2019 Antibiogram and Antibiotic Handbook

All culture data from January 1, 2018 to December 31, 2018

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Antibiotic Regimen Cost Analysis			
Antibiotic	**Usual Daily Dose**	**Cost per Dose**	**Cost per Day**
Amikacin*	500 mg IV q24	$	$
	1000 mg IV q 24	$$	$$
Amp/Sul	1.5 g IV q 6	$	$
	3 g IV q 6	$	$
Ampicillin	2 g IV q4	$	$
Aztreonam	2 g IV q8	$$	$$$
Cefazolin	1 g IV q 8	$	$
Cefepime	2 g IV q 12	$	$
	2 g IV q 8	$	$
Ceftaroline	600 mg q 12	$$$	$$$$
Ceftriaxone	1 g IV q 24	$	$
	2 g IV q 12	$	$
Clindamycin	600 mg IV q 8	$	$
	900 mg IV q 8	$	$
Daptomycin†	500 mg IV q 24	$$$	$$$
	750 mg IV q 24	$$$$	$$$$
Gentamicin*	120 mg IV q 8	$	$
	520 mg Iv q 24	$	$
Imipenem/Cilastatin	500 mg IV q 6	$	$
	250 mg IV q 12	$	$
Levofloxacin	750 mg IV q 24	$	$
	750 mg PO q 24	$	$
	500 mg IV q 24	$	$
	500 mg PO q 24	$	$
Linezolid†	600 mg IV q 12	$	$$
	600 mg PO q 12	$	$$
Meropenem	1 g IV q 8	$	$
	2 g IV q 8	$	$$
Nafcillin	2 g IV q 4	$	$
	1 g IV q 6	$	$
Penicillin G	3 mill units IV q 4	$	$$
Pip/tazo	4.5 g IV q 6	$	$
	3.375 g IV q 8	$	$
TMP/SMX	160/800 mg PO q 12	$	$
Vancomycin*	1 g q 12	$	$

* Pharmacy Driven Dosing
† Restricted

Pharmacy Automatic IV to PO Protocol

- IV to PO therapy interchange programs are often used in hospitals to promote cost-effective utilization of medications
- This protocol aligns with CDC recommendations to change from IV to PO when appropriate to improve patient safety by reducing the need for IV access
- Pharmacists follow strict inclusion and exclusion criteria per P&T approved policy (policy no. 10:08) to evaluate appropriateness of switching IV to PO

Medication Monitoring: Intravenous to Oral Therapy Interchange Program. Stanford Health Care. Available at http://med.stanford.edu/bugsanddrugs/guidebook/_jcr_content/main/panel_builder_0/panel_0/download_1/file.res/IV_to_PO_Conversion_Policy.pdf

Common IV to PO Dose Conversions

According to the P&T approved policy 10:08

MEDICATION	IV DOSE/SCHEDULE	PO DOSE/SCHEDULE	BIOAVAILABILITY
AZITHROMYCIN	250 mg IV Q24H	250 mg PO Q24H	34-52%
CIPROFLOXACIN	200 mg IV Q12H 400 mg IV Q12H	250 mg PO Q12H 500 mg PO Q12H	50-85%
CLINDAMYCIN	600-900 mg IV Q8H	300-450 mg PO Q6-8H	90%
DOXYCYCLINE	100 mg IV Q12H	100 mg PO Q12H	90-100%
FAMOTIDINE	20 mg IV Q12H	20 mg PO Q12H	40-45%
FLUCONAZOLE	100 mg IV Q24H 200 mg IV Q24H 400 mg IV Q24H	100 mg PO Q24H 200 mg PO Q24H 400 mg PO Q24H	> 90%
LEVOFLOXACIN	250 mg IV Q24H 500 mg IV Q24H 750 mg IV Q24H	250 mg PO Q24H 500 mg PO Q24H 750 mg PO Q24H	99%
LINEZOLID	600 mg IV Q12H	600 mg PO Q12H	100%
METRONIDAZOLE	500 mg IV Q8H	500 mg PO Q8H	> 90%
PANTOPRAZOLE	40 mg IV Q24H	40 mg PO Q24H	77%

Medications Adjusted per Pharmacy Renal Dosing Protocol

- Selected medications may be adjusted automatically by a pharmacist according to the P&T approved Pharmacy Renal Dosing Protocol (policy no. 14:07)
- Patients are monitored on a daily basis and doses are adjusted as renal function changes
- Providers may indicate in the instructions of the order “do not adjust dose per protocol” if they do not want pharmacy to renally adjust that medication

1. Lexicomp Online®, Adult Dosing Lexi-Drugs®, Hudson, Ohio: Lexi-Comp, Inc.; August 30, 2017.
2. Eyler RF, Vilay AM, Nader AM, et al. Pharmacokinetics of Ertapenem in Critically Ill Patients Receiving Continuous Venovenous Hemodialysis or Hemodiafiltration. Antimicrobial Agents and Chemotherapy. 2014;58(3):1320-1326. doi:10.1128/AAC.02090-12.
3. Aronoff GR, Bennett WM, Berns JS, et al. Drug Prescribing in Renal Failure: Dosing Guidelines for Adults and Children. 5th ed. Philadelphia, PA: American College of Physicians; 2007.
4. Heintz BH, Matzke GR, Dager WE, “Antimicrobial Dosing Concepts and Recommendations for Critically Ill Adult Patients Receiving Continuous Renal Replacement Therapy or Intermittent Hemodialysis,” Pharmacotherapy, 2009, 29(5):562-77.

Medications Adjusted per Pharmacy Renal Dosing Protocol

According to the P&T approved policy 14:07

Antimicrobials	
Acyclovir	Daptomycin
Ampicillin	Fluconazole
Ampicillin-Sulbactam	Imipenem-cilastatin
Aztreonam	Levofloxacin
Cefazolin	Meropenem
Cefepime	Oseltamivir
Ceftazidime	Penicillin G
Ciprofloxacin	Piperacillin-Tazobactam
Anticoagulants	
Enoxaparin	Fondaparinux
Other Medications	
Famotidine	Ketorolac

Antimicrobials That Do Not Require Renal Dose Adjustments

Antimicrobial
Azithromycin
Ceftriaxone
Clindamycin
Micafungin
Doxycycline
Fosfomycin
Linezolid
Nafcillin

Reducing Unnecessary Use of Fluoroquinolones

- Consider alternative antibiotics besides Fluoroquinolones for the following indications (unless no alternative option is available): acute sinusitis, acute exacerbation of chronic bronchitis, and acute uncomplicated cystitis
- Fluoroquinolones are associated with a risk for disabling and potentially irreversible side effects (tendonitis, peripheral neuropathy, CNS effects), and this risk ***generally*** outweighs the potential benefit in the above indications

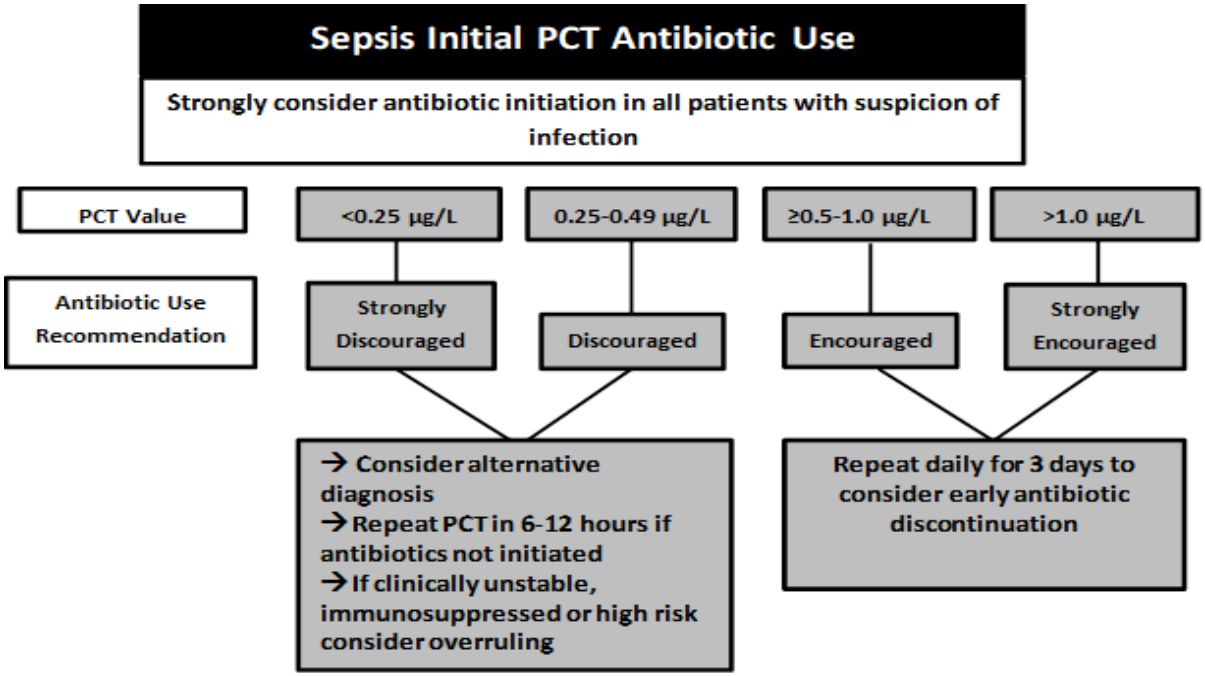
Alternative Therapies to Fluoroquinolones	
Medication	**Usual Adult Dosage** **** Dose adjust for renal impairment**
Acute Sinusitis	
Amoxicillin/Clavulanate (Augmentin) **	875mg/125mg PO q12h for 5-7 days
Doxycycline	100mg PO q12h for 5-7 days
Acute Exacerbation of Chronic (Bacterial) Bronchitis	
Azithromycin (Zithromax)	500 mg PO q24h for 3 days
Acute Uncomplicated Cystitis	
Nitrofurantoin (Macrobid)**	100mg PO q12h for 5 days
Fosfomycin	3g PO once
Sulfamethoxazole-Trimethoprim (Bactrim)**	One DS (800mg/160mg) tab BID for 3 days
Cephalexin (Keflex)**	500 mg PO q12h for 7 days

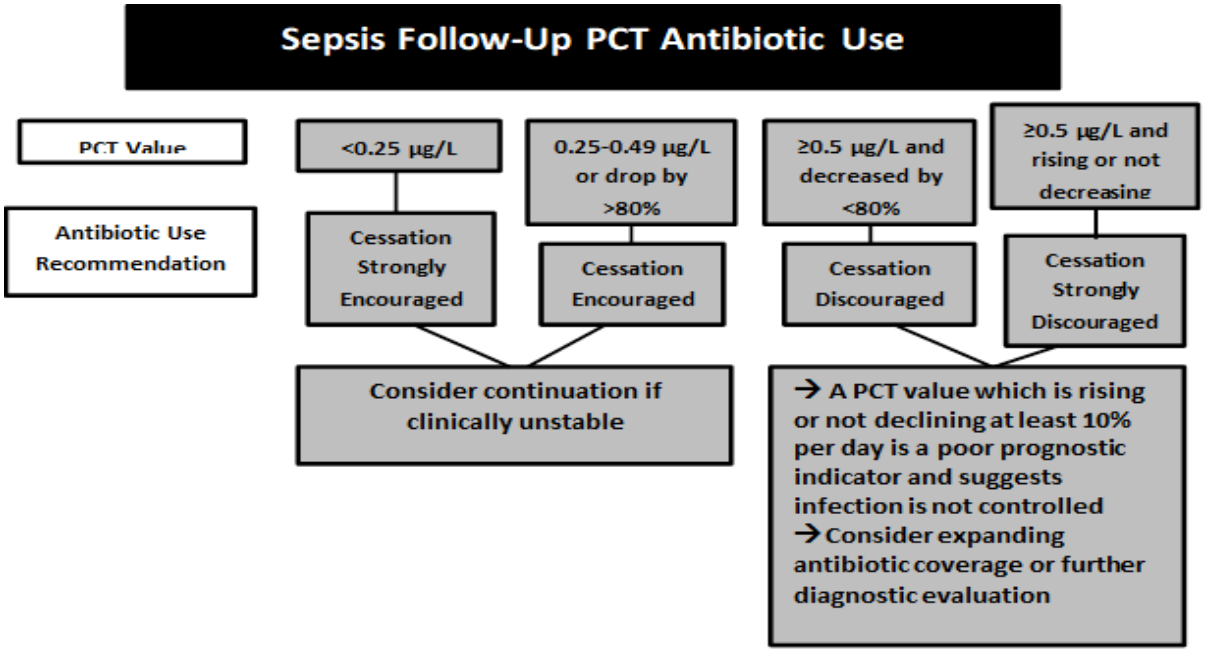
Procalcitonin Use Guidance

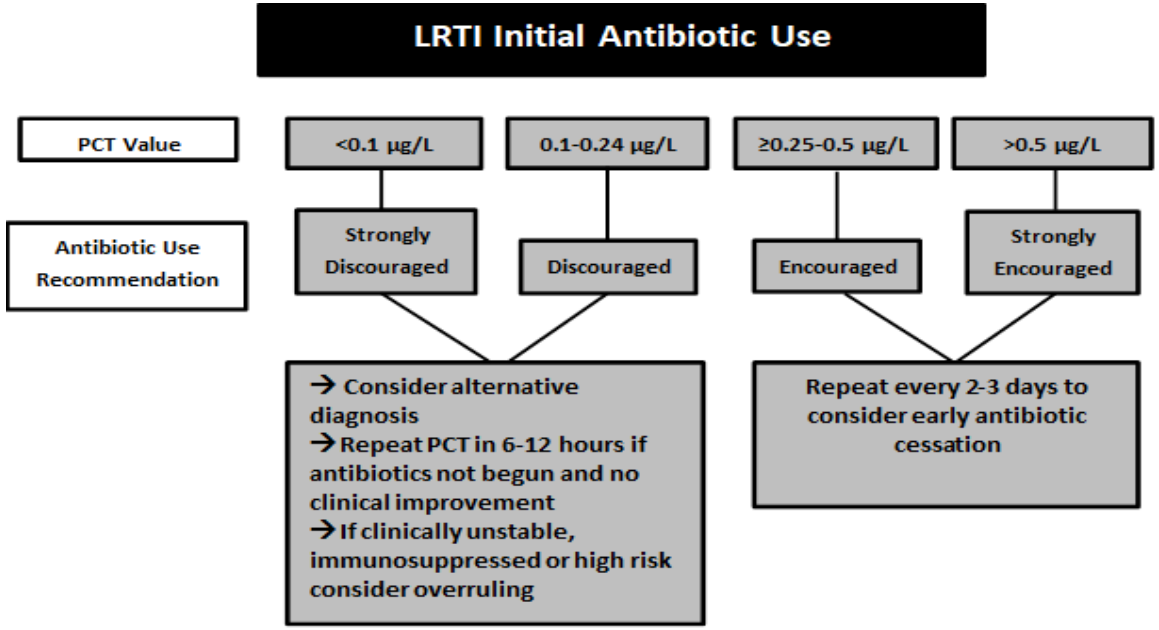
- Procalcitonin (PCT) is a potential diagnostic marker for use in determining if a patient has a bacterial infection (compared to little or no elevation in atypical, viral, or fungal infection)
- PCT has been studied in and showed clinical utility only in the below indications:
  - Acute lower respiratory tract infection (LRTI)
  - Sepsis/septic shock
- Use of PCT outside of these indications has little interpretable value
- Decisions regarding antimicrobial therapy should not be based *solely* on PCT results – this value should be placed into the clinical context of each patient's clinical picture

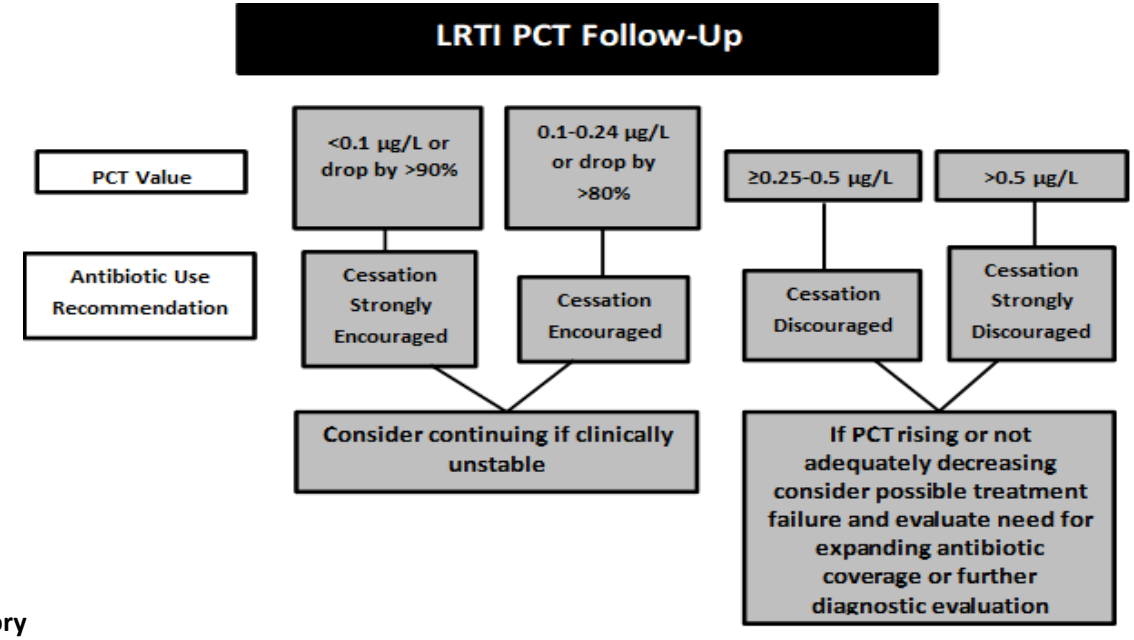
References:

1. "Procalcitonin (PCT) Guidance | Nebraska Medicine Omaha, NE." Nebraska Medicine, www.nebraskamed.com/for-providers/asp/procalcitonin-pct-guidance.
2. Li H, et al. Meta-analysis and systematic review of procalcitonin-guided therapy in respiratory tract infections. Antimicrob Agents Chemother. 2011; 55:5900-6.


Sepsis Initial PCT Antibiotic Use
Strongly consider antibiotic initiation in all patients with suspicion of infection
PCT Value
<0.25 µg/L
0.25-0.49 µg/L
≥0.5-1.0 µg/L
>1.0 µg/L
Antibiotic Use Recommendation
Strongly Discouraged
Discouraged
Encouraged
Strongly Encouraged
→ Consider alternative diagnosis
→ Repeat PCT in 6-12 hours if antibiotics not initiated
→ If clinically unstable, immunosuppressed or high risk consider overruling
Repeat daily for 3 days to consider early antibiotic discontinuation


Sepsis Follow-Up PCT Antibiotic Use
PCT Value
<0.25 µg/L
0.25-0.49 µg/L or drop by >80%
≥0.5 µg/L and decreased by <80%
≥0.5 µg/L and rising or not decreasing
Antibiotic Use Recommendation
Cessation Strongly Encouraged
Cessation Encouraged
Cessation Discouraged
Cessation Strongly Discouraged
Consider continuation if clinically unstable
→ A PCT value which is rising or not declining at least 10% per day is a poor prognostic indicator and suggests infection is not controlled
→ Consider expanding antibiotic coverage or further diagnostic evaluation





LRTI = Acute lower respiratory infection

Clostridium difficile Infection (CDI) Management Guidelines

Per 2017 Update by the Infectious Diseases Society of America and Society for Healthcare Epidemiology of America (SHEA)

CDI Classification	First Line Agent(s)	Second Line Agent(s)
Initial CDI **Non-severe: WBC ≤ 15000 cells/mL or SCr < 1.5 mg/dL** **Severe: WBC > 15000 or SCr > 1.5 mg/dL**	**PO VAN: 125 mg PO QID X 10 days**	**PO metronidazole*: 500 mg PO TID X 10 days** **(Recent RCT demonstrated PO VAN to be superior to PO metronidazole)**
Fulminant CDI **(Presence of hypotension or shock, ileus, megacolon)**	**PO VAN: 500 mg PO QID + IV metronidazole 500 mg TID X 10-14 days** **If ileus suspected: Consider adding rectal VAN 500 mg in 100 mL NS per rectum every 6 hours as retention enema**	**NA**
Recurrent CDI (first occurrence)	**PO VAN 125 mg QID if metronidazole used for initial episode** **OR** **PO VAN as a tapered and pulsed regimen** **OR** **10-day course of PO FDX if VAN used for initial episode**	**NA**
> 1 recurrent CDI	**PO VAN as a tapered and pulsed regimen** **OR** **10-day PO VAN followed by rifaximin** **OR** **10-day course of FDX** **OR** **Fecal microbiota transplantation****	**NA**

VAN=vancomycin; PO=by mouth; FDX=fidaxomicin (not on JRMC formulary); RCT=randomized controlled trials

* Metronidazole only recommended in non-severe CDI when access to vancomycin or fidaxomicin is limited/unavailable, or in the case of patient allergy to other agents

** Fecal microbiota transplantation is recommended for patients with multiple recurrences of CDI who have failed appropriate antimicrobial treatments

2019 JRMC Antibiogram *Inpatient (ALL)* Gram Negative Pathogens	Body Sites	Total Isolates	Ampicillin/ Sulbactam	Amikacin	Ampicillin	Amoxicillin/Clavulanate	Aztreonam	Cefazolin	Ceftriaxone	Ceftazidime	Cefepime	Ciprofloxacin	Nitrofurantoin	Imipenem	Levofloxacin	Piperacillin/Tazobactam	Tetracycline	Trimethoprim/Sulfamethoxazole	Tobramycin
Acinetobacter baumanii	**All**	13	54	100	--	--	--	--	--	54	54	54	--	--	54	--	--	--	92
Enterobacter cloacae	**All**	41	--	100	--	--	61	2	61	66	85	88	18	97	88	73	80	83	90
Escherichia coli	**Urine**	188	41	99	35	76	84	74	85	85	85	61	97	100	61	97	76	63	84
	Non-Urine	67	42	99	33	70	85	66	84	84	84	64	--	100	64	94	71	62	87
Klebsiella pneumoniae	**Urine**	70	64	100	0	84	79	76	79	79	79	83	49	98	90	91	76	79	83
	Non-Urine	44	75	100	2	84	84	80	84	84	84	84	--	100	89	93	73	82	84
Pseudomonas aeruginosa	**Urine**	37	--	95	--	--	65	--	--	78	65	49	--	70	49	73	--	--	76
	Non-Urine	50	--	98	--	--	70	--	--	74	74	70	--	78	70	78	--	--	94
Proteus mirabilis	**Urine**	50	90	100	88	100	100	94	100	100	100	66	0	--	68	100	0	78	92
	Non-Urine	36	86	100	78	97	97	81	97	94	97	67	--	--	69	100	0	75	89
Notes:	**Includes first isolate per patient, per year tested. Organisms with < 30 isolates are not as statistically reliable.** **-- = Not Reported**																		

2019 JRMC Antibiogram *Inpatient (ALL)* Gram Positive Pathogens	Body Sites	Total Isolates	Ampicillin	Clindamycin	Nitrofurantoin	Linezolid	Oxacillin	Trimethoprim/Sulfamethoxazole	Tetracycline	Vancomycin
Enterococcus faecalis	Urine	109	98	--	97	--	--	--	--	99
	Non-Urine	74	97	--	--	--	--	--	--	99
E. Faecium	All	49	14	--	24	97	--	--	--	24
MRSA	All	133	--	78	--	--	--	99	89	100
MSSA	All	101	--	83	--	--	100	100	95	100
Staphylococcus epidermidis	All	139	--	53	100	--	32	46	81	100
Staphylococcus hominis	All	40	--	58	--	--	38	53	63	100
Notes:	Includes first isolate per patient, per year tested. Organisms with < 30 isolates are not as statistically reliable. -- = Not Reported									

2019 JRMC Antibiogram *ED & Outpatient Only* Gram Negative Pathogens	Body Site	Total Isolates	Ampicillin/ Sulbactam	Amikacin	Amoxicillin/Clavulanate	Aztreonam	Cefazolin (1st gen)	Ceftriaxone (3rd gen)	Ceftazidime (3rd gen)	Cefepime (4th gen)	Ciprofloxacin	Levofloxacin	Imipenem	Nitrofurantoin	Piperacillin/ Tazobactam	Trimethoprim/ Sulfamethoxazole	Tobramycin
Acinetobacter spp.	**All**	25	80	96	--	--	--	44	76	72	64	72	--	--	--	72	84
Citrobacter spp.	**All**	22	100	100	100	95	95	95	95	100	100	100	100	100	100	100	95
Enterobacter cloacae	**All**	46	0	100	0	87	0	85	87	98	93	93	95	30	96	83	96
Escherichia coli	**Non-Urine**	107	61	99	85	93	82	93	93	93	75	76	100	--	98	71	94
	Urine	1080	50	100	83	94	86	94	94	94	73	74	100	97	98	65	90
Klebsiella pneumoniae	**Non-Urine**	50	76	100	94	88	86	88	88	88	88	90	100	--	96	74	86
	Urine	289	80	100	94	94	91	94	94	94	95	97	100	57	96	81	94
Morganella morganii	**All**	35	11	100	0	91	0	89	71	100	57	63	20	0	97	60	89
Pseudomonas aeruginosa	**Non-Urine**	48	--	98	--	79	--	--	83	77	75	75	75	--	83	--	88
	Urine	77	--	92	--	65	--	--	84	73	64	61	74		83		84
Proteus mirabilis	**Non-Urine**	59	78	98	93	98	78	98	98	97	64	71	--	--	100	66	86
	Urine	141	87	100	99	97	87	98	98	98	66	71	--	0	100	75	89
Notes:	**Includes first isolate per patient, per year tested. Organisms with < 30 isolates are not as statistically reliable.** **-- = Not Reported**																

2019 JRMC Antibiogram *ED & Outpatient Only* Gram Positive Pathogens	Body Sites	Total Isolates	Ampicillin	Amoxicillin/Clavulanate	Ceftriaxone	Clindamycin	Erythromycin	Nitrofurantoin	Levofloxacin	Oxacillin	Penicillin	Trimethoprim/ Sulfamethoxazole	Tetracycline	Vancomycin
Enterococcus faecalis	**Non-Urine**	100	100	--	--	--	--	--	--	--	--	--	--	100
	Urine	227	100	--	--	--	--	96	--	--	--	--	--	100
Enterococcus faecium	**All**	37	24	--	--	--	--	46	--	--	--	--	--	43
MRSA	**All**	167	--	--	--	81	--	--	--	0	--	99	92	100
MSSA	**All**	139	--	--	--	86	--	100	--	100	--	99	95	100
Staphylococcus epidermidis	**All**	304	--	--	--	61	--	98	--	38	--	50	76	100
Streptococcus pneumoniae	**All**	21	--	100	100	83	50	--	100	--	90	70	90	100
Notes:	**Includes first isolate per patient, per year tested. Organisms with < 30 isolates are not as statistically reliable.** **-- = Not Reported**													