Klebsiella spp other than Klebsiella aerogenes - Raoultella spp (LTR62807)

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Organism

Klebsiella spp. (other than Klebsiella aerogenes) / Raoultella spp.

- *K. oxytoca*
- *K. pneumoniae spp. pneumoniae*
- *K. pneumoniae spp. ozaneae*
- *K. pneumoniae spp. rhinoscleromatis*
- *K. variicola*
- *Raoultella ornithinolytica*
- *Raoultella planticola*
- *Raoultella terrigena*

Clinical

These organisms are widely distributed in nature and are part of the normal flora of the human gastrointestinal tract.

- ***K. pneumoniae spp. pneumoniae*** – causes lobar pneumonia (which is often necrotizing), usually in debilitated individuals (especially alcoholics). It may also cause urinary tract infections, hepatic and other abscesses, nosocomial pneumonia, septicemia, and meningitis in infants.
- ***K. pneumoniae spp. ozaenae*** – is associated with chronic atrophic rhinitis, and other chronic respiratory diseases.
- ***K. pneumoniae spp. rhinoscleromatis*** – causes a rare granulomatous infection of the nasal mucosa and upper respiratory tract, especially in immunocompromised individuals.
- ***K. oxytoca*** – is associated with similar infections as K. pneumoniae and is less common.
- ***K. variicola*** – has been associated with blood and urine infections.
- ***R. ornithinolytica*** – has been associated with septicemia, wound, and urinary tract infections.
- ***R. planticola*** – share pathogenicity characteristics with K. pneumoniae and has rarely been documented as a cause of human infections.
- ***R. terrigena*** - share pathogenicity characteristics with K. pneumoniae and is an aquatic and soil organism. Human infections are rare.

Usual susceptibility pattern

Klebsiella spp. produce a chromosomal Class A penicillinase (SHV in *K. pneumoniae* and K1 in *K. oxytoca*) and are intrinsically resistant to all penicillins (despite in vitro susceptible results, including piperacillin). They are usually susceptible to beta lactamase inhibitor combinations. Resistance to other beta lactams is usually attributable to plasmid mediated beta-lactamases [penicillinases, cephalosporinase (AmpC), ESBL or carbapenemase (KPC or Class B metalloenzymes) and less frequently to hyperproduction of the K1 enzyme (in *K. oxytoca* only)]. Hyperproduction of K1 enzyme is differentiated from ESBLs by their in vitro susceptibility to ceftazidime. Additional beta lactam resistance may be mediated by permeability mutations affecting cefoxitin and/or carbapenems. Carbapenem resistance may not be easily detected by automated systems. Most strains are susceptible to aminoglycosides, quinolones and nitrofurantoin. Susceptibility to TMP-SMX and tetracycline is variable.

Susceptibility method

VITEK2. Additional tests (Disc diffusion or Etest method) are performed using Mueller-Hinton agar incubated in ambient air at 35°C for 16-20 hours.

Note: For Etest use 0.5 McFarland suspension in saline. For mucoid strains use 1.0 McFarland.

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Susceptibility reporting

	CSF/ Brain	Blood/ Endo-vascular Catheter	Sterile Body Site	Urine	Other	Comments
Amikacin		3	3	3	3	3rd line if gent and tobra I/R Disc diffusion
Amoxicillin/ Clavulanate oral				✓	✓*	***See Special Considerations**
Amoxicillin/ Clavulanate IV		2*	2*		2*	2nd line if ampicillin R, cefazolin I/R and ceftriaxone S *Report if anaerobes, *Enterococcus* or *S. aureus* (MSSA) co-isolated and ceftriaxone S Report same as AMC oral
Ampicillin	R	R	R	R	R	
Cefazolin		✓	✓	✓*	✓	*K. pneumo: ≤16 Do not report (offer); ≥32 report as R Other: Always report if R. If ≤4 offer sens. Refer to Beta-Lactam Resistance Detection Charts.
Cefixime				✓		
Ceftriaxone	✓*	✓*	2*	2*	2*	Always report if I/R 2nd line if cefazolin I/R *If patient < 1 mo - report cefotaxime instead of ceftriaxone using the same interpretation.
Cephalexin				*		***Report for *Klebsiella pneumoniae* only** Add comment: For uncomplicated lower UTI only #clx1
Ciprofloxacin		✓	✓	2*	✓	Do not report in patients < 18 y 2nd line if cefixime and TMP-SMX I/R. Always report if I/R ***See Special Considerations**
Doxycycline				2		2nd line if cefixime and cipro I/R For patients ≤17 y report 2nd line if cefixime I/R Disc diffusion If patient <8 y **See Special Considerations**
Ertapenem		3	3	3	3	3rd line if ceftriaxone or ceftazidime I/R If S do not report in patients < 3 months
Gentamicin	*	✓**	✓**	✓	✓**	*Report only in neonates (<1 month) ****See Special Considerations**
Imipenem*		3	3	3	3	3rd line if ceftriaxone or ceftazidime I/R
Meropenem	2	3*	3*	3	3*	2nd/ 3rd line if ceftriaxone or ceftazidime I/R ***See Special considerations**
Nitrofurantoin				✓		Add comment: For uncomplicated lower UTI only #f1
Piperacillin/ Tazobactam		3* †	3*		3*	3rd line if AMC IV R and ceftriaxone S *Report if *P. aeruginosa* co-isolated and ceftriaxone S † For bloods report if I/R and ceftriaxone S **See Special Considerations**
TMP-SMX	*	✓	✓	✓	✓	* Report only at physician request
Tobramycin		2*	2*	2	2*	2nd line if gent I/R ***See Special considerations**

* Do NOT report Imipenem from the VITEK

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Special considerations

Amoxicillin/ Clavulanate oral:	A MIC of 8/4 µg/mL is at upper limit of susceptibility. This may be adequate to achieve reasonable pharmacodynamics in urine but may not be optimal for non-urinary sites. For all non-urinary sites if MIC 8/4 µg/mL and interpretation is S add comment: "This isolate tests at the upper limit of susceptibility for amoxicillin/clavulanate. Clinical failure may occur despite in vitro susceptibility." #A315
Ciprofloxacin:	For urine cultures add the following comment when **not** reporting ciprofloxacin (patients ≥ 18 y): "Ciprofloxacin is not routinely reported, given the potential for significant adverse events and increasing antimicrobial resistance." &3206
Doxycycline:	If reporting doxycycline on <8 years add the following comments: "Doxycycline can now be prescribed for children <8y for short-course (<21 d) therapy; OTHER tetracyclines are still contraindicated for this age group." **(27664)**
Gentamicin/ Tobramycin:	Organisms testing at upper limit of susceptibility (4µg/mL) may not achieve optimal pharmacokinetics/pharmacodynamics. **For non-urine isolates:** If MIC 4.0 µg/mL add comment: "This isolate tests at the upper limit of susceptibility for gentamicin. Clinical failure may occur despite in vitro susceptibility." #A312 **or** "This isolate tests at the upper limit of susceptibility for tobramycin. Clinical failure may occur despite in vitro susceptibility." #A313 **or** "This isolate tests at the upper limit of susceptibility for both gentamicin and tobramycin. Clinical failure may occur despite in vitro susceptibility." #A314
Meropenem:	For blood cultures, sterile body sites (other than CSF), deep wounds and respiratory cultures: If reporting meropenem as S add comment: "Meropenem is the preferred agent if carbapenem therapy is required." #A361
Piperacillin/ tazobactam:	This antibiotic is frequently used as empiric therapy for polymicrobial infections (i.e. co-infections with S. aureus, Enterococcus, Pseudomonas aeruginosa and/or anaerobes), febrile neutropenia or sepsis syndromes. Note: Do not report as S if ceftriaxone or ceftazidime I/R (≥2 µg/mL) as piperacillin/ tazobactam is not recommended if either an extended spectrum beta-lactamase (ESBL) and/or a cephalosporinase is present.

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Interpretation

For Etest, report actual MIC result. For interpretation (S, I, or R) report according to the nearest higher doubling dilution **(Appendix 1)**.

Use **CLSI** interpretive document for **Enterobacterales.**

For Beta-lactam drugs – Refer to Beta-lactam Resistance Detection Charts.
For amoxicillin/clavulanate, gentamicin, and tobramycin – Refer to Special Considerations