *et al.,* 2010). Although, different estimates of UTIs prevalence among the elderly have been reported in the literature (Nicolle, 2002, Ericksson *et al.,* 2010), we postulate that our study finding could have differed from the previous reports in Nigeria due to different diagnostic and UTIs classification criteria used in our study. The increasing prevalence of UTIs among the elderly apart from reducing the quality of life can also contribute to increased poverty among them, through an increase in the health care expenditure (WHO, 2015).

There seems to be an inverse relationship between the age and bacteriuria among the study participants. This finding is in contrast with the often-reported increase in UTIs prevalence with age (Ericksson *et al.,* 2010). Our observation is however supported by the finding of a similar study in Nigerian (Omoregie *et al.,* 2010). Sexual activity is a predisposing factor for UTIs among the general populace, the observation of this study that bacteriuria was more prevalent among the married participants supports this assertion (Jarvis *et al.,* 2014). The finding of this study concurs with the reports of many previous studies that documented diabetes as a risk factor for UTIs (Jarvis *et al.,* 2014; Hooton *et al.,* 2010).

Patients' claims of dysuria, rather than fever was

significantly associated with bacteriuria among the study participants. This observation concurs with findings of previous reports which associate dysuria with bacteriuria in different populations (August & De-Rosa, 2012; Juthani-Mehata *et al.,* 2009). This implies that the incidence of fever in the elderly is not a definitive sign for the clinical diagnosis of UTIs in suspected patients. This may have accounted for the over-diagnosis of the UTIs reported in the literature (Beveridge *et al.,* 2011).

The study also showed that *Klebsiella pneumoniae* was the most implicated UTIs-causing bacteria in the elderly Nigerians, in contrast to *E. coli* which was the main organism reported to be causing UTIs in many populations (Dibua *et al.,* 2014; Rowe and Juthani-Mehta, 2013; Grover *et al.,* 2009). Dibua *et al.,* (2014) and Sule & Kumurya (2006) had earlier reported a rise in the UTIs-causing *Klebsiella spp* in Nigeria. Our observation from this study concurs with the finding of similar studies which reported *Klebsiella spp* as the most isolated UTIs-causing bacteria in elderly and other segments of Nigerian populations (Omoregie *et al.,* 2010; Osazuwa *et al.,* 2010; Dada-Adegbola &Muili, 2010).

While there appears to be a similarity in the prevalence of UTIs-causing organisms reported in many parts of the globe, the antibacterial resistance patterns have been known to vary depending on the settings (Beverigde *et al.,* 2011; Kebira *et al.,* 2009). The majority of the isolates in this study were resistant to all the first line drugs that are currently recommended for the treatment of UTIs (Beveridge *et al.,* 2011). The result also showed that resistance to fluoroquinolones and cephalosporin is also gradually reaching an alarming rate. Our observation is not different from the resistance patterns of UTIs-causing bacteria to antibiotics previously reported in Nigeria (Dibua *et al.,* 2014; Omoregie *et al.,* 2010).

The high level of resistance observed in this study could have been as a result of the absence of antibiotics prescription policy in the country, which allows the populace to have unrestricted access to antibiotics without physicians' prescriptions. The implication of resistance to these commonly used antibiotics could be grievous, especially with the emerging *Klebsiella spp.* There is, therefore, the need for the stakeholders in Nigeria to develop frameworks and policies for appropriate use of antibiotics, in order to improve the elderly care.

CONCLUSIONS

Klebsiella pneumoniae was the most isolated bacteriuria pathogens in elderly Nigerians. The isolated bacteria were resistant to most of the first line drugs recommended for the treatment of UTIs. There is the need for effective policy guide to promote rational use of the antibiotics in Nigeria. This study evaluated elderly with and without chronic diseases, it is possible that prevalence in each group of the patients might be different. This study is limited by the number of site and the population studied. A national surveillance study is recommended.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS CONTRIBUTIONS

SSA conceptualized and wrote the final manuscript. SSA, OBE collected and analysed the data, SSA, OBE both designed the study and approved the final manuscript for submission to the journal

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