

Antimicrobial resistance of clinical isolates of bacteria in the first half of 2025

The antimicrobial susceptibility of major bacteria isolated from various clinical specimens sent to the Seoul Clinical Laboratories (SCL) in January-June 2025 was analyzed by hospital type. Requests for bacteria 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 MALDI TOF MS Biotyper (Bruker Daltonics GmbH, Bremen, Germany). Antimicrobial susceptibility was tested using a VITEK 2 (bioMérieux, Marcy-l'Étoile, France) system according to the criteria of the Clinical and Laboratory Standards Institute (CLSI). All susceptibility data for infection control and duplicated data from the same patient were excluded. In the first half of 2025, *Escherichia coli* was the most commonly isolated bacteria, followed by *Pseudomonas aeruginosa*, coagulase-negative *Staphylococcus*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*. The antimicrobial susceptibilities of *Enterobacterales* are shown in Table 1, glucose-nonfermenting Gram-negative bacilli in Table 2, and staphylococci and enterococci in Table 3.

Table 1. Antimicrobial susceptibility (%) of frequently isolated *Enterobacterales* at different types of hospitals in Korea in the first half of 2025

Antimicrobial agents	<i>Escherichia coli</i>			<i>Klebsiella pneumoniae</i>			<i>K. (Enterobacter) aerogenes</i>			<i>Klebsiella oxytoca</i>		
	SMH (13954)	GH (5950)	LTCH (1370)	SMH (1667)	GH (1335)	LTCH (642)	SMH (415)	GH (121)	LTCH (17)	SMH (156)	GH (78)	LTCH (23)
	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	26 72	10 89	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100	0 100
Amox-clavulanate	73 15	71 14	46 24	65 21	57 29	20 62	0 100	0 100	0 100	87 10	95 3	83 13
Pip-tazobactam	92 6	92 7	72 24	63 30	56 39	19 74	82 15	83 15	53 47	90 7	99 1	87 13
Cefazolin	62 38	53 47	24 76	55 45	50 50	14 86	0 100	0 100	0 100	54 46	54 46	43 57
Cefotaxime	70 30	61 39	27 73	55 45	50 49	14 85	81 19	83 17	53 47	88 10	99 1	83 17
Ceftazidime	76 12	68 17	36 47	59 36	54 43	17 80	83 16	83 16	53 47	92 7	99 1	83 13
Cefepime	80 15	71 22	34 55	62 36	55 44	20 79	95 3	98 2	94 6	96 3	99 1	91 9
Ertapenem	99 1	99 1	92 7	89 10	77 22	51 48	98 1	98 2	100 0	97 2	100 0	91 9
Imipenem	99 1	99 0	93 6	89 8	78 20	51 42	99 1	98 1	100 0	97 1	100 0	91 9
Meropenem	99 1	100 0	94 6	91 9	79 21	53 45	99 1	99 1	100 0	98 2	100 0	91 9
Ciprofloxacin	30 50	25 56	8 85	49 45	45 50	9 87	93 4	94 1	76 12	82 13	82 15	74 26
Amikacin	97 2	96 2	84 12	96 4	92 8	67 32	99 1	100 0	100 0	98 2	100 0	96 4
Gentamicin	77 23	76 24	64 36	78 22	77 23	48 52	98 2	99 1	100 0	95 5	97 3	100 0
Tobramycin	75 19	73 21	49 46	69 27	63 34	25 70	97 2	99 1	100 0	95 4	96 4	96 4
Cotrimoxazole	65 35	65 35	54 46	68 32	65 35	38 62	98 2	100 0	94 6	94 6	92 8	87 13
Nitrofurantoin ^a	96 1	95 1	92 3	19 37	15 51	9 68	16 20	10 22	0 25	83 2	88 4	85 0

Antimicrobial agents	<i>Enterobacter cloacae</i>			<i>Citrobacter freundii</i>			<i>Citrobacter koseri</i>			<i>Serratia marcescens</i>		
	SMH (322)	GH (189)	LTCH (51)	SMH (217)	GH (113)	LTCH (55)	SMH (184)	GH (62)	LTCH (125)	SMH (207)	GH (101)	LTCH (59)
	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	1 99	0 100	0 100	3 97	1 99	0 100	0 100	0 100	0 100	0 100	0 100	0 100
Amox-clavulanate	1 99	0 100	0 100	3 97	1 99	0 100	90 8	92 6	18 64	0 100	0 100	0 100
Pip-tazobactam	72 23	75 21	52 44	80 17	69 27	79 19	88 8	90 6	19 70	93 6	92 8	61 30
Cefazolin	1 99	0 100	0 100	0 100	0 100	0 100	88 12	85 15	14 86	0 100	0 100	0 100
Cefotaxime	65 34	66 33	34 66	76 23	63 35	67 33	88 12	84 16	15 85	79 18	82 15	53 46
Ceftazidime	67 31	69 30	38 56	79 20	64 34	70 25	90 10	87 11	31 65	92 7	94 2	75 19
Cefepime	81 14	79 18	50 42	96 2	96 3	87 10	89 10	87 11	29 65	92 7	96 3	79 5
Ertapenem	93 4	88 4	74 14	97 3	98 2	87 11	94 5	95 5	64 34	99 0	97 3	77 19
Imipenem	96 4	95 4	86 14	97 3	98 2	87 12	95 3	95 5	66 31	100 0	97 3	77 21
Meropenem	96 4	96 4	86 14	97 3	98 1	89 11	97 3	95 5	66 30	100 0	98 2	81 16
Ciprofloxacin	69 25	69 24	32 50	61 27	64 23	39 46	88 8	89 11	13 69	76 16	79 18	37 49
Amikacin	96 3	99 1	92 6	99 1	96 4	93 7	98 2	95 5	64 36	98 1	99 1	93 2
Gentamicin	88 12	94 6	78 22	93 7	95 5	87 13	93 7	94 6	31 69	98 1	99 1	95 5
Tobramycin	82 15	93 6	68 32	88 8	89 8	81 13	93 6	90 8	27 72	84 3	83 2	91 5
Cotrimoxazole	85 15	88 12	66 34	87 13	88 13	76 24	99 1	95 5	62 38	100 0	100 0	100 0
Nitrofurantoin ^a	34 12	39 13	41 14	97 1	95 3	93 2	85 1	82 2	56 17	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 (275)	GH (98)	LTCH (94)	SMH (965)	GH (387)	LTCH (568)	SMH (62)	GH (29)	LTCH (34)	SMH (63)	GH (18)	LTCH (67)
	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	42 58	27 72	4 96	0 98	0 97	0 100	0 97	0 100	0 100
Amox-clavulanate	0 100	0 100	0 100	59 15	55 19	40 25	0 100	0 100	0 100	0 100	0 100	0 100
Pip-tazobactam	97 3	96 4	79 21	96 3	95 5	93 6	59 41	89 11	45 55	97 3	100 0	92 8
Cefazolin	0 100	1 99	0 100	58 42	45 55	12 88	0 100	0 100	0 100	0 100	0 100	0 100
Cefotaxime	66 27	62 29	34 57	62 38	51 49	17 83	36 59	55 45	16 84	48 52	50 50	30 66
Ceftazidime	85 9	79 14	58 37	86 13	82 16	49 49	46 53	71 29	23 77	97 3	100 0	82 13
Cefepime	99 0	92 2	78 15	72 9	64 13	37 15	48 31	72 7	23 45	95 0	94 0	75 16
Ertapenem	100 0	98 0	90 7	100 0	100 0	99 0	98 2	93 7	68 23	97 2	100 0	90 6
Imipenem	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Meropenem	100 0	100 0	92 8	100 0	99 0	99 0	98 2	93 7	100 0	97 2	100 0	97 3
Ciprofloxacin	75 23	62 34	24 71	48 51	35 64	6 94	32 63	34 62	26 74	13 87	11 89	13 87
Amikacin	98 1	97 2	78 22	79 21	75 25	39 61	52 48	62 38	10 87	64 36	61 39	79 21
Gentamicin	92 8	86 14	54 45	55 45	44 55	12 88	47 52	76 21	10 90	0 100	0 100	1 99
Tobramycin	94 5	89 9	61 31	58 38	53 42	17 77	47 52	55 24	13 87	0 100	0 100	0 99
Cotrimoxazole	82 18	66 34	49 51	55 45	48 52	24 76	83 17	55 45	42 58	43 57	56 44	46 54
Nitrofurantoin ^a	0 100	0 98	0 100	0 100	0 99	0 100	4 96	0 100	13 87	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.

The cefotaxime resistance rates of *E. coli* were 30%, 39%, and 73% in SMH, GH, and LTCH, respectively, similar to the first generation cephalosporin resistance rates, and the carbapenem resistance rate was less than 7% (Table 1). The cefepime resistance rate was 55% in LTCH, which was 33-40% higher than in SMH and GH. The fluoroquinolone resistance rate was about 50% in SMH and GH, but more than 80% in LTCH. The cotrimoxazole resistance rate was 46% in LTCH, which was 11% higher than in SMH and GH. The carbapenem resistance rates were high at 42-48% for *K. pneumoniae* and 30-34% for *Citrobacter koseri* isolated from LTCH. Carbapenem-resistant *K. pneumoniae* was also high in SMH and GH, 8-10% and 20-22%, respectively. Carbapenem resistance rates of *K. oxytoca*, *E. cloacae*, and *S. marcescens* isolated from LTCH increased by 9-14%. In LTCH, cefotaxime and ceftazidime resistance rates of *K. (Enterobacter) aerogenes* increased by 16% and 32%, respectively, compared with 2024. By contrast, resistance rates of *Morganella morganii* isolates decreased by 9-11% for carbapenem, and by 19% and 14% for cefotaxime and ceftazidime, respectively. Aminoglycoside resistance rates decreased by 21-24% compared with 2024.

Table 2. Antimicrobial susceptibility (%) of frequently isolated glucose-nonfermenting Gram-negative bacilli at different types of hospitals in Korea in the first half of 2025

Antimicrobial agents	<i>Acinetobacter baumannii</i>			<i>Acinetobacter spp.</i>			<i>Pseudomonas aeruginosa</i>			<i>Stenotrophomonas maltophilia</i>		
	SMH (487)	GH (552)	LTCH (772)	SMH (395)	GH (303)	LTCH (319)	SMH (2085)	GH (1196)	LTCH (2280)	SMH (378)	GH (347)	LTCH (452)
	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	27 53	16 67	12 62	81 10	85 10	81 11	- -	- -	- -	- -	- -	- -
Pip-tazobactam	23 77	11 89	6 94	56 39	58 40	40 53	52 42	58 35	34 58	- -	- -	- -
Ceftazidime	23 76	11 88	7 93	74 17	65 15	69 24	66 29	72 25	56 38	- -	- -	- -
Cefepime	- -	- -	- -	- -	- -	- -	61 23	67 21	49 32	- -	- -	- -
Imipenem	23 77	12 88	6 94	72 28	66 33	54 42	49 46	57 39	35 62	- -	- -	- -
Meropenem	23 77	12 88	6 94	73 24	67 31	55 39	53 40	61 32	37 55	- -	- -	- -
Amikacin	34 64	27 73	17 81	84 12	86 8	72 15	- -	- -	- -	- -	- -	- -
Gentamicin	30 68	19 76	13 84	73 19	67 24	59 31	- -	- -	- -	- -	- -	- -
Tobramycin	33 67	22 78	17 83	80 19	73 24	66 33	71 29	73 27	51 49	- -	- -	- -
Ciprofloxacin	19 80	9 90	5 95	60 40	51 49	32 65	47 49	53 42	25 73	- -	- -	- -
Levofloxacin	20 75	9 87	5 91	63 21	58 27	38 34	- -	- -	- -	85 11	81 13	75 20
Cotrimoxazole	28 72	19 81	14 86	79 21	81 19	64 36	- -	- -	- -	93 7	90 10	83 17
Minocycline	77 18	82 10	68 25	95 4	88 8	86 12	- -	- -	- -	85 11	84 13	82 14

Abbreviation: Amp, ampicillin; Pip, piperacillin.

The resistance rates of *A. baumannii* were 53-67% for ampicillin-sulbactam, 77-94% for carbapenem, and 75-95% for fluoroquinolone, decreased by 1-7%, 1-5%, and 1-8%, respectively, compared with 2024. However, amikacin resistance in LTCH was 81%, increased by 8% compared with 2024. By contrast, resistance rates of non-*baumannii* *Acinetobacter* isolates were 10-11% for ampicillin-sulbactam, and 8-15% for amikacin. Carbapenem resistance rates were 24-42%, increased by 1-5%, compared with 2024 (Table 2). The resistance rates of *P. aeruginosa* were 25-38% for ceftazidime, 35-58% for piperacillin-tazobactam, and 32-62% for carbapenem, similar to 2024. The ciprofloxacin resistance rate in SMH decreased by 6%, compared with 2024. Both *Acinetobacter* and *P. aeruginosa* had high resistance rates among isolates from LTCH. *Stenotrophomonas maltophilia* resistance rates were 11-20% for levofloxacin and 7-17% for cotrimoxazole, similar to 2024. However, minocycline resistance rate increased by 8-12% compared with 2024.

Table 3. Antimicrobial susceptibility (%) of *Staphylococcus* and *Enterococcus* at different types of hospitals in Korea in the first half of 2025

Antimicrobial agents	<i>Staphylococcus aureus</i>			Coagulase-neg. <i>Staphylococcus</i>			<i>Enterococcus faecalis</i>			<i>Enterococcus faecium</i>																
	SMH	GH	LTCH	SMH	GH	LTCH	SMH	GH	LTCH	SMH	GH	LTCH														
	(2050)	(1131)	(430)	(2141)	(1606)	(710)	(1941)	(701)	(218)	(521)	(629)	(424)														
	S	R	S	R	S	R	S	R	S	R	S	R	S	R												
Ampicillin	-	-	-	-	-	-	99	1	98	2	94	6	6	94	7	93	3	97								
Penicillin G	13	87	11	89	2	98	11	89	9	91	1	99	95	5	83	17	73	27	6	94	7	93	2	98		
Oxacillin	52	48	48	52	14	86	46	54	31	69	7	93	-	-	-	-	-	-	-	-	-	-	-	-	-	
Clindamycin	68	32	63	37	40	60	73	25	68	31	41	56	-	-	-	-	-	-	-	-	-	-	-	-	-	
Erythromycin	64	35	59	41	37	63	52	47	45	53	31	68	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tetracycline ^a	86	14	85	15	88	12	82	18	81	19	85	15	14	86	13	87	11	89	75	25	80	19	73	27		
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	100	0
Cotrimoxazole	97	3	97	3	93	7	91	9	91	9	79	21	-	-	-	-	-	-	-	-	-	-	-	-	-	
Ciprofloxacin ^a	69	31	65	35	19	81	66	31	55	41	13	85	79	20	64	35	25	74	3	95	2	97	0	99		
Levofloxacin	69	30	65	34	19	80	66	33	56	43	13	87	-	-	-	-	-	-	-	-	-	-	-	-	-	
Teicoplanin	100	0	100	0	100	0	100	0	99	0	98	0	100	0	100	0	99	1	69	31	70	30	53	47		
Vancomycin	100	0	100	0	100	0	100	0	100	0	100	0	100	0	100	0	99	1	69	31	70	30	52	48		
Gentamicin	71	22	71	24	39	48	65	17	58	23	39	39	-	-	-	-	-	-	-	-	-	-	-	-	-	
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	100	0
Rifampin	99	1	99	1	98	2	94	5	91	9	81	18	-	-	-	-	-	-	-	-	-	-	-	-	-	
Nitrofurantoin ^a	-	-	-	-	-	-	-	-	-	-	-	-	99	0	99	1	97	2	7	76	5	84	6	86		

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

The oxacillin resistance rate of *S. aureus* (MRSA) was 48% and 52% in SMH and GH, respectively, and 86% in LTCH. The resistance rates were 32-60% for clindamycin, 3-7% for cotrimoxazole, and 0% for vancomycin, teicoplanin, tigecycline, and linezolid (Table 3). The antimicrobial resistance of coagulase-negative staphylococci were similar to those of *S. aureus*, but cotrimoxazole and rifampin resistance rates were high at 9-21% and 5-18%, respectively. The ampicillin resistance rate of *Enterococcus faecalis* was less than 6%, whereas that of *Enterococcus faecium* was 93-97%. Vancomycin and teicoplanin resistance rates were less than 1% for *E. faecalis*, but 30-48% for *E. faecium*. Nitrofurantoin resistance rate was less than 2% for *E. faecalis*, but was 76-86% for *E. faecium*. Resistance rates of Gram-positive cocci were similar to 2024, but teicoplanin and vancomycin resistance rates of *E. faecium* in SMH decreased by 9% and 7%, respectively.

Ranking of 10 blood pathogens in 2021 in Korea

