Antimicrobial Stewardship Implementation – Best Practices and Sharing Experiences

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UCLA Health

Objectives

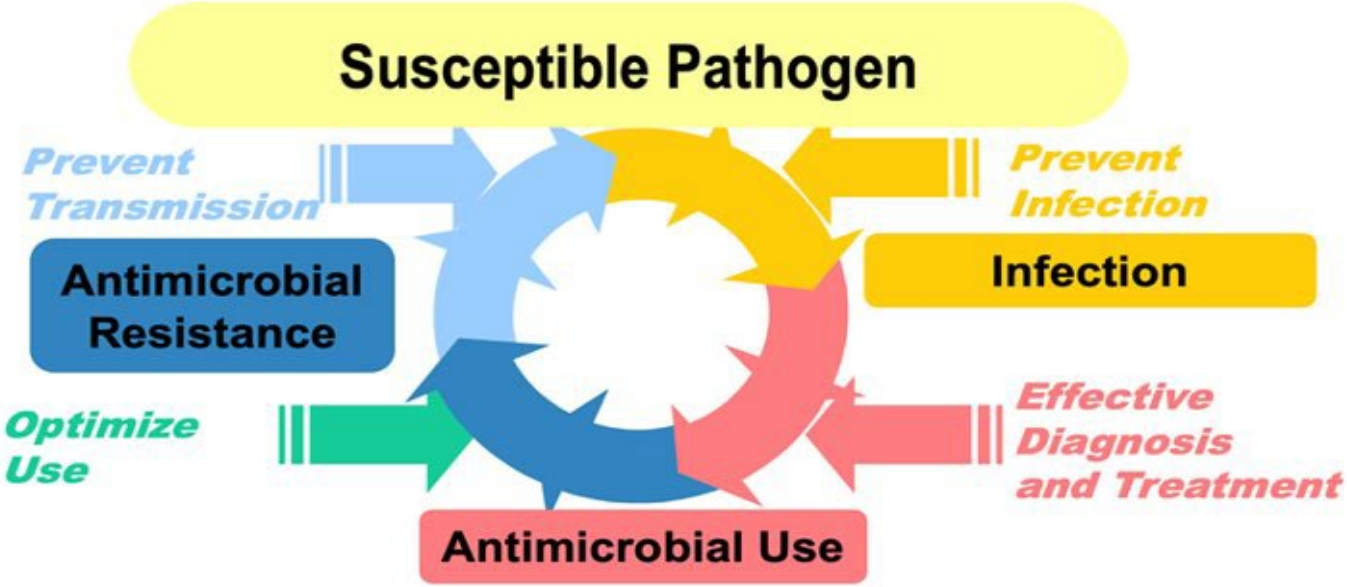
Introduce the principles, goals, and challenges of antimicrobial stewardship programs, and share successful implementation strategies

Antimicrobial Stewardship Program (ASP) Reports To Chief Medical and Quality Officer

- Tara Vijayan, MD, MPH, Medical Director, Adult ASP, UCLA Health
- Ishminder Kaur, MD, Medical Director, Pediatric ASP, UCLA Health
- Kavitha Prabaker, MD, Associate Medical Director, UCLA-SMH
- Ethan Smith, PharmD, BCIDP, ID/ASP Pharmacist, UCLA-RR
- Meganne Kanatani, PharmD, BCIDP, ID/ASP Pharmacist, PGY-2 Residency Director, UCLA-RR
- Lynn Chan, PharmD, BCIDP, ID/ASP Pharmacist, UCLA-RR
- Christine Pham, PharmD, BCIDP, ID/ASP Pharmacist, UCLA-SMH
- **Omai Garner, PhD, Director & Suki Chandrasekaran, PhD, Associate Director, Microbiology Lab, UCLA Health**
- Shaunte Walton, MS, CIC, System Director, Clinical Epidemiology & Infection Prevention
- Dan Uslan, MD, MBA, Chief, Infection Prevention
- Cecilia Borja and Diane Luo, Principal Data Analyst, Quality Informatics and Analytics
- Prest Oshodi, RN, Patty Rodriguez, LVN, Infectious Disease Transition Service

UCLA Health Antimicrobial Stewardship Program (ASP)

- The UCLA ASP is a multidisciplinary team whose mission is to improve the care of patients with infectious diseases while supporting appropriate use of antimicrobials



Knowledge Check

Which of the following are common goals for an ASP?

A. Improve patient outcomes
B. Reduce adverse events
C. Reduce antibiotic resistance
D. Use resources optimally
E. All of the above

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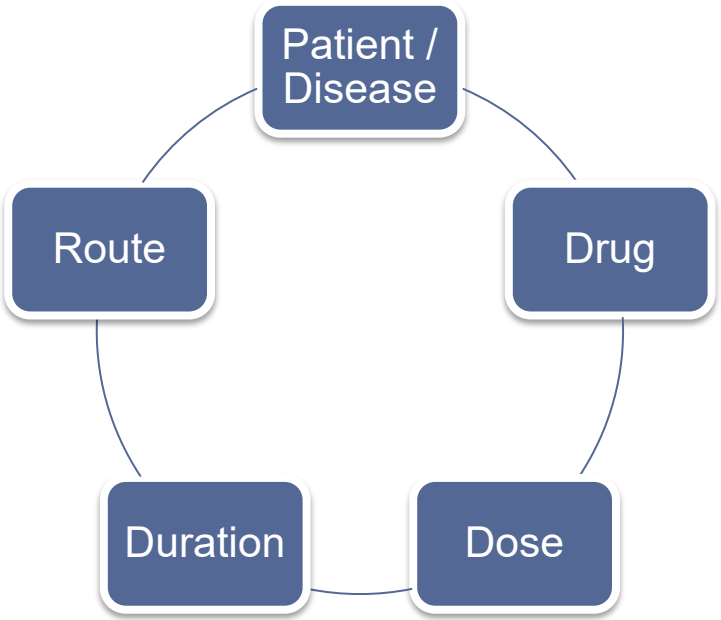
What is Antimicrobial Stewardship?

- **IDSA/SHEA/PIDS Definition:**
  "coordinated interventions designed to improve and measure the appropriate use of [antimicrobial] agents by promoting the selection of the optimal [antimicrobial] drug regimen including dosing, duration of therapy, and route of administration."
  - Improved patient outcomes
  - Reduced adverse events
  - Improvement in rates of antibiotic susceptibility
  - Optimization of resource allocation

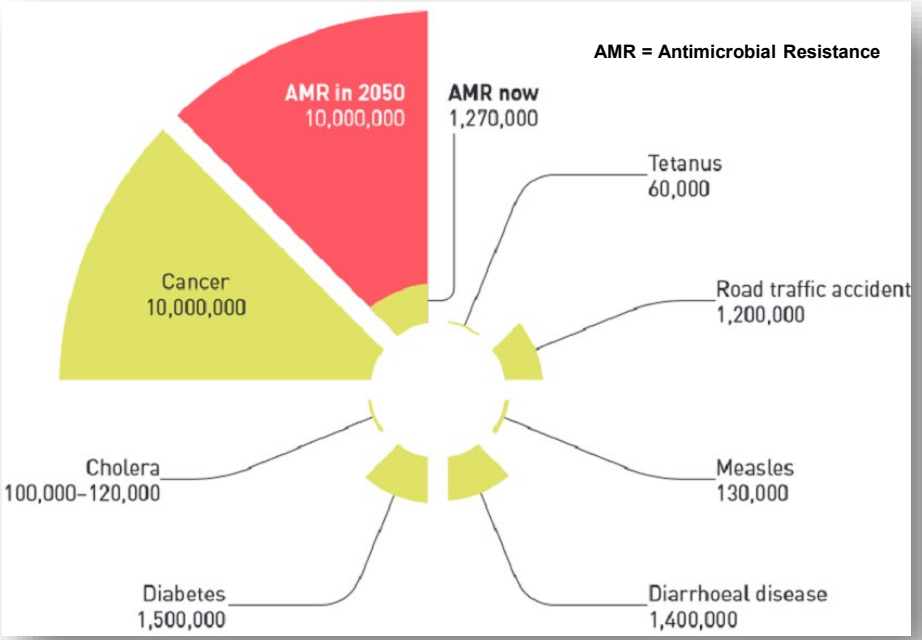


5 "Rights" of Antimicrobial Stewardship

Clin Infect Dis. 2016;62(10):e51-77.

Why is Antimicrobial Stewardship Important?

- More than **2.8 million antibiotic-resistant infections** occur in the U.S. every year and more than **35,000 patients die** as a result
- Sepsis contributes to over **1/3 of in-hospital deaths** and is a **major driver of new morbidity** in those who survive
- COVID-19 had a major impact on antimicrobial resistance:
  - 15% increase in infections/deaths
  - Increases in 4 out of 6 types of hospital-acquired infections
- Globally – **$3.4 trillion annual GDP loss, 10 mil. annual deaths, 24 million more people pushed to extreme poverty** in the next decade



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https://www.cdc.gov/narms/resources/threats.html
https://www.cdc.gov/sepsis/pdfs/sepsis-core-elements-h.pdf
https://www.cdc.gov/antimicrobial-resistance/media/pdfs/covid19-impact-report-508.pdf

How Are Hospital ASPs Structured?

- **CDC's Core Elements of ASP:**
  - Hospital leadership commitment
  - Accountability
  - Pharmacy expertise
  - Action
  - Tracking
  - Reporting
  - Education

- **Regulatory Bodies:**
  - The Joint Commission
  - Centers for Medicare & Medicaid Services
  - CDC/NHSN (by way of CMS)
  - Local public health jurisdictions or credentialing bodies (e.g., CDPH)

Preauthorization | Prospective Audit		
Upstream: • Primary service needs prescriptive approval • ASP may act as arbitrator • Typically requires significant ASP resources prior to dispensing • "Antibiotic queue" • Restrictions to certain services (e.g., infectious diseases)	• Criteria for use/review • Education • Mechanism for access "after hours" • Antibiotic "time outs" • Syndromic- or antimicrobial-based • IT/technology resources are key to success	**Downstream:** • Primary service initiates therapy • ASP intervenes in targeted cases after initial Rx • More data at time of intervention • ASP team rectifies therapeutic issues when suboptimal prescribing identified • May be less resource intensive

Clin Infect Dis. 2016;62(10):e51-77.
https://www.cdc.gov/antibiotic-use/healthcare/pdfs/hospital-core-elements-H.pdf
https://www.medscape.com/viewarticle/755822_6

The Joint Commission and ASPs

Medication management standard MM.09.01.01 established ASP as an organizational priority

10. Allocate financial resources (staffing and IT) to support ASP
11. Appoint MD/Rx leader
12. Follow national guidelines/standards, document activities, collaboration, competency-based education
13. Multidisciplinary ASP committee that oversees program
14. Coordination amongst all components of hospital responsible for antibiotic use and resistance
15. Document evidence-based use of antibiotics in all departments and services of hospital
16. Monitor antibiotic use by calculating DOTs/1,000 patient days or reporting to NHSN AUR module
17. Implement preauthorization and/or prospective audit and feedback by a member of the ASP
18. Implement at least 2 evidence-based guidelines to improve antibiotic use
19. Evaluate adherence to at least one of the evidence-based guidelines from EP18
20. Collect, analyze, report data to hospital leadership and prescribers
21. Take action on improvement opportunities identified by the ASP

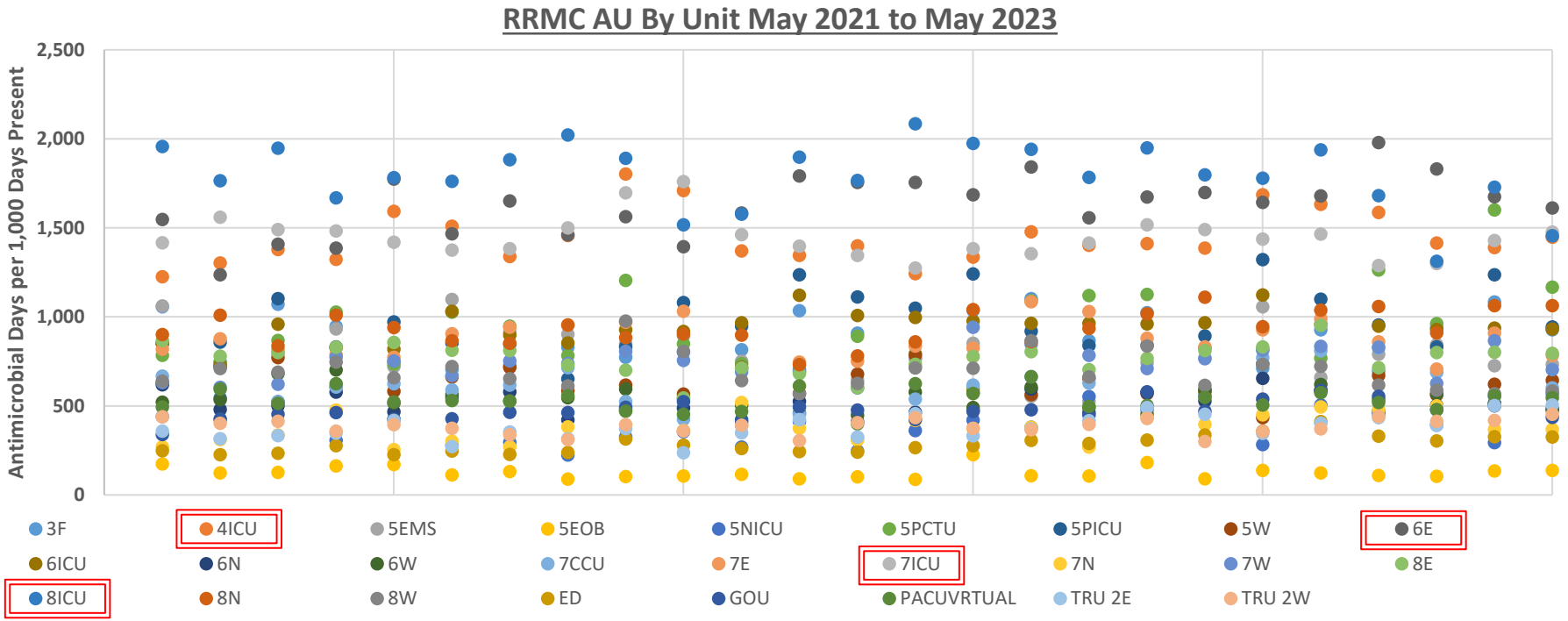
https://www.jointcommission.org/-/media/tjc/documents/standards/r3-reports/r3_antibioticstewardship_july2022_final.pdf

Where Do I Find UCLA Health ASP Guidelines?

Firstline:
(https://app.firstline.org/en/clients/5-ucla-health)

ASP Website:
(https://asp.mednet.ucla.edu/pages/)

How Does UCLA Health ASP Track Data?
RRUMC: AU by Units, All Antimicrobials



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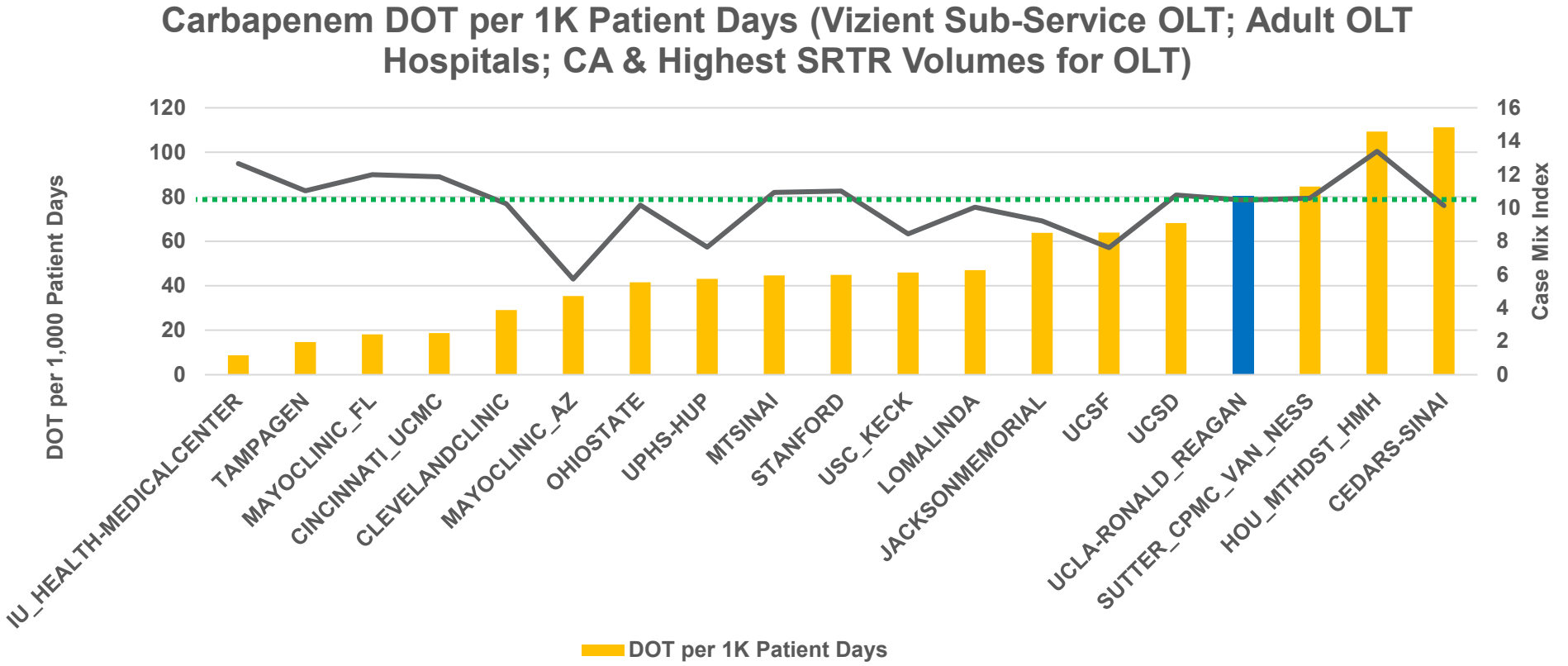
How Does UCLA Health ASP Track Data?



Key Activities and Roles for Microbiology Laboratory Staff in Antibiotic Stewardship Programs

Integrate microbiology laboratory staff into the functions of the antibiotic stewardship program.

- Diagnostic stewardship
- Development of antibiograms to support optimal antibiotic use
- The introduction of new diagnostic tests into the laboratory
- The implementation of new antibiotic susceptibility testing interpretative criteria
- Education of clinicians on laboratory testing practices.

Diagnostic Stewardship

Optimize testing practices that impact antibiotic stewardship

- Improve test ordering menus and order sets
- Improve sample collection practices and quality of specimens processed by the microbiology laboratory
- Ensure laboratory procedures reflect best practices in the workup of specimens, antimicrobial susceptibility testing [AST], and result reporting
- Report microbiology laboratory results in a way that encourages appropriate antibiotic therapy and de-escalation (e.g., reporting “usual respiratory flora, no *S. aureus* or *P. aeruginosa* found” instead of “usual respiratory flora” for a sputum culture).
- Consider adopting diagnostic tests that can help optimize antibiotic therapy

Education

- Promote education and communication between the laboratory and clinicians about test characteristics (e.g., test performance, expected turn-around-time, etc.).
- Teach staff about best practices in specimen collection.
- Educate clinicians how to interpret test reports, including:
- Understanding report language used, such as categorical interpretations (e.g. intermediate vs. susceptibly dose-dependent).
- Understanding the principles behind selective reporting and how to contact the laboratory if questions arise regarding additional drug susceptibility results

Antimicrobial Susceptibility Reporting

At least annually, update institution antibiograms

Important aspects of developing an antibiogram that are useful for both selection of empiric antibiotic therapy and antibiotic stewardship include the following:

- Report on the percent of isolates tested and found susceptible.
- Only present results for those organisms and settings with sufficient numbers of isolates tested
- Follow standardized procedures for de-duplication of multiple results from the same patient
- Where possible, stratify data by major clinical settings including ICUs vs. wards, community onset vs. hospital onset, and specimen type

Antibiogram (Clinical Lab information for Antimicrobial Stewardship)

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Table 1. Adults (> 21 y.o.) Most Common Gram-negative Bacteria – Non-Urine Isolates, % Susceptible

Organism	Location	No. Isolates	Penicillin				Cephalosporins				Carbapenems			Aminoglycosides			Fluoro-quinolone		Other
			Ampicillin	Amoxicillin-Clavulanic acid	Ampicillin - sulbactam	Piperacillin – tazobactam [1]	Cefazolin	Cefepime [1]	Ceftazidime	Ceftriaxone	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Trimethoprim - sulfamethoxazole
Enterobacter cloacae complex[2]	OP	118	R	R	R	89	R	94	—[3]	—[3]	97	99	99	99	98	99	92	96	87
	IP	116	R	R	R	76	R	88	—[3]	—[3]	95	99	99	99	98	98	88	90	87
	ICU	56	R	R	R	64	R	86	—[3]	—[3]	88	99	99	99	96	96	93	93	93
Escherichia coli	OP	374	—	73	—	96	60	84	85	79	99	99	9	98	87	87	69	70	61
	IP	461	—	67	—	91	52	76	77	71	98	98	99	96	84	82	63	65	58
	ICU	147	—	58	—	82	34	65	66	59	99	99	99	95	82	80	48	52	51
Klebsiella pneumoniae	OP	182	R	88	—	91	76	85	86	85	98	99	99	98	92	91	83	91	81
	IP	246	R	80	—	83	65	76	78	76	94	97	96	97	89	84	73	85	72
	ICU	121	R	69	—	78	56	68	68	65	91	96	93	96	84	74	65	76	64
Proteus mirabilis	OP	131	—	91	—	99	13	92	97	85	99	—[4]	99	93	92	89	73	73	73
	IP	137	—	85	—	98	9	87	96	80	99	—[4]	99	88	84	80	61	62	60
	ICU	40	—	78	—	98	10	78	93	70	98	—[4]	99	85	83	80	45	45	53
Pseudomonas aeruginosa	OP	526	R	R	R	89	R	91	90	R	R	88	92	—[5]	—[5]	93	81	77	R
	IP	439	R	R	R	80	R	86	84	R	R	81	85	—[5]	—[5]	95	77	71	R
	ICU	172	R	R	R	65	R	76	74	R	R	63	68	—[5]	—[5]	91	73	65	R

Table 3. Adults (> 21 y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible

Organism	Location	No. Isolates	Penicillin		Cephalosporin				Carbapenem			Aminoglycoside			Fluoro-quinolone		Other		
			Ampicillin	Amoxicillin – Clavulanic acid	Oral Cephalosporin [1]	Cefepime [2]	Ceftazidime	Ceftriaxone	Ertapenem	Imipenem	Meropenem	Gentamicin	Tobramycin	Amikacin	Ciprofloxacin	Levofloxacin	Nitrofurantoin	Trimethoprim/ sulfamethoxazole	Piperacillin/ Tazobactam
Enterobacter cloacae complex	OP	223	R	R	R	92	— [3]	— [3]	95	99	99	96	96	—	92	90	48	85	77
	IP	25 [4]	R	R	R	84	— [3]	— [3]	96	96	96	99	92	—	76	76	58	80	52
Escherichia coli	OP	9172	57	87	89	—	75	90	99	99	99	91	90	—	77	72	98	75	96
	IP	408	41	81	70	—	50	72	99	99	99	83	81	—	56	52	94	62	91
Klebsiella pneumoniae	OP	1571	R	R	89	—	44	90	99	99	99	95	94	—	86	84	29	86	90
	IP	144	R	R	64	—	0	66	94	97	97	83	77	—	63	58	20	65	68
Proteus mirabilis	OP	845	81	79	93	—	94	95	99	—	99	93	93	—	85	84	R	80	99
	IP	85	74	75	86	—	100	88	99	—	99	86	82	—	65	66	R	73	99
Pseudomonas aeruginosa	OP	433	R	R	R	95	93	R	R	87	93	— [5]	97	99	84	81	R	R	92
	IP	108	R	R	R	92	87	R	R	83	89	— [5]	97	99	80	73	R	R	82

Table 4. Adults (> 21 y.o.) Gram-positive Cocci, % Susceptible

Organism	Location	No. Isolates	Penicillins			Other										
			Ampicillin	Oxacillin	Penicillin	High Level Gentamicin [1]	Ciprofloxacin	Clindamycin	Daptomycin	Doxycycline	Erythromycin	Linezolid	Rifampin [2]	Trimethoprim sulfamethoxazole	Vancomycin	Ceftaroline
Staphylococcus aureus	All	2399	—	75 [3]	25	—	74	72	100	98	55	100	99	96	100	100
Oxacillin-resistant *S. aureus* (MRSA)	OP	416	—	R [3]	R [3]	—	28	65	100	97	16	100	99	91	100	99
	IP	148	—	R [3]	R [3]	—	20	55	100	100	19	100	99	91	100	99
	ICU	75	—	R [3]	R [3]	—	15	44	100	97	17	100	97	95	100	100
Oxacillin-susceptible *S. aureus* (MSSA)	OP	1271	—	100	35	—	90	75	100	98	67	100	100	97	100	100
	IP	279	—	100	30	—	90	74	100	98	67	100	100	96	100	99
	ICU	156	—	100	22	—	91	69	100	99	65	100	98	99	100	100
Staphylococcus epidermidis	All	522	—	47	13	—	63	63	100	88	38	100	98	67	100	—
Staphylococcus haemolyticus	All	62	—	52	40	—	55	57	100	88	37	100	86	68	100	—
Staphylococcus lugdunensis [4]	All	329	—	88	45	—	99	81	100	99	79	100	100	100	100	—
Staphylococcus pseudintermedius/ intermedius	All	62	—	61	16	—	60	55	100	55	45	100	97	55	100	—
Coagulase negative *Staphylococcus* [5,6]	All	103	—	64	32	—	69	67	99	98	40	100	97	81	100	—
Enterococcus spp.[7] [8]	All	46	74	—	—	—[9]	61	R	84	69	42	100	31	R	78	R
Enterococcus faecalis [7]	All	622	100	—	—	72[10]	69	R	97	41	R	100	19	R	98	R
Enterococcus faecium [7]	All	260	15	—	—	92[10]	10	R	90[11]	54	R	100	5	R	34	R

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Table 8. Pediatrics (≤ 21 y.o.) Gram-negative Bacteria – Urine Isolates, % Susceptible

Organism	No. Isolates	Penicillins		Cephalosporins				Carbapenems			Amino-glycosides			Fluoroqui-nolone	Other	
		Ampicillin	Amoxicillin - Clavulanic acid	Oral Cephalosporins [1]	Cefepime	Ceftazidime	Ceftriaxone	Ertapenem	Imipenem	Meropenem	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin [2]	Trimethoprim – sulfamethoxazole	Nitrofurantoin
Enterobacter cloacae complex [3]	14 [4]	R	R	R	86	—	—	93	100	100	—	100	—	100	93	50
Klebsiella (Enterobacter) aerogenes	17 [4]	R	R	R	88	—	—	100	100	100	—	94	—	82	88	12
Escherichia coli	882	58	86	91	—	—	92	100	99	99	—	91	91	85	76	99
Klebsiella pneumoniae	91	R	95	91	—	—	92	100	99	99	—	98	95	84	86	23
Proteus mirabilis	85	84	84	96	—	—	98	100	—[5]	99	—	95	97	93	85	R
Pseudomonas aeruginosa	26 [4]	R	R	R	89	89	R	R	92	92	100	—[6]	100	96	R	R

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Table 6. Multiple Drug Resistant Gram-negative Bacteria – All sources
% Susceptible

Organism	Amikacin		Aztreonam		Ceftazidime-Avibactam [1]		Ceftolozane-Tazobactam [1]		Tigecycline [2]		Meropenem-Vaborbactam [1]		Eravacycline [2, 3]		Omadacycline [2, 4]	
	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible	Number of isolates tested	% Susceptible
Carbapenem Resistant Enterobacterales (CRE) [5]	324	84	81	12	324	95	320	73	85	92	81	85	81	75	81	82

Organism	Number of Isolates	Amikacin	Gentamicin	Ciprofloxacin	Piperacillin-Tazobactam	Cefepime	Ceftazidime	Ceftazidime-Avibactam [1, 2]	Ceftolozane-Tazobactam [1, 2]	Minocycline	Trimethoprim-sulfamethoxazole
Pseudomonas aeruginosa, Imipenem or Meropenem resistant	202	89 [6]	—	49	46	59	55	86	87	0	R
Pseudomonas aeruginosa, Imipenem and Meropenem resistant	140	88 [6]	—	44	28	45	40	78	83	0	R
Acinetobacter baumannii complex [7], Meropenem resistant	27 [8]	26	19	11	0	4	7	—	—	55	26

Table 10. Yeasts, %S, %I, %SDD, %R, 2022-2023

1. Most yeast infections can be treated empirically. Antifungal testing of yeasts may be warranted for the following:
   - Oropharyngeal or vaginal infections due to *Candida* spp. in patients who appear to be failing therapy.
   - Management of invasive *Candida* spp. infections when utility of an azole agent is uncertain (e.g., *Candida* spp. other than *C. albicans*), per IDSA guidelines for candidiasis: CID 2016:62, E1-E50. Clinical Practice Guidelines for the Management of Candidiasis.
2. Isolation of Candida in respiratory specimens of immunocompetent patients should be interpreted as airway colonization.

Organism	No. of Isolates		Percent Susceptible, Susceptible Dose Dependent, Intermediate, Resistant at Breakpoints[1, 2]														
			Fluconazole [3]			Voriconazole [3]			Caspofungin [3]			Micafungin [3]			Anidulafungin [3]		
			S	SDD	R	S	I	R	S	I	R	S	I	R	S	I	R
Candida albicans	333	MIC µg/mL	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1
		%	90	6	5	88	10	2	99	0	0	99	0	0	99	0	0
Candida glabrata	179	MIC µg/mL	—	≤ 32	≥ 64	— [4]	— [4]	— [4]	≤ 0.12	0.25	≥ 0.5	≤ 0.06	0.12	≥ 0.25	≤ 0.12	0.25	≥ 0.5
		%	—	84	16	— [4]	— [4]	— [4]	88	10	2	99	0	1	98	1	2
Candida parapsilosis	75	MIC µg/mL	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 2	4	≥ 8	≤ 2	4	≥ 8	≤ 2	4	≥ 8
		%	85	4	11	89	3	8	99	0	0	99	0	0	92	8	0
Candida tropicalis	50	MIC µg/mL	≤ 2	4	≥ 8	≤ 0.12	0.25-0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1
		%	88	4	8	90	4	6	98	0	2	99	0	0	98	2	0
Candida krusei	31	MIC µg/mL	—	—	—	≤ 0.5	1	≥ 2	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1	≤ 0.25	0.5	≥ 1
		%	R	R	R	97	3	0	94	3	3	94	0	6	97	0	3
Candida guilliermondii	9 [5]	MIC µg/mL	—	—	—	—	—	—	≤ 2	4	≥ 8	≤ 2	4	≥ 8	≤ 2	4	≥ 8
		%	—	—	—	—	—	—	99	0	0	99	0	0	99	0	0

Table 11. Emerging Resistance Concerns (cont.)

Organism	Resistant to:	Percent Resistant:	Therapeutic Options	Comments
Klebsiella spp. (not aerogenes) *E. coli*	ceftriaxone or other 3rd generation cephalosporin	Blood isolates: *Klebsiella* spp.(n = 190) 25% *E. coli* (n = 333) 32%	ertapenem ciprofloxacin	In vitro resistance to 3rd generation cephalosporins suggests the strain is producing extended-spectrum ß-lactamases (ESBL), or AmpC
K. pneumoniae and other *Enterobacterales*	carbapenem	All isolates (n = 18395): 3% Blood isolates (n=682): 2%	Check in vitro susceptibility results and contact Infectious Diseases.	Decreased susceptibility to carbapenems is increasing primarily among ICU patients' isolates. These isolates may be resistant to all available antimicrobial agents.
Citrobacter freundii complex *Enterobacter* cloacae complex *Klebsiella (Enterobacter) aerogenes*	3rd generation cephalosporins (e.g. ceftriaxone)	See comments	cefepime aminoglycoside ciprofloxacin ertapenem meropenem trimeth-sulfa	Organisms listed typically produce inducible ß-lactamases. Isolates that appear susceptible to 3rd generation cephalosporins may develop resistance during therapy.[1]
Pseudomonas aeruginosa	cefepime and/or piperacillin-tazobactam	All isolates: (n=1568) 15%	Check in vitro susceptibility results and contact Infectious Diseases.	Therapeutic management must be determined on a case by case basis.
Acinetobacter baumannii complex	amikacin, cefepime, ceftazidime, ciprofloxacin, meropenem, piperacillin-tazobactam, and trimeth-sulfa	All isolates: (n=109) 16%	Check in vitro susceptibility results and contact Infectious Diseases.	Therapeutic management must be determined on a case by case basis.

Table 12. Resistance Trends: 1990-2023

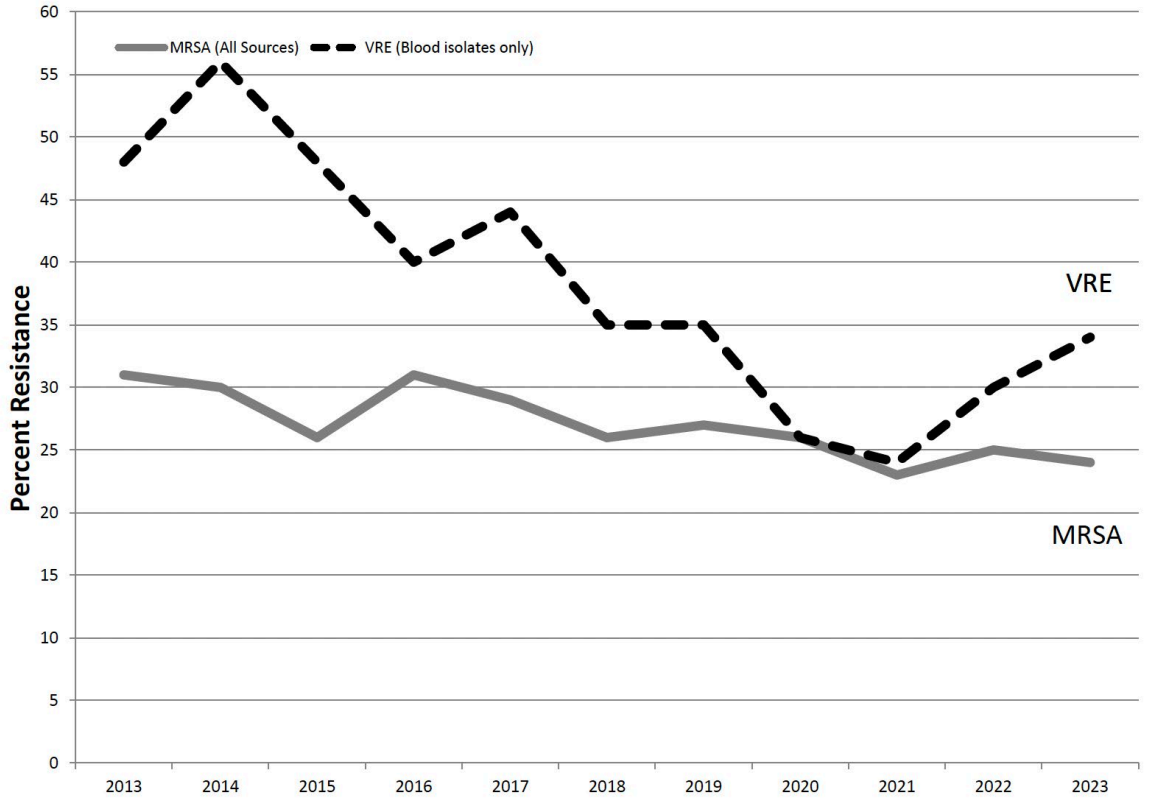

Table 12. Resistance Trends: 1990-2022
(cont.)

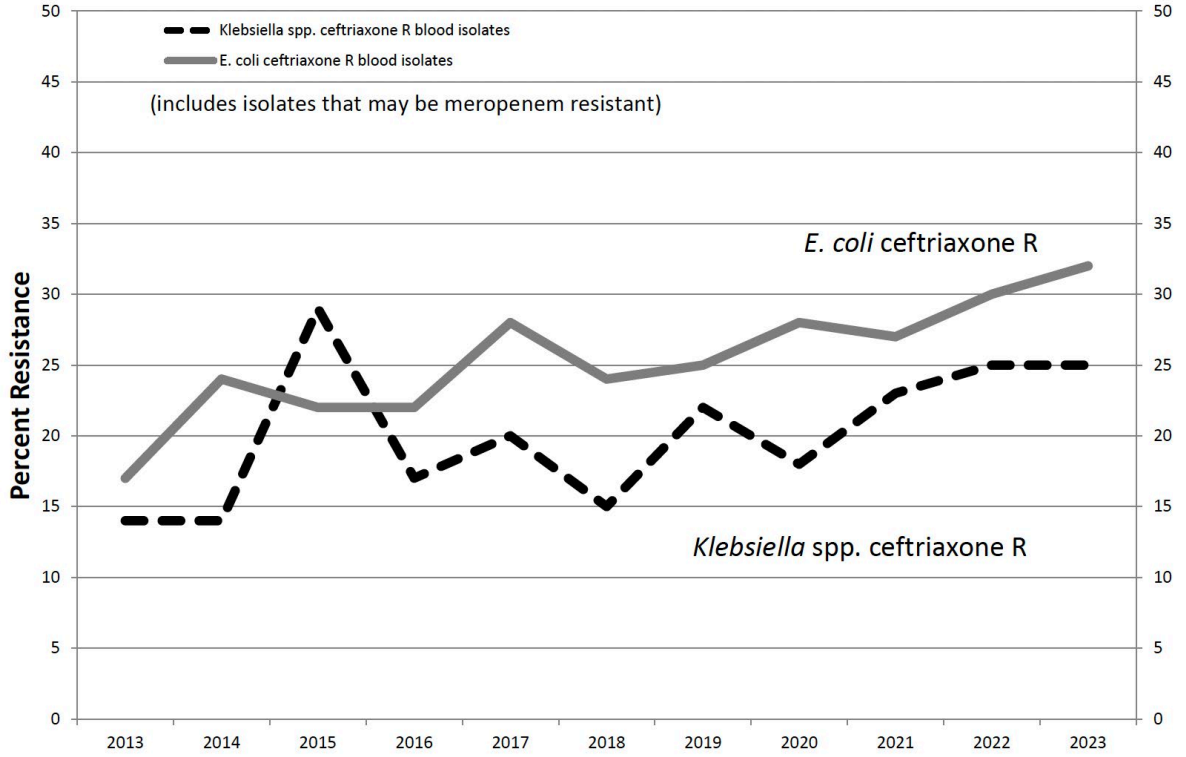

Table 13. Carbapenem-resistant Enterobacterales (CRE), 2018-2023

Year	Non-CP CRE	KPC	OXA	NDM	NDM & OXA	KPC & OXA	VIM	IMP
2018	31	24	4	3	1	0	0	0
2019	25	32	0	2	1	0	0	0
2020	42	25	2	5	1	1	0	0
2021	67	25	2	5	0	1	0	0
2022	104	15	3	5	1	0	0	0
2023	57	23	6	7	1	1	0	0

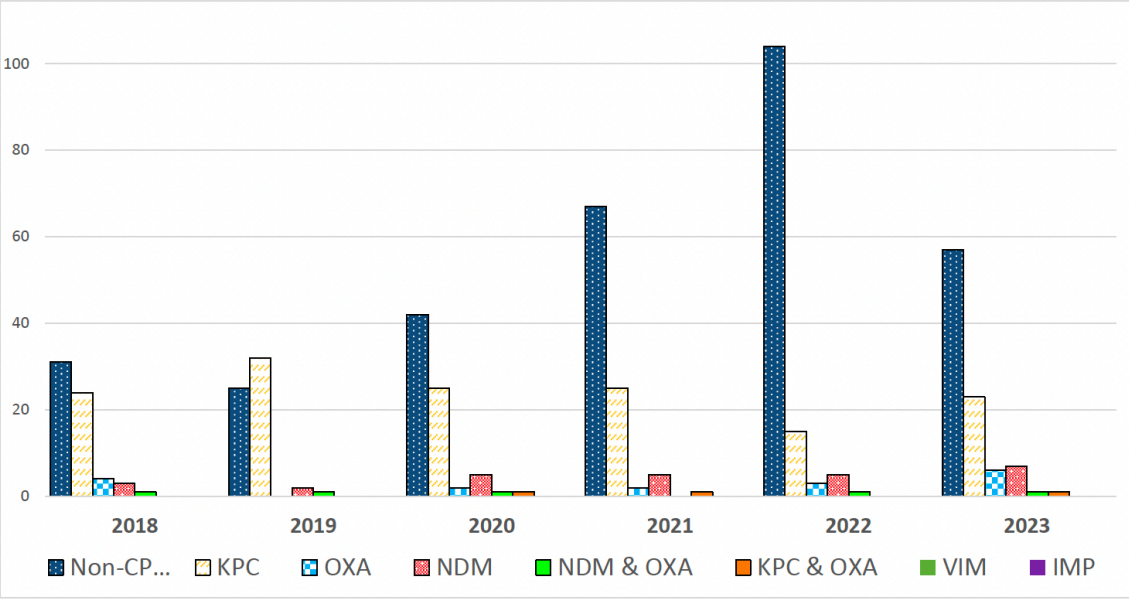

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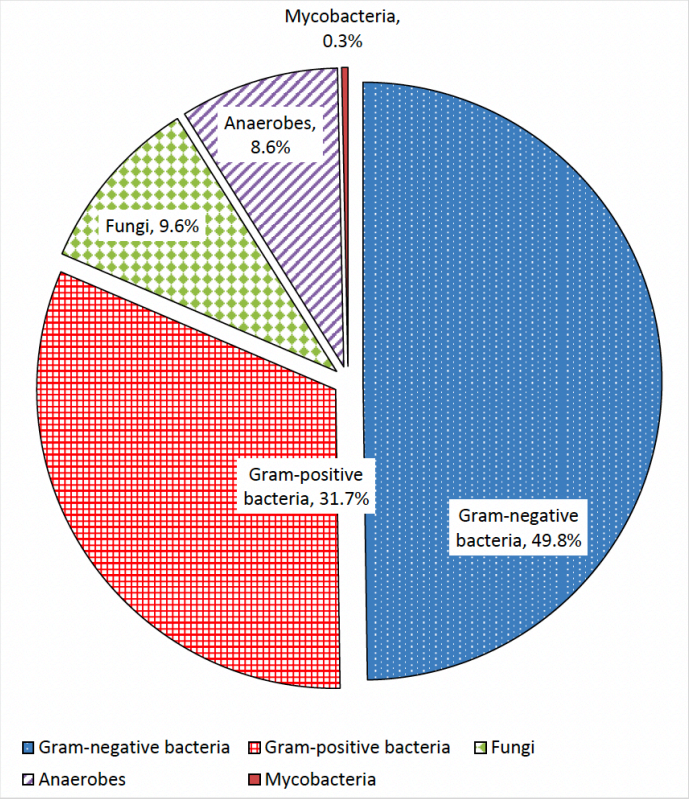
Table 14. Treatment Suggestions for Organisms for which Susceptibility Testing is not Routinely Performed

Organism	Recommended	Alternate treatment	Comments / Also Effective
Aerococcus urinae	Amoxicillin	Levofloxacin or Ciprofloxacin	Fluoroquinolones resistant strains (27%-33%) have been reported. [1]
Bordetella pertussis[2]	Azithromycin or Clarithromycin	Trimethoprim-sulfamethoxazole	
Campylobacter jejuni[2]	Azithromycin	Consult with ID	Trimethoprim-sulfamethoxazole, Penicillin & Cephalosporins **NOT Active**
Campylobacter fetus[2]	Gentamicin	Imipenem or Ceftriaxone	Ampicillin
Legionella spp.[2]	Levofloxacin or Azithromycin	Moxifloxacin or doxycycline	
Mycoplasma pneumoniae[2]	Doxycycline	Azithromycin, Minocycline	Clindamycin & B-lactams **NOT Effective**. Increasing macrolide resistance.
Mycoplasma hominis	Consult with ID	Consult with ID	**Resistant** to Erythromycin and azithromycin. Fluoroquinolone and Tetracycline resistant strains have been reported. [3]
Stenotrophomonas maltophilia [4]	Consult with ID	Consult with ID	Fluoroquinolone [5] For moderate to severe infections, combination therapy should be considered until clinical improvement occurs.
Streptococcus agalactiae (Group B Streptococcus)	Penicillin, Ampicillin, or Amoxicillin	Cefazolin or Vancomycin	
Cutibacterium (Proprionibacterium) acnes[2]	Penicillin, Ceftriaxone	Vancomycin, Daptomycin, Linezolid	Resistant to Metronidazole
Ureaplasma	Azithromycin, Doxycycline		Resistant to Clindamycin. Tetracycline resistant strains have been reported.[3]

Table 15. Blood: One Isolate per Patient, 2023



Most Common Organism	n	% of Total Blood Isolates
Escherichia coli, 32% ceftriaxone R	299	19.9%
Enterococcus species, 34% VRE	168	11.2%
Staphylococcus aureus, 31% MRSA	154	10.3%
Klebsiella pneumoniae, 21% ceftriaxone R	142	9.5%
Pseudomonas aeruginosa	56	3.7%
Other Enterobacteriaceae spp.	43	2.9%
Candida glabrata	41	2.7%
Enterobacter cloacae complex	40	2.7%
Proteus mirabilis	39	2.6%
Candida albicans	34	2.3%
Bacteroides species	31	2.1%
Streptococcus anginosus group	29	1.9%
Streptococcus pyogenes	25	1.7%
Klebsiella oxytoca	25	1.7%
Streptococcus pneumoniae	21	1.4%
Stenotrophomonas maltophilia	17	1.1%
Candida tropicalis	16	1.1%
Candida parapsilosis	15	1.0%
Streptococcus agalactiae	14	0.9%
Total blood isolates * 1489		

*Excludes
Coagulase-negative *Staphylococcus* (n= 603)
Viridans group Streptococcus (n=87)
Corynebacterium spp. (n= 57)
Bacillus spp. (n=25)
Micrococcus spp. (n= 24)
Cutibacterium (Propionibacterium) acnes (n=10)
Aerococcus urinae (n=2)

Table 24. Antimicrobial Agents Routinely Reported – Aerobic Bacteria (cont.)

Primary antimicrobials	Conditions for supplemental antimicrobial reporting	Supplemental antimicrobial(s)[1]
***Salmonella* spp.,[1] *Shigella* spp.[2]**		
ciprofloxacin (>11 y.o.) trimethoprim-sulfamethoxazole	 *Shigella spp.* Non-fecal sources/resistant to all primary antimicrobials	 azithromycin ceftriaxone
Pseudomonas aeruginosa		
cefepime	Resistant to cefepime	imipenem, meropenem, ceftolozane - tazobactam
	Resistant to imipenem or meropenem	ceftolozane - tazobactam
 ciprofloxacin (>11 y.o.) Tobramycin piperacillin-tazobactam ceftazidime	ceftolozane – tazobactam MIC ≥4 µg/mL Urine Resistant to piperacillin-tazobactam	cefiderocol amikacin imipenem, meropenem
***Acinetobacter* spp.**		
cefepime ceftazidime ciprofloxacin (>11 y.o.) gentamicin piperacillin-tazobactam trimethoprim-sulfamethoxazole	 Resistant to ceftazidime Resistant to meropenem or imipenem Resistant to gentamicin	 imipenem, meropenem minocycline amikacin, tobramycin
Stenotrophomonas maltophilia*- Sterile body site isolates** ***Burkholderia cepacia complex		
levofloxacin (>11 y.o.) minocycline trimethoprim-sulfamethoxazole	 *Burkholderia cepacia complex* *Burkholderia cepacia complex*	 meropenem ceftazidime

[1] If stool isolates, perform on patients ≤3 mo., or if isolate is *Salmonella typhi* or *Salmonella paratyphi A*.

[2] Susceptibility performed on stool isolates.

Table 28. Antimicrobial Stewardship

1) Treatment of asymptomatic bacteriuria
    a. A urine culture must ALWAYS be interpreted in the context of the urinalysis and patient symptoms.
    b. If a patient has no signs of infection on urinalysis and no symptoms of infection, but a positive urine culture, the patient by definition has **asymptomatic bacteriuria**.
    c. Patients with chronic indwelling catheters, urinary stoma, and neobladders will almost universally have positive urine cultures.
    d. The only patient populations for which it is recommended to screen for and treat asymptomatic bacteriuria are **pregnant women** and **patients scheduled for a genitourinary surgical procedure**. Screening during the first 2 months of renal transplant is acceptable.
    e. Avoid routine urine analysis and/or urine cultures for the sole purpose of screening for UTI in asymptomatic patients.
2) Treatment of VRE Isolated from stool cultures
    a. *Enterococcus* are normal bowel flora and do not cause enteric infections, regardless of vancomycin susceptibility.
    b. Antibiotic treatment of VRE in stool cultures is discouraged, and may lead to increased transmission by causing diarrhea and emergence of antimicrobial resistance among VRE.
3) Treatment of *Candida* isolated from bronchoscopic samples in non-neutropenic patients
    a. Isolation of *Candida*, even in high concentrations, from respiratory samples of immunocompetent patients, including bronchoscopy, should be interpreted as airway colonization.
    b. Antifungal therapy should not be initiated unless *Candida* is also isolated from sterile specimens or by histologic evidence in tissue from at-risk patients.

4) Use of “double coverage” for gram-negative bacteria
    a. “Double coverage” of suspected gram-negative infections serves the purpose of providing broad spectrum initial empiric coverage until susceptibility data are known.
    b. No evidence exists to support the superiority of combination therapy over monotherapy for gram-negative infections once susceptibilities are known.
    c. Once culture identification and susceptibilities have been reported, de-escalation to a single agent is strongly recommended.
5) Use of two agents with anaerobic activity to treat infections with potential anaerobic bacteria involvement
    a. Double anaerobic coverage is not necessary and puts the patient at risk for additional drug toxicities. No data or guidelines support double anaerobic coverage in clinical practice.
    b. Example: use of piperacillin/tazobactam + metronidazole.
    c. Two clinical exceptions are:
        i. Addition of metronidazole to another agent with anaerobic activity to treat *Clostridioides difficile* infection.
        ii. Clindamycin added to another agent with anaerobic activity when treating necrotizing fasciitis.

For additional information, refer to the Antimicrobial Stewardship website, https://asp.mednet.ucla.edu/pages/

Thank You!
Questions?