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Faecal carriage of extended spectrum β-lactamase producing Enterobacterales (ESBL-PE) in children under five years of age at a tertiary hospital in southwest Nigeria

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Abstract:

Background: The main reservoir of Enterobacterales is the human gut, which has been reported as a source of hospital acquired infection. Enterobacterales carrying the extended spectrum β-lactamase (ESBL) genes have emerged over the years as significant multidrug resistant (MDR) pathogens, that have hindered effective therapy of infections caused by them, and limited treatment to a small number of drugs such as carbapenems, leading to selection pressure and emergent resistance to carbapenems. The objective of this study was to determine the faecal carriage of ESBL-producing Enterobacterales (ESPL-PE) among children under 5 years of age at the Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Nigeria.
Methodology: A total of 144 children under 5 years of age were consecutively recruited over a period of 5 months from the paediatrics outpatient clinic, children emergency, paediatrics ward, and neonatal unit of the hospital. Rectal swabs were collected from selected children and transported to the medical microbiology laboratory of the hospital for inoculation on MacConkey agar plates and aerobic incubation at 37°C for 24 hours. All positive growth on the culture plates were identified by colony morphology, Gram stain reaction and conventional biochemical tests scheme. Antimicrobial susceptibility test was performed by the disc diffusion method against selected antibiotics, and ESBL production was confirmed by the double disc synergy test (DDST). Association of risk factors with ESBL-PE faecal carriage was determined using Chi-square or Fisher Exact test, with statistical significance set at $p< 0.05$.
Results: The prevalence of ESBL-PE faecal carriage was 37.5% (54/144), with 34.7% (50/144) for *Escherichia coli* and 2.1% (3/144) for *Klebsiella pneumoniae.* The overall resistance rate of both ESBL and non-ESBL producing isolates were to ampicillin (100.0%), amoxicillin-clavulanic acid (96.2%), ceftazidime (94.3%) and ciprofloxacin (90.6%), while resistance to carbapenems was low at 22.2%. Significant risk factors associated with ESBL-PE faecal carriage were age group 24-59 months (p=0.0187), prior intake of antibiotics (p=0.014), and intake of antibiotics without prescription (p=0.0159), while gender (p=0.8877), mother's education level (p=0.3831) and previous hospital visit (p=0.8669) were not significantly associated with faecal ESBL carriage.
Conclusion: The relatively high faecal carriage rate of ESBL-PE in children <5 years of age in our study highlights the risk for antimicrobial resistance transmission within the hospital and community.

Keywords: Antimicrobial resistance; Faecal carriage; ESBL; Enterobacterales; Children

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Transport fécal d'entérobactéries productrices de β-lactamases à spectre étendu (ESBL-PE) chez des enfants de moins de cinq ans dans un hôpital tertiaire du sud-ouest du Nigéria

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Résumé:

Contexte: Le principal réservoir d'Enterobacterales est l'intestin humain, qui a été signalé comme source d'infections nosocomiales. Les Entérobactéries porteuses des gènes des β-lactamases à spectre étendu (BLSE) sont apparues au fil des années comme d'importants agents pathogènes multirésistants (MDR), qui ont entravé le traitement efficace des infections provoquées par elles et ont limité le traitement à un petit nombre de médicaments tels que les carbapénèmes, conduisant à une pression de sélection et à une résistance émergente aux carbapénèmes. L'objectif de cette étude était de déterminer le portage fécal d'entérobactéries productrices de BLSE (ESPL-PE) chez les enfants de moins de 5 ans à l'hôpital universitaire de technologie Ladoke Akintola, à Ogbomoso, au Nigeria.
Méthodologie: Au total, 144 enfants de moins de 5 ans ont été recrutés consécutivement sur une période de 5 mois dans la clinique externe de pédiatrie, les urgences pédiatriques, le service de pédiatrie et l'unité néonatale de l'hôpital. Des écouvillons rectaux ont été prélevés sur des enfants sélectionnés et transportés au laboratoire de microbiologie médicale de l'hôpital pour inoculation sur plaques de gélose MacConkey et incubation aérobie à 37°C pendant 24 heures. Toutes les croissances positives sur les plaques de culture ont été identifiées par la morphologie des colonies, la réaction de coloration de Gram et le schéma de tests biochimiques conventionnels. Le test de sensibilité aux antimicrobiens a été réalisé par la méthode de diffusion sur disque contre des antibiotiques sélectionnés, et la production de BLSE a été confirmée par le test de synergie à double disque (DDST). L'association des facteurs de risque avec le portage fécal des BLSE-PE a été déterminée à l'aide du test du Chi carré ou de Fisher Exact, avec une signification statistique fixée à $p<0,05$.
Résultats: La prévalence du portage fécal des BLSE-PE était de 37,5% (54/144), dont 34,7% (50/144) pour *Escherichia coli* et 2,1% (3/144) pour *Klebsiella pneumoniae*. Le taux de résistance global des isolats produisant et non des BLSE était à l'ampicilline (100,0%), à l'amoxicilline-acide clavulanique (96,2%), à la ceftazidime (94,3%) et à la ciprofloxacine (90,6%), tandis que la résistance aux carbapénèmes était faible à 22,2%. Les facteurs de risque significatifs associés au portage fécal de BLSE-PE étaient le groupe d'âge de 24 à 59 mois (p=0,0187), la prise antérieure d'antibiotiques (p=0,014) et la prise d'antibiotiques sans ordonnance (p= 0,0159), tandis que le sexe (p=0,8877), le niveau d'éducation de la mère (p=0,3831) et la visite antérieure à l'hôpital (p=0,8669) n'étaient pas significativement associés au portage fécal de BLSE.
Conclusion: Le taux de portage fécal relativement élevé d'EP-BLSE chez les enfants de moins de 5 ans dans notre étude met en évidence le risque de transmission de la résistance aux antimicrobiens au sein de l'hôpital et de la communauté.

Mots-clés: Résistance aux antimicrobiens; Transport fécal; BLSE; Enterobacterales; Enfants

Introduction:

Bowel carriage has been identified as the main reservoir of Enterobacteriaceae and they have been reported to cause hospital acquired infections (HAIs) which are defined as infections not present and without evidence of incubation at the time of admission to a healthcare setting, and associated with prolonged hospital stay (1). The order Enterobacterales carrying the extended-spectrum β-lactamase (ESBL) genes have emerged over the years as significant human pathogens. Such strains are resistant to multiple antimicrobial agents, and can be challenging to treat, as therapeutic options for them are few (2).

Resistance to β-lactam antibiotics in Enterobacterales is primarily due to β-lactamases-mediated antibiotic hydrolysis. Alteration in the expression of efflux pumps and/or porins also play important roles in bacteria resistance to antibiotics, as they limit interaction of the drug with its intracellular target and consequently its deleterious effect on the cell (3).

Extended-spectrum β-lactamases are enzymes which can hydrolyze virtually all penicillins and cephalosporins, including extended-spectrum cephalosporins such as cefotaxime or ceftazidime (4). Many ESBL producing bacteria are multi-resistant to non-β-lactam antibiotics such as the fluoroquinolones, aminoglycosides, tetracyclines, trimethoprim, and sulfonamides (5,6). Consequently, effective antibiotic therapy for treating these infections is limited to a small number of drugs such as carbapenems and thus increasing the chance of resistance to carbapenems among the Enterobacterales (7).

Epidemiologically, Gram-negative bacteria are frequent cause of infections in both adults and paediatric population globally, especially of the urinary tract, and as a group are second to staphylococcus as a cause of bloodstream infections (8). They have also been reported to be the most common cause of serious bacterial infections in the paediatric age groups (8). The global emergence and spread of the extended spectrum β-lactamase producing Enterobacterales (ESBL-PE) have threatened the ability to treat infection

caused by them. Studies in many countries have reported increasing emergence of ESBL-PE (9,10) in recent years, providing information necessary to understand the mechanism of and the threats posed by ESBL-PE and other multi-resistant bacteria (3,11).

Over the years in Europe, there have been increasing reports of invasive infections caused by *Klebsiella pneumoniae* and *Escherichia coli* resistant to the third-generation cephalosporins, and this is believed to be due to the dissemination of ESBL-producing bacteria in both the hospitals and communities. An increase in carbapenemase producing clinical bacterial isolates has also been reported and this raises grave concerns on the future of antimicrobial therapy (10). For example, the prevalence of faecal carriage of ESBL-PE in children under 5 years of age in a study by Tola et al., (12) was 17.1%. In the SMART (Study for Monitoring Antimicrobial Resistance Trends) study of urinary tract isolates conducted between 2009 and 2010 in Europe, the prevalence rates of ESBL producing *E. coli* and *K. pneumoniae* were 17.6% and 38.9% respectively (13). In North America, the respective prevalence rates were 8.5% and 8.8% (14). In Asia, the respective ESBL prevalence rates were 5.0% and 0%, while New Zealand, they were 67.0% and 61.0% respectively (15).

In the study performed at a Dutch hospital in Switzerland, the prevalence of ESBL-PE carriage was 4.5% (25/559) from the faecal swabs analyzed (16). In Nigeria, a study done by Jewoola et al., (1) reported prevalence of rectal carriage of ESBL-PE to be 25.3%, with the common strains isolated being *K. pneumoniae* (44.2%), *E. coli* (34.2%) and *Enterobacter* species (12.8%). The common risk factors identified for acquisition of ESBL-PE in children includes nutritional status such as the consumption of poorly cooked meat and chicken, dairy products (milk, yoghourt and cheese) and poor personal hygiene (12,17).

Due to paucity of data on faecal carriage of ESBL-PE in developing countries, this study aimed to determine the faecal carriage rate of ESBL-PE in children under 5 years of age at the Ladoke Akintola University of Technology (LAUTECH) Teaching Hospital Ogbomoso, southwest Nigeria.

Materials and method:

Study area, design and ethical approval

This was a descriptive cross-sectional study conducted on a total of 144 children recruited from the outpatient clinic, children emergency, paediatrics wards and neonatal unit of the Paediatrics and Child Health Department of the LAUTECH Teaching Hospital, Ogbomoso. Approval of the Research and Ethics Committee (REC) of the hospital was obtained before the commencement of the study. Informed consent of the parent/guardian was also obtained.

Study population and participants:

All children aged 0 to 5 years including those placed on observation for < 48 hrs in the hospital either for medical or surgical treatment were included in the study. Children who have been on admission for > 48 hrs prior to commencement of the study as well as children whose parents/guardian did not give consent were excluded from the study.

Sample size and participants selection:

The sample size of 144 patients was calculated using the Fisher formula, with an estimated ESBL-PE prevalence rate of 17.1%, determined in a previous study (12), and adjusting for 10% attrition. Children who satisfied the inclusion criteria were recruited consecutively over a period of 5 months until the sample size of 144 was attained.

Data and sample collection:

Structured questionnaires were designed and interview-administered to collect relevant children's demographic and clinical data including age, gender, educational level of child and mother/guardian, family size, underlying medical conditions/co-morbidities, intake of anti-microbial drugs prior to study, and hospitalization history within previous 12 months. Information on potential risk factors such as dietary habits (intake of yoghourt, milk, cheese, meat, chicken), source of drinking water, toilet facility, and personal hygiene habits of parents/guardians when caring for children (i. e. after child's urination, defaecation or diaper change, parents wash intimate parts of the child with water only or with soap and water, or use dry tissue or wipes), were also collected.

Rectal swab samples were collected using sterile swabs from all the selected children. The samples were kept in re-sealable polyethylene bag and transferred to the Medical Microbiology Research Laboratory of the hospital for immediate processing and microbiological analysis.

Culture isolation and identification of bacterial isolates:

The samples were inoculated on MacConkey agar plate and incubated aerobically at 37^{o}C for 24 hrs. All positive cultures were characterized by colonial morphology, Gram stain reaction and conventional biochemical test scheme including indole, citrate, and urease tests (18). Quality control strains (*E. coli*

ATCC25922 and *K. pneumoniae* ATCC70063) were included in each run as negative and positive controls respectively.

Antimicrobial susceptibility testing:

Antimicrobial susceptibility testing (AST) was performed by the Kirby-Bauer disc diffusion technique on Mueller-Hinton (MH) agar plates against the following antibiotics; amikacin 30µg, ampicillin 30µg, amoxicillin-clavulanic acid (co-amoxiclav) 30µg, piperacillin-tazobactam, ceftazidime 30µg, cefotaxime 30µg, ciprofloxacin 5µg, gentamicin 10µg, cefepime 30µg, and meropenem 10µg. The diameter of inhibition zone was interpreted as susceptible, intermediate or resistant according to the Clinical and Laboratory Standards Institute (CLSI) guidelines (19).

Screening identification of ESBL-PE:

Enterobacterales isolate was presumptively identified to be ESBL producer on AST plate when the zone diameter of inhibition was ≤22 mm to ceftazidime disc or ≤27 mm to cefotaxime disc or to both (19).

Phenotypic confirmation of ESBL-PE by double disc synergy test:

Presumptive ESBL-PE isolates were confirmed by the double disc synergy test (DDST) on MH agar plate, with cefotaxime (30µg) and ceftazidime (30µg) discs placed 25-30 mm apart on either side of amoxicillin-clavulanic acid (20/10µg) disc. ESBL positive (*K. pneumoniae* ATCC 700603) and ESBL negative (*E. coli* ATCC 25922) control strains were similarly tested.

A difference in inhibition zone diameter of ≥5 mm produced on the amoxicillin-clavulanic acid disc side compared to the zone diameters produced by either of the cephalosporin discs alone, confirmed phenotypic ESBL production by the isolate (20).

Data analysis:

Data were analyzed using SPSS for windows version 21.0. Categorical data were presented as proportions and percentages while quantitative data were presented as mean, median, standard deviation, and range as appropriate. Statistical association of a risk factor and faecal ESBL carriage was determined using Chi-square or Fisher Exact test with statistical significance put at $p<0.05$.

Results:

Demographic characteristics of the children:

A total of 144 children aged <5 years (from whom faecal swab specimens were collected) were studied. There were 77 (53.5%) males and 67 (46.5%) females, with 40 (28%) in age group 1-23 months (infants) and 104 (72.0%) in age group 24-59 months (children). Most of the children (73, 50.6%) had family members of one to five in number. Majority (70.1%) of the mothers fall between age-range 25-34 years. Majority (108, 75%) of the mothers of the children had tertiary education level. The source of drinking water in the majority (85, 59.0%) of the family is tap water while the toilet type used by majority of the children's family (122, 85.0%) is private latrines (Table 1)

Clinical characteristics of participants:

Most children had received antibiotics 3 weeks prior to the study (122, 84.7%), and most had been given antibiotics by their mothers without medical prescription (118, 82.0%). Most of the mothers (131, 91.0%) claimed to clean anogenital region of their children after defecation with water while the remaining (13, 9.0%) use tissue paper. A total of 83 (58.0%) children had history of previous hospital visits, 40 (28.0%) had history of previous hospital admission, and 12 (8.0%) had history of previous surgery.

Prevalence of ESBL-PE faecal carriage:

Enterobacterales (*E. coli* and *K. pneumoniae*) were isolated from faecal samples of all 144 children, with 137 (95.1%) *E. coli* and 7 (4.9%) *K. pneumoniae*. The overall prevalence of ESBL-PE faecal carriage among the children is 37.5% (53/144), with prevalence of ESBL-producing *E. coli* faecal carriage of 34.7% (50/144) and ESBL-producing *K. pneumoniae* faecal carriage rate of 2.1% (3/144).

Of the 53 ESBL-PE, 50 (94.3%) are *E. coli* while 3 (5.7%) are *K. pneumoniae* isolates. However, 36.5% (50/137) of the *E. coli* isolates were ESBL-producing compared to 42.9% (3/7) of *K. pneumoniae* isolates (OR = 0.7663; 95%CI = 0.1647-3.564; p=0.7083).

Antimicrobial susceptibility test result:

The AST result of the ESBL-producing and non-ESBL producing *E. coli* and *K. pneumoniae* isolates is presented in Table 3. The overall resistance rate of both ESBL and non-ESBL-producing isolates were to ampicillin (100.0%), amoxicillin-clavulanic acid (96.2%), ceftazidime (94.3%) and ciprofloxacin (90.6%). Resistance rate was higher to cephalosporins and fluoroquinolones among ESBL-producing *E. coli* while it was higher to aminoglycoside, cephalosporins and amoxicillin-clavulanic acid in ESBL-producing *K. pneumoniae* compared to the non-ESBL producers that showed lower resistance rates. Resistance of both ESBL and non-ESBL producing *E. coli* and *K. pneumoniae* isolates to carbapenems was low at the rate of 22.2%.

Risk factors for ESBL-PE faecal carriage

Risk factors analysis (Table 3) showed that children aged 24-59 months (p=0.019), those with prior intake of antibiotics within 1

and 2 weeks (p=0.014), and those who have taken antibiotics without prescription (p=0.02) had significantly higher faecal carriage rate. However, gender of children (p=0.8877), educational level of the mother (p=0.3831) and previous hospital visit by children (p=0.8669) were not significantly associated with faecal carriage of ESBL-PE.

Table 1: Socio-demographic characteristics of children under five years of age recruited for the study at the Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Nigeria

Characteristics		**Frequency**	**Percent (%)**
Age of children (in months)	1 -23	40	28.0
	24-59	104	72.0
Gender of children	Male	77	53.5
	Female	67	46.5
Age group of mothers (years)	15-24	11	7.6
	25-34	101	70.1
	35-44	28	19.4
	45-54	4	2.8
Family size	1-3	73	50.6
	3-5	55	38.2
	6 and above	16	11.1
Educational level of mother	None	5	3.4
	Primary	2	1.4
	Secondary	29	20.0
	Tertiary	108	75.0
Educational status of child	None	75	52.1
	Creche	36	25.0
	Nursery	33	22.9
Source of drinking water	Bore hole	85	59.0
	Boiled water	16	11.1
	Bottled water	34	23.6
	Well water	9	6.3
Toilet facility for family use	Private	122	84.7
	Communal	12	8.3
	Bush faecal disposal	10	6.9

Table 2: Antimicrobial resistance pattern of faecal ESBL and non-ESBL producing Enterobacterales isolated from children under five years of age at Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Nigeria

Antibiotics	**No of resistant ESBL-PE (%)**			**No of resistant non-ESBL-PE (%)**			**Total no of resistant Enterobacterales (%)**
	***E. coli* (n=50)**	***K. pneumo* (n=3)**	**Sub-total (n=53)**	***E. coli* (n=87)**	***K. pneumo* (n=4)**	**Sub-total (n=91)**	**(n = 144)**
Ampicillin	50 (100.0)	3 (100,0)	53 (100.0)	87 (100.0)	4 (100.0)	91 (100.0)	144 (100.0)
Ciprofloxacin	46 (92.0)	2 (66.7)	48 (90.6)	70 (80.5)	4 (100.0)	74 (81.3)	122 (84.7)
Amikacin	7 (14.0)	3 (100,0)	10 (18.9)	29 (33.3)	1 (25.0)	30 (33.0)	40 (27.8)
Meropenem	11 (22.0)	2 (66.7)	13 (24.5)	18 (20.7)	1 (25.0)	19 (20.9)	32 (22.2)
Gentamicin	35 (70.0)	3 (100.0)	38 (71.7)	27 (31.0)	1 (25.0)	28 (30.8)	66 (45.8)
Cefotaxime	46 (92.0)	2 (66.7)	48 (90.6)	22 (25.3)	1 (25.0)	23 (25.3)	71 (49.3)
Piperacillin-tazobactam	17 (34.0)	0	17 (32.1)	23 (26.4)	3 (75.0)	26 (28.6)	43 (29.9)
Cefepime	45 (90.0)	3 (100.0)	48 (90.6)	31 (35.6)	3 (75.0)	34 (37.4)	82 (56.9)
Amoxicillin-clavulanate	48 (96.0)	3 (100.0)	51 (96.2)	78 (89.6)	3 (75.0)	81 (89.0)	132 (91.7)
Ceftazidime	49 (98.0)	1 (33.3)	50 (94.3)	63 (72.4)	4 (100.0)	74 (81.3)	117 (81.3)

n = no of isolates; ESBL-PE = Extended spectrum β-lactamase producing Enterobacterales

Table 3: Demographic characteristics and risk factors for ESBL faecal carriage among under 5 years old children in Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Nigeria

Characteristics		**ESBL**			x^2	**OR (95% CI)**	***p* value**
		Positive (%)	**Negative (%)**	**Total (n=144)**			
Age group (months)	1-23	27 (33.7)	53 (66.3)	80	5.532	0.4221 (0.22-0.83)	0.0187*
	24-59	35 (55.0)	29 (45.0)	64			
Gender	Male	33 (43.0)	44 (57.0)	77	0.01994	1.111 (0.57-2.16)	0.8877
	Female	27 (40.3)	40 (59.7)	67			
Prior intake of antibiotics	1 week	9 (69.2)	4 (30.8)	13	8.531	NA	0.014*
	2 weeks	7 (87.5)	1 (12.5)	8			
	≥ 3 weeks	28 (41.2)	40 (58.8)	68			
Intake of antibiotics without prescription	Yes	18 (69.2)	8 (30.7)	26	5.817	3.491 (1.34-9.07)	0.0159*
	No	29 (39.2)	45 (60.8)	74			
Hospital visit	Yes	14 (45.1)	17 (54.8)	31	0.02809	1.071 (0.48-2.38)	0.8669
	No	50 (39.1)	65 (61.9)	105			
Educational level of mother	None	3 (60.0)	2 (40.0)	5	3.056	NA	0.3831
	Primary	0	2 (100.0)	2			
	Secondary	16 (59.3)	11 (40.7)	27			
	Tertiary	34 (49.3)	35 (50.7)	69			

*=statistically significant; x^2=Chi square; OR=Odds ratio; CI=Confidence interval; ESBL=Extended spectrum beta-lactamase; NA=Not applicable

Discussion:

In this study, the overall prevalence of ESBL producing *E. coli* and *K. pneumoniae* fecal carriage among children under 5 years of age was 37.5%. This prevalence is lower when compared with the reports of some previous studies such as that reported by Desta et al., (21) with a prevalence of 52.0% faecal ESBL carriage. It is also lower than the prevalence of 55.4% reported by Sageerabanoo et al., (22). In contrast, the prevalence in our study is comparable with the study carried out by Isendahl et al., (23) who reported a prevalence of 32.6% of ESBL carriers and by Tellevik et al., (24) who reported a prevalence of 34.3% in their study. On the other hand, the prevalence of ESBL reported in our study is higher when compared to the study carried out by Tola et al., (11) who reported a rate of 17.1% in Nigeria. Another study carried out by Jewoola et al., (1) reported the prevalence of rectal carriage of ESBL-PE to be 25.3%. The differences in prevalence rates in these studies might be due to differences in the study participants, study settings, and geographical locations.

In this study, the most common ESBL producing strains isolated from the children was *E. coli* (34.7%), similar to the studies from Turkey and Korea that reported *E. coli* as the most common ESBL-producing isolates (25,26), as well as a study from India where *E. coli* was the most common ESBL producer (77.0%), followed by *Klebsiella* spp (16.4%) (22). In contrast, the study by Jewoola et al., (1) reported the most common ESBL-PE to be *K. pneumoniae* (44.2%), followed by *E. coli* (34.2%) and *Enterobacter* spp (12.8%). While *E. coli* was the most common ESBL-PE in this study, the rate of ESBL-production by *K. pneumoniae* was slightly higher (42.9%, 3/7) than *E. coli* isolates (36.5%, 50/137), although this difference in rate was not statistically significant (OR=0.7663; 95%CI=0.165-3.564; *p*=0.7083), probably due to the rather small number of *K. pneumoniae* isolates

In our study, ESBL producing *E. coli* and *K. pneumoniae* isolates showed high resistance rate to ampicillin (100.0%), ceftazidime (98.0%), amoxicillin-clavulanate (96%), cefotaxime (92.0%), and cefepime (90.0%). This is a similar pattern to another study in Nigeria which reported ESBL-producing isolates exhibiting high resistance to cefotaxime (98.6%), ceftazidime (95.1%), ciprofloxacin (72.7%) and cefepime (58.7%) (1). A study in Ethiopia similarly reported ESBL-producing isolates with high resistance rates to ampicillin (94.9%), cefepime (74.4%), and ceftazidime (71.8%) (11). However, up to 22.0% of the ESBL producing *E. coli* and *K. pneumoniae* isolates in our study were resistant to carbapenem, the currently most active drug

against them. This rate is higher than the 2% resistant rate of ESBL producing isolates to carbapenem, reported in the study by Desta et al., (21).

Significant risk factors associated with faecal ESBL carriage in this study were aged 24-59 months, intake of antibiotics 1 or 2 weeks preceding the study and intake of antibiotics without medical prescription while gender of children, level of mother's education and previous hospital visit by children were not significantly associated with faecal ESBL carriage.

Conclusion:

The findings of our study showed that faecal carriage rate of ESBL-PE (*E. coli* and *K. pneumoniae*) was high at 37.5% among children under 5 years of age in LAUTECH Teaching Hospital, Ogbomoso, southwest Nigeria. The ESBL producing isolates also exhibited high rate of multi-drug resistance (MDR) to ampicillin, amoxicillin-clavulanic acid, ceftazidime, cefotaxime, and cefepime.

Routine screening of Gram-negative bacterial isolates for phenotypic ESBL production is crucial for surveillance of antimicrobial resistance (AMR) in the hospital. Surveillance information is important for the hospital antimicrobial stewardship (AMS) programme, particularly in guiding appropriate antibiotic selection and the development of antibiotic guideline for initial empirical therapy of suspected infections caused by ESBL-producing pathogens.

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Contributions of authors:

ASA conceived and designed the study, and wrote the initial manuscript draft; OOT coordinated fieldwork during sample collection; LOA reviewed the literature; OKI was involved in data collection and sample processing; AOA was involved in data collection and editing of the manuscript; and OMO was involved in coordination of the fieldwork and review of the manuscript. All authors read and approved the final manuscript.

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