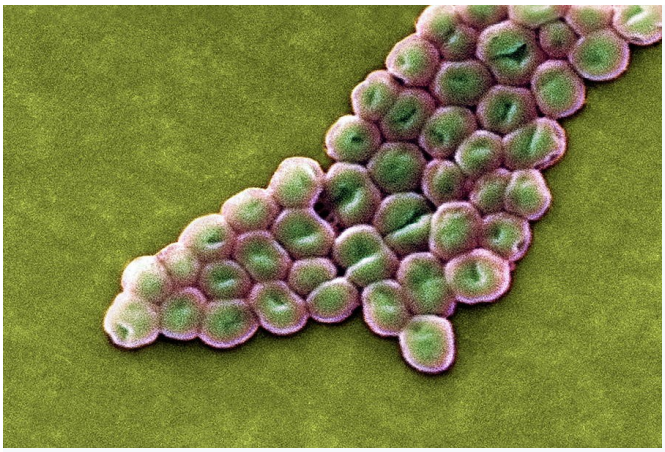
pennsylvania
DEPARTMENT OF HEALTH

THE STEWARD

2022 QUARTER 2

A PARTNERSHIP IN REDUCING ANTIMICROBIAL RESISTANCE THROUGH ANTIMICROBIAL STEWARDSHIP



The Crafty CRAB: What You Need to Know about Carbapenem-resistant Acinetobacter baumannii

By: Julie Paoline, MA, CPHA, CIC, FAPIC; Christine L. Mulgrew, MPH, PhD; Jane M. Gould, MD, FAAP, FPIDS

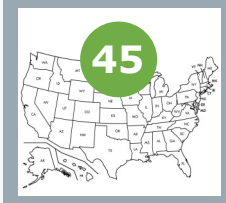
Acinetobacter is already known to many laboratorians as a member of the ESKAPE pathogens (*Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa* and *Enterobacter* species*)* that are typically multi-drug resistant (Mansura, 2019). *Acinetobacter baumannii* is a non-fermenting, gram negative, naturally competent organism that can acquire and maintain multiple genetic elements encoding anti-microbial resistance. **(Page 2)**

Tracking Antibiotic Use and Outcomes

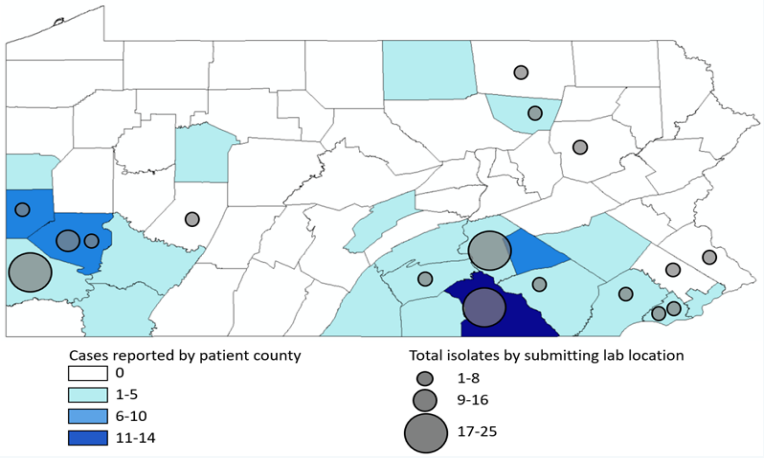
By: Christine L Mulgrew MPH, PhD

The evaluation and success of any antimicrobial stewardship program (ASP) requires specific, measurable, achievable, relevant and timely (SMART) performance measures. The Centers for Disease Control and Prevention (CDC) recommends tracking both antibiotic use and outcomes, but it places priority on 4 measures. The first priority measure, applicable only to hospitals, is the collection of antimicrobial use (AU) data through participation in the National Healthcare Safety Network (NHSN) AU option. The Infectious Diseases Society of America (IDSA) and the Society for Healthcare Epidemiology of America (SHEA) recommend that antimicrobial-specific use be measured by every ASP (Barlam, 2016). **(Page 3)**

Number of PA hospitals that ever submitted AU data to NHSN.



Number of states with a higher proportion of hospitals that submitted AU data to NHSN compared to PA.



Summary of 2021 Reports of Carbapenemase-producing Organisms

By: Jenna Sinkevitch, MSPH

Carbapenemase-producing organisms (CPOs) are bacteria such as *Klebsiella, Escherichia coli (E. coli), Acinetobacter, Pseudomonas* and others that contain a highly transmissible carbapenemase enzyme that confers resistance to carbapenem antibiotics. These infections are a major public health concern because there are limited treatment options and because they are highly transmissible (CDC, 2019). **(Page 5)**

The Crafty CRAB: What You Need to Know about Carbapenem-resistant *Acinetobacter baumannii* (con't)

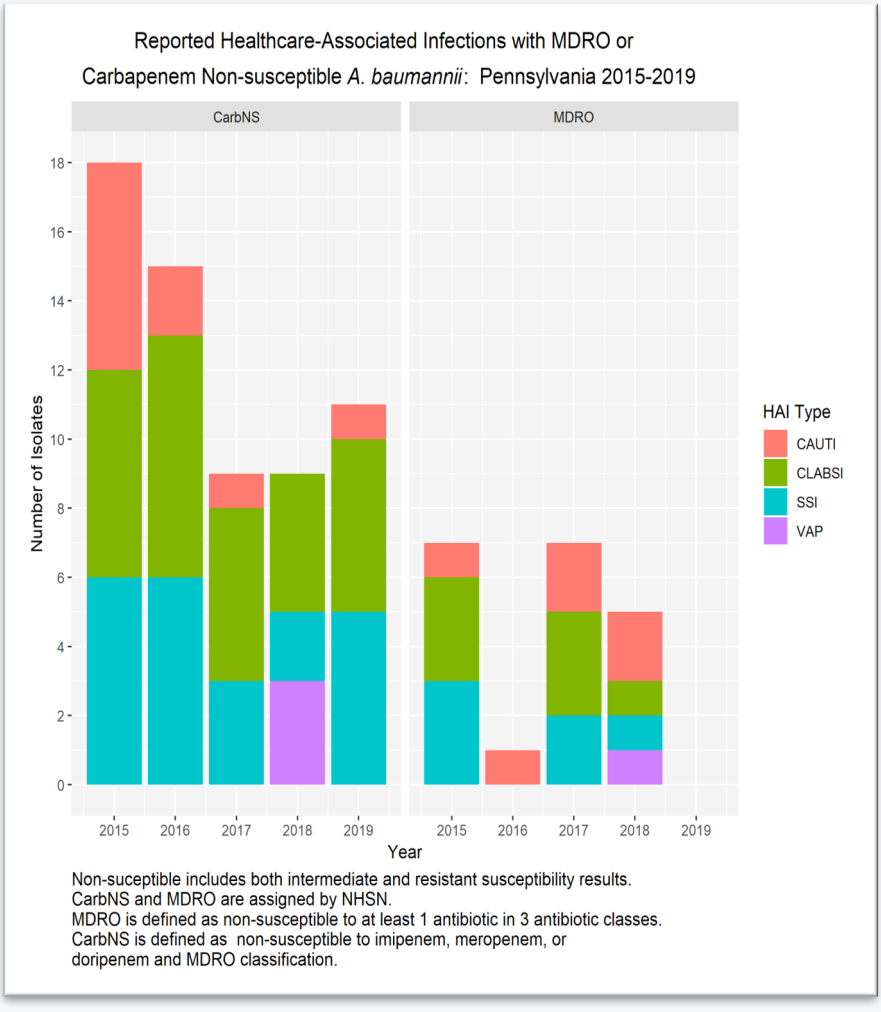
It is ubiquitous in the environment. Resistance to last resort drugs such as carbapenems further reduces treatment options for patients. Overall rates of carbapenem-resistant *Acinetobacter baumannii* (CRAB) cases have decreased in the United States; however, carbapenemase production in CRAB (CP-CRAB) is on the rise (CDC, 2019*)* and can spread to other bacteria through transfer of mobile genetic elements.

CP-CRAB are an urgent level threat for federal, state and local public health. Public health resources can be used to test clinical specimens with CRAB for carbapenemases.

Pennsylvania NHSN CRAB Data

In a review of the National Healthcare Safety Network (NHSN) data, Pennsylvania had 386 *Acinetobacter baumannii* healthcare associated infections (HAI) reported from 2015-2019. One hundred seventy-eight isolates were found to be multidrug-resistant and the percent resistant to carbapenems was 21.7% (n=62). Resistance profile or phenotype was not reported for all *A. baumannii* which makes it difficult to generalize this rate across the state.

The figure below shows the number of CRAB isolates identified in Pennsylvania (including Philadelphia) each year over that five-year span and the proportion contributed by type of HAI. Reported HAI events include central line associated bloodstream infections (CLABSI), catheter associated urinary tract infections (CAUTI), surgical site infections (SSI) and ventilator associated pneumonia (VAP).



Carbapenemase Mechanisms

In a review of Pennsylvania data excluding Philadelphia from August 1, 2019, to present, 20 CP-CRAB reports were investigated by state and local public health. The OXA-23 gene was detected in all of the cases. This epidemiologic trend, with OXA-23 gene being detected among most CP-CRAB isolates, is being observed across the nation.

Treatment Limitations and Innovations

CDC tracks and monitors *A. baumannii*, and the infections it can cause, through its Emerging Infections Program, known as EIP. Additionally, CDC works closely with partners, including public health departments, other federal agencies, healthcare providers, and patients, to prevent healthcare infections and to slow the spread of resistant bacteria. However, treatment options are becoming extremely limited as there are few new drugs in the development pipeline.

Bacteriophages are viruses that target and lyse bacteria without disrupting the host's normal flora and can multiply at the site of infection creating a self-limiting infection in the absence of the specific target. A 2017 report details treatment of a severely ill patient with a multidrug-resistant disseminated CRAB infection. The patient did not respond to multiple courses of antibiotics but was successfully treated with a personalized cocktail of nine different bacteriophages with activity against the patient's own *A. baumannii* isolate (Schooley, 2017). This successful case motivated the development in 2018 of the Center for Innovative Phage Applications and Therapeutics (IPATH) at the University of California. In 2020, Center researchers published a case report of 10 patients treated with phage therapy against different pathogens (Aslam 2020).

Response to CRAB

Multidrug-resistant *A. baumannii* are resilient bacteria that survive under a wide range of environmental conditions and persist for extended periods on surfaces making them a formidable cause of outbreaks in healthcare facilities. In response to recent increases of individual cases and outbreaks, healthcare facilities, laboratorians and public health must work together to ensure appropriate antibiotic use and strict adherence to infection prevention and control practices. Currently, the Antimicrobial Resistance Laboratory Network (ARLN) Regional Laboratory at the Maryland Department of Health is able to test CRAB isolates for carbapenemase-production and in conjunction with the Pennsylvania and Philadelphia HAI programs, to conduct colonization screening in response to a CRAB outbreak. ARLN resources are critical tools in our cooperative efforts to limit the spread of CRAB, especially carbapenemase-producing CRAB.

Tracking Antibiotic Use and Outcomes (con't)

NHSN calculates drug specific rates of AU per 1,000 days present for each care location. Use of the AU module in NHSN is a priority goal set forth in the United States National Strategy for Combating Antibiotic-Resistant Bacteria and by the President's Advisory Committee on Combating Antibiotic Resistant Bacteria. The Pennsylvania Department of Health strongly recommends that hospitals use NHSN to track their AU.

The next three CDC priorities, applicable to all facilities, are to track adherence to the policies that have been implemented through an intervention protocol. These policies are 1) audit and feedback 2) preauthorization and 3) adherence to facility-specific treatment recommendations. One performance measure used for tracking these interventions is adherence to the audit and feedback or facility-specific treatment recommendations; however, a variety of other associated process and outcome measures should be considered. (See the table located on page 4.)

The Department of Health recommends using data from electronic health records (EHR) to calculate additional performance measures. To assess the usefulness and feasibility of performance measures calculated from EHR files, the Duke Antimicrobial Stewardship Outreach Network (DASON) tested several of them among a group of hospitals. Consider reading their report which describes their findings and precise methods to calculate performance measures from EHR data.

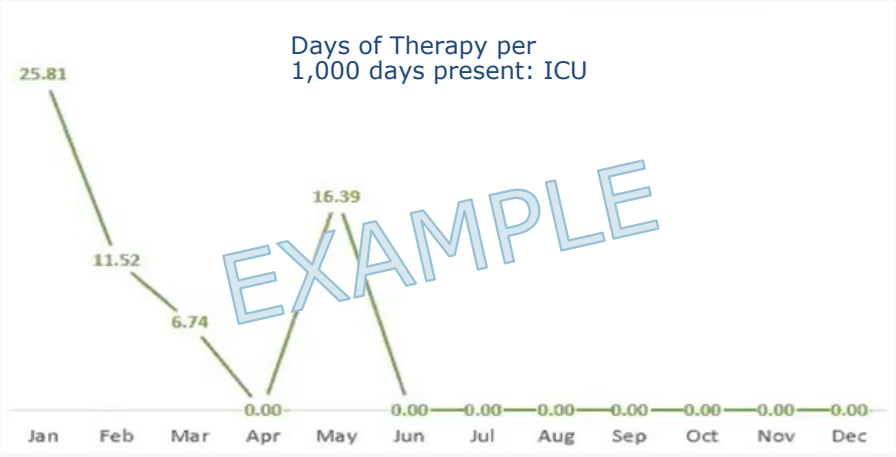
Table 1: Autogenerated graph produced by pre-populated Excel file after data is entered

Month	Total ABX Start Date	Patient Days Present-Acute Care	Rate Per 1000
Jan	2	465	4.30
Feb	2	[illegible]	4.61
Mar	1	445	2.25
Apr	1	425	2.35
May	2	427	4.68
Jun	2	0	#DIV/0!
Jul	0	0	#DIV/0!

When complete EHR data cannot be downloaded, facilities can use a spreadsheet to track AU data. In a March 2019 webinar, the American Hospital Association highlighted an Excel template to track AU data. This file automatically populates built-in charts to display location- and drug-specific AU rates (days per 1,000 patient days present) (Figure 1). Users enter or import patient information within one Excel worksheet and days present for specific hospital locations in another Excel worksheet (Table 1). Those data are analyzed within the Excel file to populate predetermined tables and associated charts. Antimicrobial starts per month are displayed by prescriber, antibiotic class, and indication (if those data are entered). This template will prove useful for interventions that target a small number of patients or antimicrobials.

Recently, there has been emphasis by CDC on outcome measures; however, process measures, which were predominantly used to evaluate the effectiveness of an ASP several years ago, (McGowan, 2012, Khadem, 2012) are still important to monitor. Without process measures, key information can be missed such as the causes of intervention failure and the percent of targeted population reached. In an evaluation of 179 hospitals' ability to adopt and refine an ASP, process measures were considered essential and limited the evaluation when they were not measured (Burgess, 2019). Some process measures may not be included in an ASP report, but they are essential to measure and monitor over time.

Figure 1: Autogenerated graph produced by pre-populated Excel file after data is entered



In conclusion, effective ASPs measure both process and outcome SMART measures. This includes measuring antimicrobial-specific use, which is the gold standard measure according to CDC, SHEA and IDSA. The Department of Health and CDC strongly recommend that every hospital submit AU data to NHSN and other facility types either export data from EHRs to calculate performance measures or manually enter AU data into template Excel files that have built in functions to calculate performance measures. Table 2 shows different process, outcome and antibiotic use measures that you may want to incorporate into your ASP.

Tracking Antibiotic Use and Outcomes (con't)

Table 2: Pennsylvania Department of Health Suggested Process, Outcome, and Antimicrobial Use Performance Measures

Process Measures	• Number of hospital staff who received the yearly or monthly ASP report • Percent of targeted staff who received antimicrobial educational training • Percent of targeted staff who passed an ASP competency assessment the first time • Percent of targeted patients whose records were reviewed by experts working on intervention • Percent of patients where recommendation was successfully communicated to the prescriber • Percent of patients where guideline, formulary agent, protocol or bundle was followed ǂ • Percent of antibiotics deemed appropriate § • Percent of targeted patients where antibiotic use was appropriate • Time between request for expert review and recommendation being issued • Time between delivery of recommendation and implementation (or receipt) of recommendation by the prescriber • Percent of targeted patients with appropriate culture results obtained prior to start of antibiotic ǂ • Percent of patients converted from intravenous to oral medication ǂ • Percent change of empirical therapy to pathogen-directed therapy when culture results become available ◇
Outcome Measures	• Clinical outcomes ♦ Length of stay ♦ Cure rates – or clinical failure rates • Adverse events ♦ Rate of adverse drug reactions § ♦ Percent or number of infections classified as multi-drug resistant § ♦ Hospital-onset C. difficile infection rate ◇ ♦ Healthcare associated C. difficile infection rate ◇ ♦ Rate of unintended consequences of intervention § ♦ Risk-adjusted mortality rates – 30 day or infection-related mortality ♦ Unplanned 30-day hospital readmission rate ǂ • Costs* (Begin monitoring prior to start date of intervention.) ♦ Percent of pharmacy budget spent on antimicrobials ♦ Antimicrobial cost per month ♦ Antimicrobial cost per patient day ♦ Cost per admission ♦ Cost among those readmitted
Antimicrobial Use Measures	• Days of therapy per patient days or days present– overall or for specific agents or groups of agents or for specific locations or for different conditions or for different physicians (preferred metric over defined daily dose) ◇ • Defined daily dose per 1,000 patient days (if days of therapy not available) Φ • Redundant therapy rate ◇ • Standardized antibiotic administration ratio • Days inpatient and outpatient antimicrobial use per admission ◇ • Antimicrobial-free days • Percent appropriate antibiotic use among all days used

Evaluated by DASON and classified outcome metrics as ◇ useful and feasible, or ǂ feasible but not routine, or § not feasible or Φ feasible but not useful.

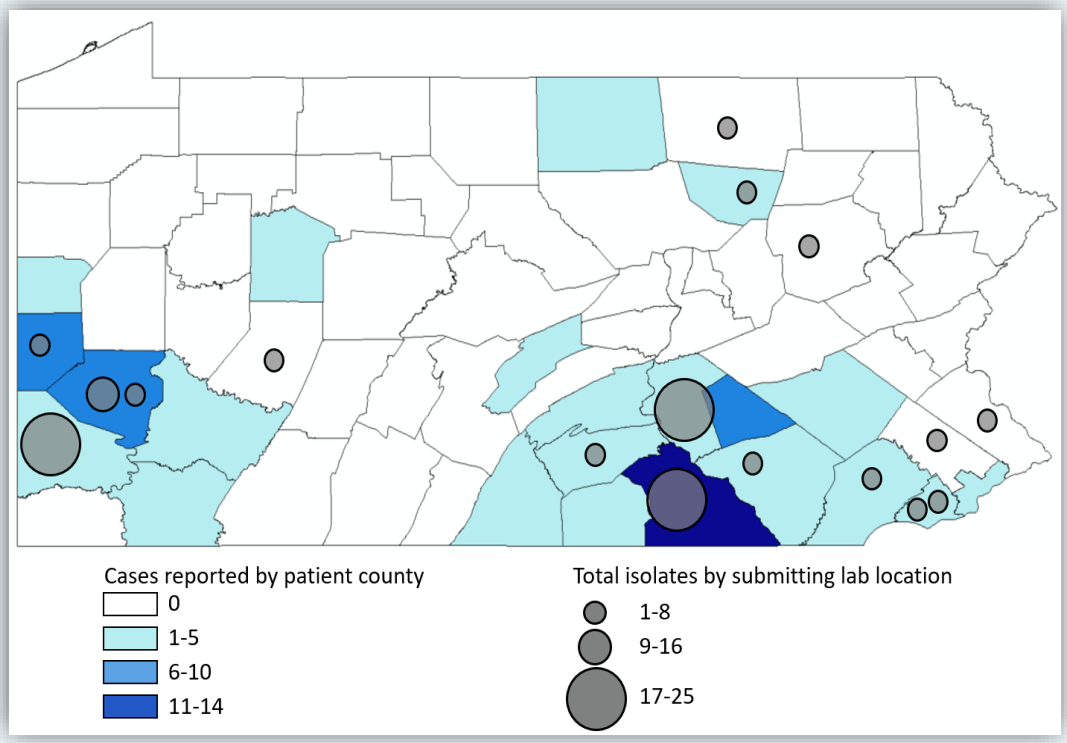
Summary of 2021 Reports of Carbapenemase-producing Organisms (con't)

Patients within healthcare facilities are at greatest risk for CPOs because transmission can occur from direct person-to-person contact from colonized healthcare personnel to patients or through contaminated surfaces (Logan & Weinstein, 2017). The Pennsylvania Department of Health (PA DOH) Healthcare-associated Infection Prevention & Antimicrobial Stewardship (HAIP/AS) program receives CPO reports through voluntary report for all PA counties except Philadelphia. Summary data for 2021 reports are outlined below.

Table 1. Patient characteristics of confirmed CPO cases, Pennsylvania (excluding Philadelphia), 2021 (N=82)

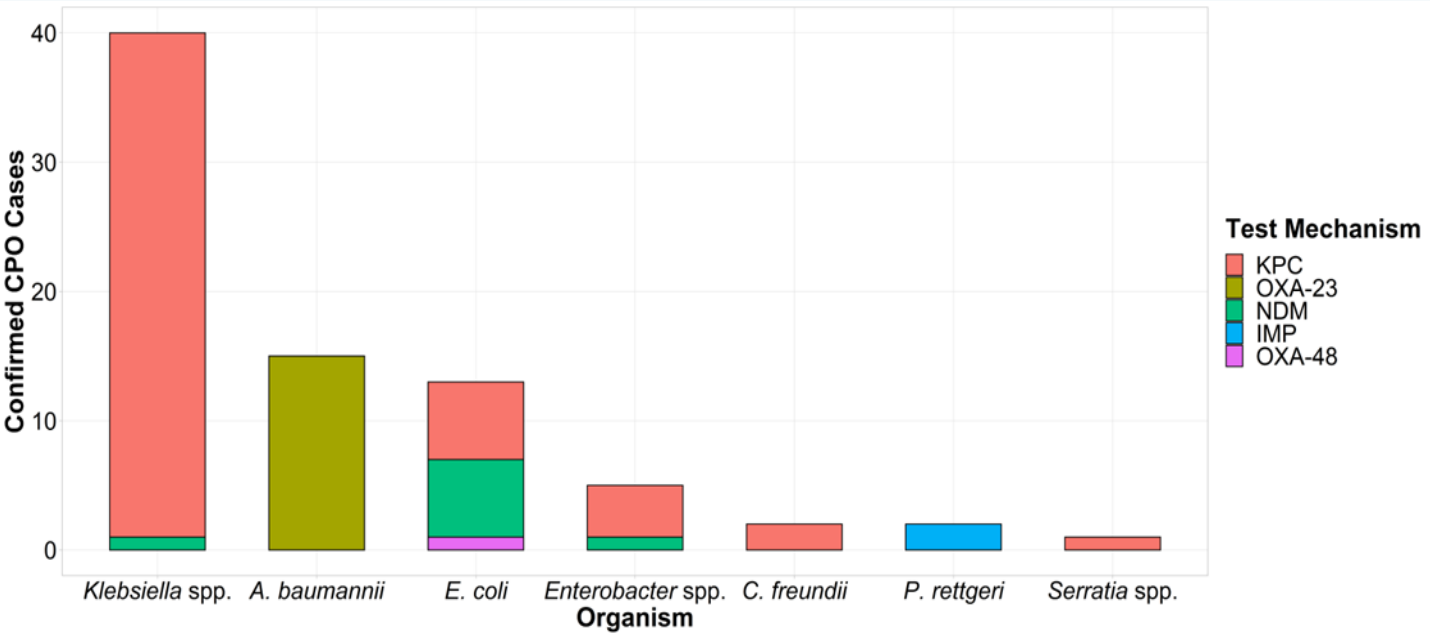
Patient Characteristics	Total (N=82)
Age (Median (range))	72 (30, 93)
Sex (n (%))	
Female	46 (56)
Male	36 (44)
Hospitalized in prior 30 days? (n (%))	
Yes	61 (74)
No	19 (23)
Unknown	2 (2)
LTCF Resident? (n (%))	
Yes	35 (43)
No	43 (52)
Unknown	4 (5)

Figure 1. Total CPO isolates by lab submitter location and number of confirmed CPO cases by patient county, 2021 (N=102)



Summary of 2021 Reports of Carbapenemase-producing Organisms (con't)

Figure 2. CPO organism stratified by test mechanism, Pennsylvania (excluding Philadelphia), 2021 (N=78)



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Quarterly Data Update

Antimicrobial Resistant Organisms Reported in Pennsylvania

Carbapenemase	Quarter 1 -2022 (1/1/2022 – 3/31/2022)			
	CRE	CRAB	CRPA	Total by Mechanism
KPC	12	0	0	12
NDM	3	0	0	3
IMP	0	0	0	0
OXA-like	0	5	0	5
VIM	0	0	0	0
Carbapenemase detected by phenotype, no genotype detected	1	0	1	2
Total by Organism	16	5	1	22

	Clinical	Colonized	Total
Candida auris	7	6	13

Abbreviations: CRE=Carbapenem-resistant *Enterobacterales*; CRAB=Carbapenem-resistant *Acinetobacter baumannii*; CRPA=Carbapenem-resistant *Pseudomonas aeruginosa.* Learn more about carbapenemases and CRE at CRE Technical Information | CRE | HAI | CDC

*Data include all counties in PA except for Philadelphia. The counts were captured through voluntary reporting by health care facilities and laboratories, including the PA Bureau of Laboratories. To view Philadelphia's surveillance data, please visit their website at https://hip.phila.gov/data-reports-statistics/healthcare-associated-infections .

We would love to feature your facility or lab as a success story in a future edition of *The Steward*

Please send a brief summary related to preventing antimicrobial resistance or promoting stewardship activities to our resource mailbox:

News You Can Use

Comprehensive Stewardship in Nursing Homes

A recent report in the American Journal of Infection Control described a national survey that was conducted in 2018 which evaluated characteristics of nursing homes with comprehensive antimicrobial stewardship programs (ASP). The survey concluded that infection control training and partnerships with Quality Innovation Network-Quality Improvement Organization (QIN-QIOs) can support nursing homes to increase ASP comprehensiveness. The full text can be found at this link.

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