Proteus mirabilis (LTR62809)

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Organism	**Proteus mirabilis**
Clinical	This organism is found in a variety of environmental sources and may be part of the normal flora of the gastrointestinal tract. It is a cause of both community and nosocomial urinary tract infections, usually catheter associated infections or in chronically catheterized patients. It accounts for 90% of *Proteus spp*. infections. Infection with this organism indicates upper urinary tract involvement. *P. mirabilis* has also been associated with post-operative wound infections, skin/soft tissue infections, and bacteremia (usually secondary to a urinary tract focus).
Usual susceptibility pattern	This organism does not produce any chromosomal beta-lactamase and is usually susceptible to ampicillin and cephalosporin. However, plasmid mediated beta-lactamases [penicillinase, cephalosporinase, extended spectrum beta-lactamases (ESBL) and carbapenemase (metalloenzyme, KPC or Class D OXA enzyme)] are increasingly being described. ESBL production may be more difficult to detect. Beta-lactam resistance may also be mediated by permeability mutations. *P. mirabilis* is usually susceptible to aminoglycosides, quinolones, TMP-SMX and carbapenems. (Exception: May exhibit decreased susceptibility to imipenem (decreased affinity to PBP2) that does not affect other carbapenems.) *P. mirabilis* is resistant to nitrofurantoin, tetracycline and colistin. **Note:** Although generally susceptible to beta-lactam antibiotics, non-beta-lactam antibiotics appear to be more efficacious in treatment of urinary tract infections with this organism.
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.

Proteus mirabilis, Continued

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				✓	✓	If Amp S and Amox-Clav I/R – Do Amp and AMC disc diffusion, consult tech 2 with results **See Special Considerations**
Amoxicillin/ Clavulanate IV		2*	2*		2*	2nd line if ampicillin I/R, cefazolin I/R and ceftriaxone S *Report 1st line if ampicillin I/R and ceftriaxone S and anaerobes, *Enterococcus* or *S. aureus* (MSSA) co-isolated Report same as AMC oral
Ampicillin	*	✓	✓	✓	✓	* Report only in neonates (<1 month)
Cefazolin		✓	✓	✓*	✓	*If MIC ≤16 Do not report (offer); ≥32 report as R. 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				✓		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**
Ertapenem		3	3	3	3	3rd line if ceftriaxone **or** ceftazidime I/R If S do not report in patients < 3 months **See Special Considerations**
Gentamicin	*	✓**	✓**	✓	✓**	* Report only in neonates (< 1 month) ****See Special Considerations**
Meropenem	2	3	3	3	3	2nd or 3rd line if ceftriaxone or ceftazidime I/R **See Special Considerations**
Nitrofurantoin				R		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**

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 **I/R VITEK 2** results are not recommended due to a card limitation. Perform an alternate method prior to reporting of results.
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
Ertapenem / Meropenem:	If reporting ertapenem and meropenem add comment: "Imipenem has intrinsically low activity against this organism." #A375
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
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.

Interpretation

For Etest, report actual MIC result. For interpretation (S, I, and R) report according to 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