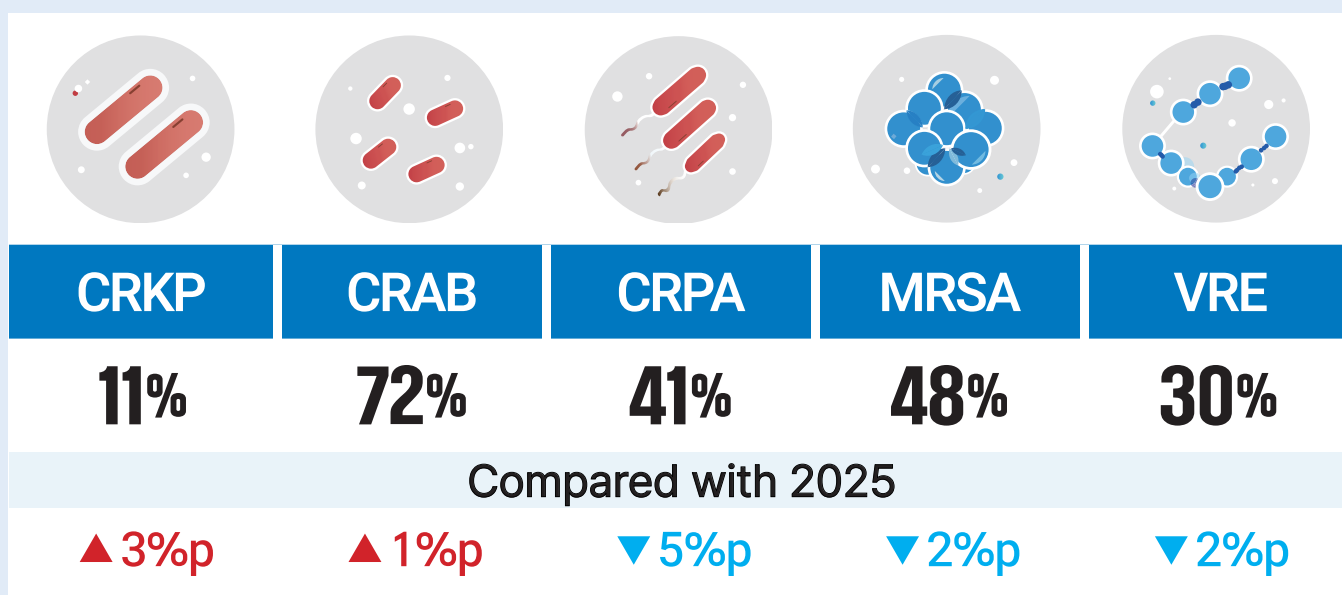


Antimicrobial Resistance Newsletter

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Key Findings for the First Half of 2026 (Focus on small and medium-sized hospitals)



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Antimicrobial resistance of clinical isolates of bacteria in the first half of 2026

The antimicrobial susceptibility patterns of major bacteria isolated from various clinical specimens submitted to the Seoul Clinical Laboratories (SCL) from January to June 2026 were analyzed according to hospital type. Requests for bacterial cultures were received from general hospitals (GH) with more than 100 beds, small and medium-sized hospitals (SMH) with fewer than 100 beds, and long-term care hospitals (LTCH). Bacterial identification was performed using the MALDI-TOF MS (Bruker Daltonics GmbH, Bremen, Germany). Antimicrobial susceptibility testing was performed using the VITEK 2 system (bioMérieux, Marcy-l'Étoile, France) according to the criteria of the Clinical and Laboratory Standards Institute (CLSI). All susceptibility data obtained for infection control and duplicate data from the same patient were excluded.

Antimicrobial susceptibility of *Enterobacterales*

The cefotaxime resistance rates of *E. coli* were 30%, 41%, and 74% in SMH, GH, and LTCH, respectively, similar to the resistance rates for first-generation cephalosporins, while carbapenem resistance rates were less than 7% (Table 1). The cefepime resistance rate was 50% in LTCH, which was higher than those in SMH and GH. The ciprofloxacin resistance rates were approximately 50% in SMH and GH, but exceeded 80% in LTCH. The cotrimoxazole resistance rate was 48% in LTCH, slightly higher than those in SMH and GH. The carbapenem resistance rates of *K. pneumoniae* were high at 44-50% in LTCH and were also relatively high at 10-11% and 19-21% in SMH and GH, respectively. Among isolates from LTCH, the carbapenem resistance rates of *Citrobacter koseri* were high at 28-32%, whereas those of *Serratia marcescens* and *Morganella morganii* were 12-13% and 0%, respectively, representing decreases of 15-17% and 5%, respectively, compared with 2025. In addition, the cefotaxime and aminoglycoside resistance rates of *C. koseri* were 70% and 26-47%, respectively, representing decreases of 14% and 11-21%, whereas the cefotaxime resistance rate of *Enterobacter cloacae* was 70%, an increase of 8% compared with 2025.

Table 1. Antimicrobial susceptibility (%) of frequently isolated *Enterobacterales* by hospital type at a referral medical laboratory in the first half of 2026

Antimicrobial agents	<i>Escherichia coli</i>			<i>Klebsiella pneumoniae</i>			<i>K. (Enterobacter) aerogenes</i>			<i>Klebsiella oxytoca</i>		
	SMH	GH	LTCH	SMH	GH	LTCH	SMH	GH	LTCH	SMH	GH	LTCH
	(17141)	(6070)	(1341)	(1752)	(1255)	(837)	(527)	(140)	(21)	(175)	(82)	(27)
	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R
Ampicillin	30 69	25 74	9 89	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100
Amox-clavulanate	71 17	65 19	43 35	65 23	58 31	15 68	0 100	0 100	0 100	92 4	90 7	96 4
Pip-tazobactam	94 5	91 8	70 27	68 26	61 35	16 76	89 9	83 15	29 67	92 5	90 6	96 4
Cefazolin	62 38	51 49	23 77	59 41	53 47	12 88	0 100	0 100	0 100	51 49	57 43	63 37
Cefotaxime	70 30	59 41	26 74	60 40	53 47	14 86	90 10	82 17	33 67	94 6	93 8	93 7
Ceftazidime	75 12	65 20	33 50	63 33	56 41	15 81	90 10	82 17	43 57	98 2	95 2	96 4
Cefepime	83 12	71 20	38 50	66 32	58 41	18 81	99 1	98 1	86 10	99 1	96 4	96 4
Ertapenem	99 1	99 1	92 7	87 11	78 21	49 50	99 0	97 1	81 10	99 1	99 1	96 4
Imipenem	99 0	99 1	93 5	87 10	79 19	50 44	100 0	99 1	86 10	99 1	98 1	100 0
Meropenem	99 0	99 1	94 5	89 11	80 20	52 47	100 0	99 1	90 10	99 1	99 1	100 0
Ciprofloxacin	30 49	25 58	7 85	54 40	47 49	11 87	94 3	95 4	71 14	83 11	83 12	89 4
Amikacin	97 2	95 4	81 15	95 5	94 5	68 31	100 0	99 1	100 0	100 0	100 0	100 0
Gentamicin	78 22	76 24	66 33	83 17	82 18	50 50	99 1	99 1	95 5	98 2	96 4	100 0
Tobramycin	76 18	72 22	52 44	72 25	68 29	28 70	99 1	99 1	95 5	99 1	94 4	96 4
Cotrimoxazole	64 36	63 37	52 48	71 29	69 31	36 64	99 1	100 0	100 0	94 6	95 5	96 4
Nitrofurantoin ^a	95 1	94 1	91 2	18 38	15 47	11 73	12 24	19 21	0 25	75 2	79 0	93 0

Table 1 (Continued)

Antimicrobial agents	<i>Enterobacter cloacae</i>			<i>Citrobacter freundii</i>			<i>Citrobacter koseri</i>			<i>Serratia marcescens</i>		
	SMH (386)	GH (193)	LTCH (64)	SMH (267)	GH (121)	LTCH (36)	SMH (216)	GH (72)	LTCH (76)	SMH (253)	GH (108)	LTCH (68)
	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R
Ampicillin	0 100	0 100	2 98	2 98	2 98	3 97	0 100	0 100	0 100	0 100	0 100	0 100
Amox-clavulanate	0 100	0 100	2 98	2 98	2 96	3 97	90 7	88 10	26 65	0 100	0 100	0 100
Pip-tazobactam	76 21	71 27	53 42	81 15	74 22	64 33	88 7	88 7	26 65	93 5	91 6	68 29
Cefazolin	0 100	0 100	2 98	1 99	1 99	0 100	87 13	86 14	26 74	0 100	0 100	0 100
Cefotaxime	69 31	64 36	28 70	73 26	72 27	67 33	86 14	88 11	26 70	87 12	77 18	51 47
Ceftazidime	71 27	66 30	38 58	80 19	72 27	66 28	90 9	93 6	36 61	95 4	95 5	71 24
Cefepime	85 12	77 16	52 36	94 3	94 5	91 6	91 7	94 4	36 54	94 5	94 5	75 19
Ertapenem	91 4	87 5	81 8	96 4	95 4	88 9	97 2	99 0	62 32	99 1	97 2	85 13
Imipenem	96 3	94 4	91 6	96 4	96 4	91 6	99 1	99 0	65 28	99 1	98 2	85 13
Meropenem	97 3	95 4	92 6	96 4	96 4	94 6	99 1	100 0	66 29	99 1	98 2	87 12
Ciprofloxacin	75 19	68 25	33 53	61 28	63 24	52 39	82 12	85 7	19 68	80 15	79 15	34 44
Amikacin	98 2	94 6	94 5	99 1	94 5	97 3	97 3	100 0	74 26	99 0	96 2	94 4
Gentamicin	92 8	91 8	72 28	94 6	92 8	91 9	93 7	96 4	54 46	98 2	98 2	96 4
Tobramycin	91 8	88 11	59 34	91 6	88 10	85 6	90 7	97 3	49 47	84 2	73 5	82 9
Cotrimoxazole	89 11	85 15	56 44	87 13	85 15	73 27	95 5	99 1	73 27	100 0	100 0	99 1
Nitrofurantoin ^a	25 20	32 24	41 17	93 2	89 4	82 4	71 5	76 2	46 30	0 100	0 100	0 100

Antimicrobial agents	<i>Morganella morganii</i>			<i>Proteus mirabilis</i>			<i>Providencia rettgeri</i>			<i>Providencia stuartii</i>		
	SMH (285)	GH (75)	LTCH (78)	SMH (1108)	GH (404)	LTCH (582)	SMH (55)	GH (27)	LTCH (17)	SMH (39)	GH (15)	LTCH (69)
	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R
Ampicillin	0 100	0 100	0 100	45 55	30 70	5 95	0 100	0 100	0 100	0 100	0 100	0 100
Amox-clavulanate	0 100	0 100	1 99	63 15	53 17	42 20	0 100	0 100	0 100	0 100	0 100	0 100
Pip-tazobactam	98 2	99 0	96 3	95 4	96 2	93 5	81 19	96 4	79 21	86 14	100 0	96 4
Cefazolin	0 100	0 100	1 99	65 35	43 57	12 88	0 100	4 96	0 100	0 100	0 100	0 100
Cefotaxime	70 20	68 26	40 50	66 33	49 51	15 85	67 31	56 32	40 60	37 63	53 40	36 63
Ceftazidime	88 9	80 14	66 24	85 14	80 18	49 51	75 24	64 36	53 47	89 11	93 7	81 15
Cefepime	99 0	97 3	93 4	75 8	60 9	32 18	72 17	84 8	60 20	92 5	93 0	76 6
Ertapenem	100 0	99 0	100 0	100 0	100 0	99 0	95 2	100 0	93 0	97 0	100 0	100 0
Imipenem	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Meropenem	99 0	100 0	100 0	99 0	100 0	99 0	98 2	100 0	100 0	100 0	100 0	99 0
Ciprofloxacin	75 24	75 23	31 66	55 45	35 65	5 95	42 58	48 52	53 40	16 84	33 60	12 88
Amikacin	96 3	93 4	83 15	82 17	75 25	38 62	75 25	68 32	50 50	45 55	87 13	72 28
Gentamicin	92 8	91 8	59 39	60 39	41 58	13 86	73 25	92 0	43 57	0 100	0 100	1 99
Tobramycin	92 6	89 8	68 25	61 34	48 44	17 76	69 29	60 8	40 53	0 100	0 100	1 99
Cotrimoxazole	85 15	85 15	51 49	55 45	46 54	25 75	73 27	72 28	73 27	47 53	47 53	50 50
Nitrofurantoin ^a	0 100	0 100	2 98	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100

Abbreviation: SMH, small and medium-sized hospital; GH, general hospital; LTCH, long-term care hospital; (), No. tested; S, susceptible; R, resistant; Amox, amoxicillin; Pip, piperacillin; -, Not tested. Intrinsic resistances are blue shaded.

^a Only on organisms isolated from the urinary tract.



Antimicrobial susceptibility of glucose-nonfermenting Gram-negative bacilli

The resistance rates of *A. baumannii* were 47-63% for ampicillin-sulbactam, 71-92% for carbapenems, 71-94% for fluoroquinolones, and 59-83% for amikacin, similar to those in 2025. In contrast, the resistance rates of non-*baumannii* *Acinetobacter* spp. were 6-8% for ampicillin-sulbactam, 17-39% for carbapenems, 16-59% for fluoroquinolones, and 3-10% for amikacin, representing decreases of 4-8%, 1-8%, 2-10%, and 2-9%, respectively, compared with 2025 (Table 2). The resistance rates of *P. aeruginosa* were 26-46% for ceftazidime, 36-64% for piperacillin-tazobactam, 32-63% for carbapenems, and 42-74% for ciprofloxacin, similar to those in 2025. Both *Acinetobacter* spp. and *P. aeruginosa* showed higher resistance rates among isolates from LTCH. The resistance rates of *Stenotrophomonas maltophilia* were 14-20% for levofloxacin and 11-15% for minocycline, similar to those in 2025. However, the cotrimoxazole resistance rates among isolates from both SMH and LTCH increased by 7% compared with 2025.

Table 2. Antimicrobial susceptibility (%) of frequently isolated glucose-nonfermenting Gram-negative bacilli by hospital type at a referral medical laboratory in the first half of 2026

Antimicrobial agents	<i>Acinetobacter baumannii</i>			<i>Acinetobacter</i> spp.			<i>Pseudomonas aeruginosa</i>			<i>Stenotrophomonas maltophilia</i>		
	SMH (465)	GH (581)	LTCH (749)	SMH (526)	GH (333)	LTCH (391)	SMH (1939)	GH (1245)	LTCH (2385)	SMH (389)	GH (345)	LTCH (492)
	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R	S R
Amp-sulbactam	34 47	21 63	11 61	87 7	83 6	87 8	- -	- -	- -	- -	- -	- -
Pip-tazobactam	28 72	17 83	8 92	60 32	54 42	45 49	54 40	58 36	29 64	- -	- -	- -
Ceftazidime	30 69	17 82	8 90	79 11	66 11	71 16	68 27	71 26	49 46	- -	- -	- -
Cefepime	- -	- -	- -	- -	- -	- -	63 21	67 22	45 37	- -	- -	- -
Imipenem	28 72	17 83	8 92	78 20	64 36	59 39	56 41	63 34	34 63	- -	- -	- -
Meropenem	29 71	17 82	8 92	80 17	67 33	59 36	55 39	63 32	34 61	- -	- -	- -
Amikacin	40 59	30 69	14 83	88 8	94 3	76 10	58 42	51 49	27 72	- -	- -	- -
Gentamicin	35 62	24 74	11 87	80 13	71 21	70 19	- -	- -	- -	- -	- -	- -
Tobramycin	37 63	25 75	16 84	80 19	82 17	73 27	73 27	75 24	47 53	- -	- -	- -
Ciprofloxacin	25 75	15 85	6 94	64 34	56 42	39 59	49 48	55 42	24 74	- -	- -	- -
Levofloxacin	25 71	16 81	6 90	68 16	62 18	46 25	- -	- -	- -	79 17	82 14	74 20
Cotrimoxazole	38 62	27 73	13 87	81 19	87 13	77 23	- -	- -	- -	85 15	90 10	76 24
Minocycline	80 15	84 11	69 23	92 6	97 1	95 5	- -	- -	- -	81 14	88 11	78 15

Abbreviation: Amp, ampicillin; Pip, piperacillin.



Antimicrobial susceptibility of *Staphylococcus* and *Enterococcus*

The oxacillin resistance rates of *Staphylococcus aureus* (MRSA) were 48% and 53% in SMH and GH, respectively, and 88% in LTCH. Among *S. aureus* isolates, the resistance rates were 33-53% for clindamycin, 3-5% for cotrimoxazole, and 0% for vancomycin, teicoplanin, tigecycline, and linezolid (Table 3). The antimicrobial resistance patterns of coagulase-negative *Staphylococcus* were similar to those of *S. aureus*. However, oxacillin and cotrimoxazole resistance rates were high at 54-92% and 8-22%, respectively. The ampicillin resistance rate of *Enterococcus faecalis* was less than 6%, whereas that of *E. faecium* was 92-98%. Vancomycin and teicoplanin resistance rates were less than 1% for *E. faecalis*, but 30-46% for *E. faecium*. The nitrofurantoin resistance rate was less than 1% for *E. faecalis*, but 77-90% for *E. faecium*. The resistance rates of Gram-positive cocci were mostly similar to those in 2025. However, clindamycin resistance rates among *S. aureus* and coagulase-negative *Staphylococcus* isolates from LTCH decreased by 5% and 7%, respectively, compared with 2025.

Table 3. Antimicrobial susceptibility (%) of *Staphylococcus* and *Enterococcus* by hospital type at a referral medical laboratory in the first half of 2026

Antimicrobial agents	<i>Staphylococcus aureus</i>						Coagulase-neg. <i>Staphylococcus</i>						<i>Enterococcus faecalis</i>						<i>Enterococcus faecium</i>					
	SMH (2191)		GH (1348)		LTCH (486)		SMH (2027)		GH (1661)		LTCH (601)		SMH (2583)		GH (595)		LTCH (226)		SMH (585)		GH (651)		LTCH (385)	
	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Ampicillin	-	-	-	-	-	-	-	-	-	-	-	-	99	1	98	2	94	6	8	92	5	95	2	98
Penicillin G	13	87	12	88	3	97	13	87	8	92	2	98	97	3	87	13	72	28	8	92	4	96	2	98
Oxacillin	52	48	47	53	12	88	46	54	29	71	8	92	-	-	-	-	-	-	-	-	-	-	-	-
Clindamycin	66	33	58	42	47	53	74	24	70	28	47	50	-	-	-	-	-	-	-	-	-	-	-	-
Erythromycin	61	39	56	44	44	56	53	46	47	52	36	63	-	-	-	-	-	-	-	-	-	-	-	-
Tetracycline ^a	85	15	82	18	88	12	82	17	81	19	82	18	13	87	15	85	7	93	78	22	77	23	72	28
Tigecycline	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
Cotrimoxazole	97	3	97	3	95	5	92	8	88	12	78	22	-	-	-	-	-	-	-	-	-	-	-	-
Ciprofloxacin ^a	66	33	63	36	21	78	66	29	54	41	15	79	81	18	65	34	22	78	3	94	1	98	1	99
Levofloxacin	67	33	64	35	22	77	67	32	54	45	16	82	82	17	66	34	23	76	4.5	93	1	99	1	99
Teicoplanin	100	0	100	0	100	0	100	0	100	0	100	0	100	0	99	1	99	1	71	29	66	34	54	46
Vancomycin	100	0	100	0	100	0	100	0	100	0	100	0	100	0	99	1	99	1	70	30	66	34	54	46
Gentamicin	66	26	70	24	37	50	58	24	49	32	34	44	-	-	-	-	-	-	-	-	-	-	-	-
Linezolid	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0
Rifampin	99	1	99	1	99	1	95	4	90	9	77	22	-	-	-	-	-	-	-	-	-	-	-	-
Nitrofurantoin ^a	-	-	-	-	-	-	-	-	-	-	-	-	99	1	99	1	98	1	7	77	5	83	2	90

^a Only on *Enterococcus* spp. isolated from the urinary tract.

Antimicrobial susceptibility may vary depending on specimen type and the characteristics of healthcare institutions. In this issue, antimicrobial susceptibility results for major organisms isolated from urine cultures were newly added to the existing susceptibility data for overall clinical isolates.

Healthcare institutions were categorized according to the existing classification criteria. For the urine culture data, the existing category of small and medium-sized hospitals (SMH) with fewer than 100 beds was subdivided into hospitals and clinics, and the distribution of isolates and antimicrobial susceptibility results were compared among the different healthcare settings.

The 10 most frequently isolated organisms from urine cultures submitted to SCL during the first half of 2026 are shown in Table 1. *E. coli* was the most frequently isolated organism in all healthcare settings, while the distribution of major isolates varied by setting.

Table 1 Top 10 organisms isolated from urine cultures by healthcare institution type

Rank	Organism (n, %)			
	Clinic	Hospital	General hospital	Long-term care hospital
1	<i>Escherichia coli</i> (10,468, 70%)	<i>E. coli</i> (4,542, 54%)	<i>E. coli</i> (4,618, 57%)	<i>E. coli</i> (1,063, 28%)
2	<i>Enterococcus faecalis</i> (1,485, 10%)	<i>Klebsiella pneumoniae</i> (682, 8%)	<i>K. pneumoniae</i> (594, 7%)	<i>Pseudomonas aeruginosa</i> (539, 14%)
3	<i>K. pneumoniae</i> (582, 4%)	<i>P. aeruginosa</i> (483, 6%)	<i>Enterococcus faecium</i> (473, 6%)	<i>Proteus mirabilis</i> (481, 13%)
4	<i>P. mirabilis</i> (499, 3%)	<i>E. faecalis</i> (458, 5%)	<i>E. faecalis</i> (436, 5%)	<i>K. pneumoniae</i> (402, 11%)
5	<i>Klebsiella aerogenes</i> (285, 2%)	<i>P. mirabilis</i> (453, 5%)	Yeast (372, 5%)	<i>E. faecium</i> (317, 8%)
6	<i>Streptococcus agalactiae</i> (251, 2%)	<i>E. faecium</i> (428, 5%)	<i>P. mirabilis</i> (320, 4%)	Yeast (178, 5%)
7	<i>Morganella morganii</i> (145, 1%)	Yeast (286, 3%)	<i>P. aeruginosa</i> (299, 4%)	<i>E. faecalis</i> (173, 5%)
8	<i>Citrobacter koseri</i> (125, 1%)	<i>S. agalactiae</i> (107, 1%)	<i>Enterobacter cloacae</i> complex (79, 1%)	<i>Acinetobacter baumannii</i> (65, 2%)
9	<i>P. aeruginosa</i> (118, 1%)	<i>Citrobacter freundii</i> complex (100, 1%)	<i>C. freundii</i> complex (76, 1%)	<i>M. morganii</i> (62, 2%)
10	<i>C. freundii</i> complex (109, 1%)	<i>E. cloacae</i> complex (97, 1%)	<i>K. aerogenes</i> (73, 1%)	<i>Providencia stuartii</i> (60, 2%)

n = number of isolates of each organism

Percentage (%) = number of isolates of each organism / total number of urine culture isolates in the corresponding healthcare institution type × 100

Total number of urine culture isolates: Clinic (14,897), Hospital (8,441), General hospital (8,044), Long-term care hospital (3,826)

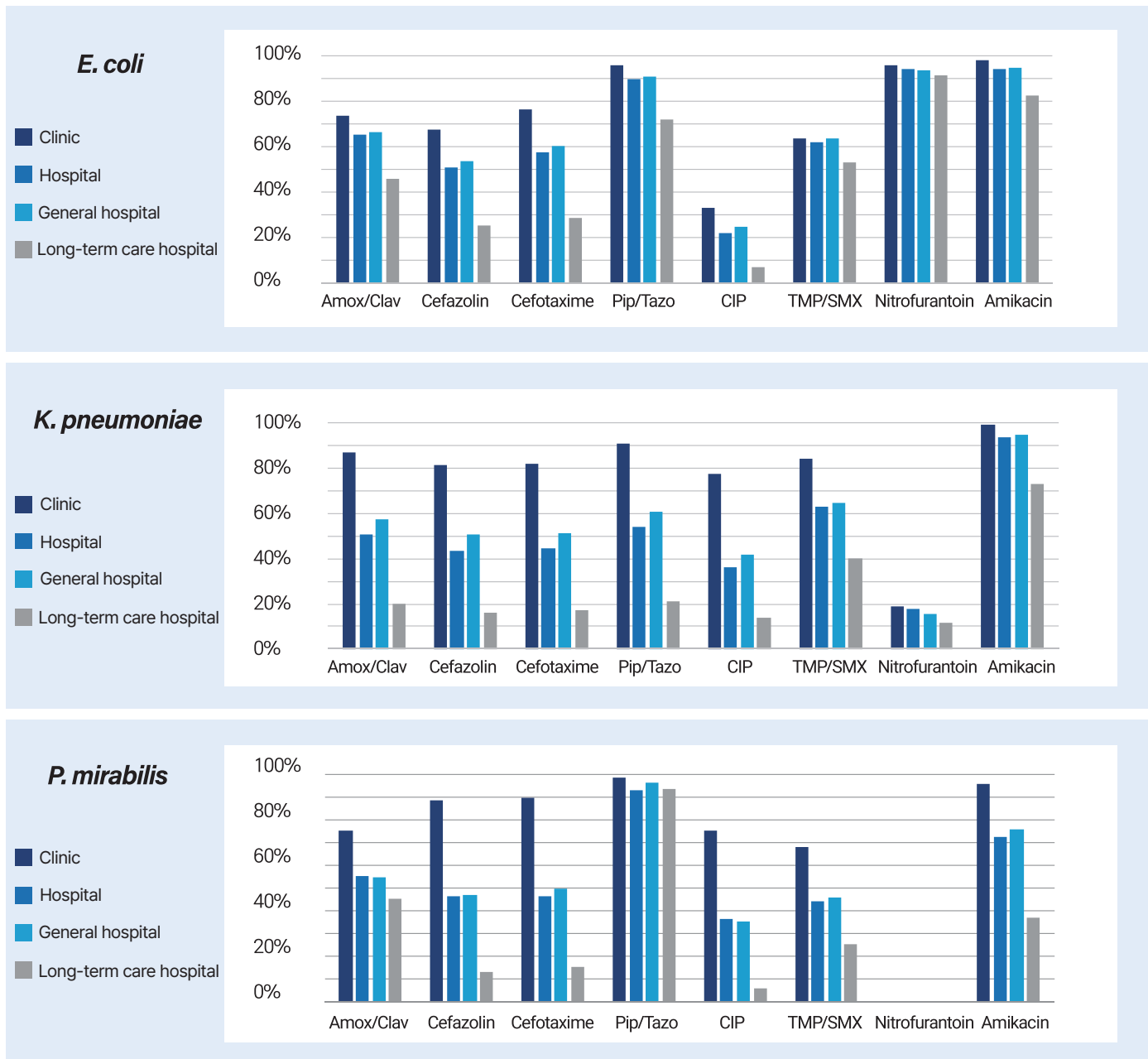


Figure 1. Antimicrobial susceptibility rates (%) of major *Enterobacteriales* from urine cultures by healthcare institution type
Abbreviations: Amox/Clav, amoxicillin-clavulanate; Pip/Tazo, piperacillin-tazobactam; CIP, ciprofloxacin; TMP/SMX, trimethoprim-sulfamethoxazole.

- ✓ For the three most commonly isolated *Enterobacteriales*—*E. coli*, *K. pneumoniae*, and *P. mirabilis*—shown in Table 1, susceptibility to eight major antimicrobial agents was compared across healthcare settings (Figure 1).
- ✓ For nitrofurantoin, *E. coli* showed high susceptibility rates exceeding 90% across all healthcare settings. In contrast, susceptibility rates for *K. pneumoniae* were low, ranging from 11% to 19%, while *P. mirabilis* exhibited intrinsic resistance.
- ✓ Ciprofloxacin susceptibility rates for *E. coli* were generally low across all healthcare institution types.

1. CRE and CPE

Carbapenem-resistant *Enterobacterales* (CRE) are *Enterobacterales* that are resistant to carbapenem antimicrobial agents. CRE are often resistant to multiple classes of antimicrobial agents, which can limit treatment options. CRE can be classified into carbapenemase-producing *Enterobacterales* (CPE), which produce carbapenemases, and non-CPE CRE, which exhibit carbapenem resistance through other mechanisms. Carbapenemase genes in CPE can spread between bacteria, increasing the risk of transmission and outbreaks in healthcare settings.

CRE infections have been subject to nationwide mandatory surveillance in Korea since June 2017 and have been classified as a class 2 notifiable infectious disease since 2020. The number of reported CRE cases increased from 11,954 in 2018 to 42,347 in 2024, and CPE accounted for 78.3% of reported cases in 2024. Major carbapenemases include KPC, NDM, VIM, IMP, and OXA-48, with KPC being the most commonly identified carbapenemase in Korea.

2. CRE-related laboratory testing

CRE culture is a screening test used to detect intestinal CRE colonization using rectal swab or stool specimens, while the carbapenemase gene test directly detects major carbapenemase genes from rectal swab specimens. For CRE isolates recovered from culture, CRE genotyping can be used to detect carbapenemase genes and identify their genotypes, and additional antimicrobial susceptibility testing can be performed to assess susceptibility to selected antimicrobial agents, including newer therapeutic options. The characteristics of CRE-related laboratory tests currently performed in our laboratory are summarized in Table 1.

Table 1 Characteristics of CRE-related laboratory tests

Test	Specimen	Purpose
CRE culture	Rectal swab, stool	Screening for intestinal CRE colonization
Carbapenemase gene test	Rectal swab	Rapid detection of major carbapenemase genes
CRE genotyping	CRE isolate	Detection and identification of carbapenemase genes
Antibiotic susceptibility_MDR	CRE isolate	Susceptibility testing for newer and additional antimicrobial agents