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Prevalence of ESBL-producing Gram-Negative Bacteria in Residents of a Long-term-care Health Facility in Japan

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Background

The prevalence of extended-spectrum β-lactamase (ESBL)-producing Gram-Negative bacteria has been increasing in medical institutions in Japan.

However, the extent of ESBL-producing Gram-Negative bacterial colonization in elderly long-term care (LTC) facility residents remains largely unknown.

This study aimed to investigate the carriage rate of ESBL-producers in elderly residents of a LTC facility in Japan.

Methods

Patients and data collection

Between May 2024 and March 2025, disposable diapers and urine samples were collected from non-symptomatic elderly LTC residents.

Bacterial isolates were identified using conventional urine culture methodology.

Antimicrobial susceptibility testing and ESBL typing

Antimicrobial susceptibility testing was performed by CLSI agar dilution method.

The CLSI disk test was used to detect ESBL production.

Genotyping of ESBL producing *E. coli* was performed by PCR to characterize genetic features.

Table 1
Isolation frequencies and ESBL positivity rates of bacterial species from urine samples

(164 residents)

Bacterial species	Number of detected strains(%)
Enterobacterales	**255**
Escherichia coli	**140 (54.9)**
Escherichia coli (ESBL-P)	**69 (49.3)**
Escherichia coli (ESBL-N)	71
Klebsiella pneumoniae	**47 (18.4)**
Klebsiella pneumoniae (ESBL-P)	**9 (19.1)**
Klebsiella pneumoniae (ESBL-N)	38
Klebsiella oxytoca	4
Klebsiella aerogenes	1
Proteus mirabilis	**37 (14.5)**
Proteus vulgaris	1
Providencia rattgeri	2
Morganella morganii	5
Citrobacter braakii	5
Citrobacter koseri	4
Citrobacter freundii	1
Enterobacter cloacae	4
Serratia marcescens	4
Staphylococcus aureus (MRSA)	1
Staphylococcus aureus (MSSA)	14
Non-glucose fermenting bacteria	20
Enterococcus spp.	48
Streptococcus spp.	28
Others	74
Total	440

ESBL-P: ESBL-producing bacteria
ESBL-N: ESBL-nonproducing bacteria

Table 2
Antimicrobial susceptibilities of ESBL-producing and Non-ESBL-producing *E. coli* Isolates

Antimicrobials	MIC (μg/ml)							
	ESBL-producing strains (69 strains)				ESBL non-producing strain (71 strains)			
	range	MIC50	MIC90	I+R*%	range	MIC50	MIC90	I+R*%
CEZ	>64	>64	>64	100	0.5 - >64	1	4	14.1
CMZ	0.25 - 8	1	2	0	0.25 - 32	0.5	2	1.4
CAZ	≦0.06 - >64	8	>64	55.1	≦0.06 - 32	0.25	0.5	42.8
CTRX	2 - >64	64	>64	100	≦0.06 - 16	≦0.06	≦0.06	1.4
MEPM	≦0.06	≦0.06	≦0.06	0	≦0.06	≦0.06	≦0.06	0
LVFX	0.12 - 32	16	32	85.5	≦0.06 - >64	0.25	16	47.3
AMK	2 - 32	4	16	1.4	1 - 16	4	8	0
SMT/TMP	≦0.06 - >64	0.12	>64	21.7	≦0.06 - >64	≦0.06	>64	16.9
PIPC/TAZ	0.25 - 8	1	4	0	0.12 - 64	1	4	0

* R; resistant, I; intermediate, according to CLSI M100-Ed31

Table 3
Antimicrobial susceptibilities of ESBL-producing and Non-ESBL-producing *K. pneumoniae* Isolates

Antimicrobials	MIC (μg/ml)							
	ESBL-producing strains (9 strains)				ESBL non-producing strain (38 strains)			
	range	MIC50	MIC90	I+R*%	range	MIC50	MIC90	I+R*%
CEZ	>64	>64	>64	100	1 - >64	0.5	64	18.4
CMZ	0.5 - 16	0.5	16	0	1 - 64	0.25	>64	8.4
CAZ	8 - 64	8	64	100	0.25 - 2	≦0.06	64	7.9
CTRX	64 - >64	64	>64	100	≦0.06 – 0.25	≦0.06	64	7.9
MEPM	≦0.06	≦0.06	≦0.06	0	≦0.06	≦0.06	0.12	0
LVFX	1 - 2	≦0.06	22	55.6	≦0.06 – 0.12	≦0.06	0.5	0
AMK	2 - 8	2	8	0	2 - 4	2	8	0
SMT/TMP	4 - >64	0.5	>64	55.6	0.25 – 0.5	≦0.06	>64	2.6
PIPC/TAZ	2 - 16	1	16	0	2 - 8	0.12	>64	5.3

* R; resistant, I; intermediate, according to CLSI M100-Ed31

Table 4 Genotypes of ESBL-producing *E. coli*

ESBL type	No. of strains (%)
CTX-M-1 group	18 (26.1)
CTX-M-9 group	**45 (65.2)**
TEM variants	3 (4.3)
Unknown	3 (4.3)
Total	69

Results

- Of the 440 isolates from 162 residents, 225 were Enterobacterales with the following distribution:
  - 140 (54.9%) *Escherichia coli* isolates, with 69 (49.3%) ESBL-producers.
  - 47 (18.4%) *Klebsiella pneumoniae* isolates, with 9 (19.1%) ESBL-producers.
  - 37 (14.5%) *Proteus mirabilis* isolates, with no ESBL-producers. (Table 1)
- Of the 69 ESBL-producing *E. coli* isolates, 59 (85.5%) showed resistance to fluoroquinolones. (Table 2)
- Of the 9 ESBL-producing *K. pneumoniae* isolates, 5 (55.6%) showed resistance to fluoroquinolones and sulfamethoxazole-trimethoprim. (Table 3)
- The CTX-M9 group was the most prevalent CTX-M group gene in ESBL-producing *E. coli*. (Table 4)

Conclusion

A high carriage rate of ESBL-producers was observed. A significant proportion of ESBL-producing *E. coli* were fluoroquinolone resistant, highlighting the importance of infection control measures and affecting antimicrobial treatment strategies.

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