

Carbapenem-Resistant Organisms (CROs) and Carbapenemase-Producing Organisms (CPOs): Infection Prevention and Control for Healthcare Facilities



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CROs/CPOs are a Public Health Concern

What Are Carbapenem-Resistant Organisms (CROs) and Carbapenemase-Producing Organisms (CPOs)?

- Bacteria that are resistant to carbapenem antibiotics are called carbapenem-resistant organisms (CROs). Carbapenems are a class of broad-spectrum antibiotics reserved to treat serious multidrug-resistant infections, often the last resort for treatment. This antibiotic class includes: ertapenem, imipenem, and meropenem.
- CROs can be characterized by the bacteria’s family or genus/species. Carbapenem-resistant Enterobacterales (CRE) include carbapenem-resistant *E. coli* and carbapenem-resistant *Klebsiella pneumoniae*. Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA) and carbapenem-resistant *Acinetobacter baumannii* (CRAB) may also be encountered in healthcare settings.
- Carbapenemase-producing organisms (CPOs) are CROs that produce enzymes called carbapenemases. These enzymes allow the bacteria to break down antibiotics used to treat them. When carbapenemases are on mobile genetic elements (i.e., plasmids), it is easier to transmit resistance genes within and between bacterial species and, subsequently, between patients. Early detection and implementation of infection prevention and control strategies are necessary to prevent widespread transmission of CROs/CPOs.
 - Often in healthcare facilities a CRO is first identified through a laboratory culture. With review of the antibiotic susceptibility report, it will show the organism as resistant to one or more carbapenems.
 - Many healthcare facilities do not have the laboratory capability to detect a CPO. This is usually identified from testing at a public health laboratory (e.g., Division of Consolidated Laboratory Services) or reference laboratory.

Table 1. Examples of Carbapenemases Found in Virginia

Carbapenemases	Comments
Imipenemase metallo-β-lactamase (IMP)	Endemic to areas outside of the United States
<i>Klebsiella pneumoniae</i> carbapenemase (KPC)	Most widespread in the United States; more commonly seen in Enterobacterales compared to other gram-negative organisms
New Delhi metallo-β-lactamase (NDM)	Endemic to areas outside of the United States; increasing reports of United States residents without international healthcare exposure
Oxacillinase-type carbapenemases (OXA)	Different subtypes such as OXA-48 or OXA-23
Verona Integron-encoded metallo-β-lactamase (VIM)	Endemic to areas outside of the United States; more commonly seen in <i>Pseudomonas</i> spp. that produce a carbapenemase

Why Are We Concerned About CPOs?

They are becoming more common

- CROs/CPOs are an epidemiologically important group of multidrug-resistant organisms (MDROs) classified by the Centers for Disease Control and Prevention (CDC) as an urgent threat to public health.
- [CPO cases in Virginia are on the rise and have been detected in all regions of Virginia.](#)
- Case counts are available on the [Virginia Department of Health's Carbapenemase-Producing Organisms data dashboard.](#)

They can cause serious infections that are difficult to treat

- CROs/CPOs may cause many types of infections, affecting the blood, respiratory tract, urinary tract, and wounds. These infections are resistant to multiple antibiotics, so they have limited treatment options.
- Infections caused by these organisms are associated with higher mortality rates among hospitalized patients, up to [40-50% in some studies.](#)
- Healthy people usually do not get CRO/CPO infections, but there are certain patients/residents at higher risk which includes those who:
 - Require devices like ventilators, urinary catheters, or intravenous catheters
 - Are taking long courses of certain antibiotics
 - Are immunocompromised
 - Have received international healthcare

They transmit easily from person to person, especially in the healthcare setting

- CROs/CPOs have caused outbreaks in healthcare facilities.
- CROs/CPOs can be carried on the skin without signs of infection (colonization) and can be spread to others.
 - CROs/CPOs most frequently colonize the gut but can occur in other body sites such as wounds or urine.
- They spread through contact with affected patients/residents, contaminated hands, surfaces and shared medical equipment.
 - Spread of CROs/CPOs can occur as healthcare workers come into contact with these areas that have not been appropriately cleaned/disinfected, if personal protective equipment (PPE) is used improperly, or if appropriate hand hygiene practices are not followed.
- CROs/CPOs can be persistent in the environment and live on surfaces for several weeks to months.
 - Additionally, sink drains and toilets are increasingly recognized as an environmental reservoir and CRO/CPO transmission source.

Early detection and implementation of infection prevention and control strategies are necessary to prevent further spread of CROs/CPOs.

How Do We Contain the Spread?

CROs/CPOs can be contained by using core infection prevention measures: Enhanced Barrier Precautions (nursing homes only) or Contact Precautions, hand hygiene, personal protective equipment (PPE), environmental cleaning and disinfection, water management, and communication. The following sections will cover each measure in detail.

Contact Precautions and Enhanced Barrier Precautions (EBP)

All patients/residents who have been identified to have CRO/CPO colonization or infection need to be placed on appropriate precautions. CDC recommends continuing Contact Precautions or Enhanced Barrier Precautions (nursing homes only) for the entire duration of the healthcare encounter. In a nursing home, a resident may be de-escalated from Contact Precautions to EBP when clinically appropriate (e.g., when a draining wound that is positive for a CPO heals such that it is able to be covered or contained).

- **Contact Precautions**
 - Contact Precautions (gown and glove upon room entry) should always be used in the acute care setting and in all healthcare settings if a patient/resident has acute diarrhea, draining wounds, or other sites of secretions or excretions that are unable to be covered or contained.
 - Dedicate non-critical patient/resident care equipment (e.g., stethoscope, blood pressure cuff) to the room if feasible.
- **Enhanced Barrier Precautions (EBP)** (only applicable in nursing homes)
 - EBP can be used for a resident with a CRO/CPO infection or colonization who does not meet criteria for Contact Precautions.
 - For a limited period of time during a suspected or confirmed MDRO outbreak investigation, Contact Precautions should be used in place of EBP.
 - EBP involves the use of gown and gloves for high-contact resident care activities only.
 - For more information refer to CDC's [Implementation of Personal Protective Equipment \(PPE\) in Nursing Homes to Prevent Spread of Multidrug-resistant Organisms \(MDROs\)](#).
 - See the *Educational Resources and References* section of this document for resources to aid with EBP implementation.
- Regardless of the type of precautions, place a sign exterior to the patient's/resident's door to indicate the type of precautions and PPE needed
 - [Contact Precautions signage](#)
 - [EBP signage](#)

Patient/Resident Placement

Whenever possible, a single room is the preferred placement for a patient/resident with a CRO/CPO infection or colonization.

In nursing homes:

- Single-person rooms (if available) should be prioritized for residents who have other communicable diseases (such as influenza, SARS-CoV-2) or for residents placed on Contact Precautions for presence of acute diarrhea, draining wounds, or other sites of secretions or excretions that are unable to be covered or contained.
- Residents on EBP may share rooms with other residents. Facilities with capacity to offer single-person rooms or create roommate pairs based on MDRO colonization or infection may choose to do so. If there are multiple residents with the same MDRO in the facility, they may be cohorted in a room with a private bathroom. During an outbreak, the local health department may make further recommendations on resident placement in your facility.

In hospitals:

- If single-person rooms are limited or not available, prioritize single rooms for patients who have other communicable diseases or those with acute diarrhea, draining wounds, or other sites of secretions or excretions that are unable to be covered or contained.
- When making cohorting decisions, only place patients together if they have the same CPO resistance mechanism (e.g., NDM) and other communicable disease diagnoses (e.g., both patients co-infected with *Candida auris*).

When patients/residents are placed in shared rooms, facilities must implement strategies to help minimize transmission of pathogens between roommates including:

- Maintaining spatial separation of at least 3 feet between beds to reduce opportunities for inadvertent sharing of items between the roommates
- Use of privacy curtains to limit direct contact
- Cleaning and disinfecting any shared reusable equipment between the roommates (or dedicating equipment to a single person)
- Cleaning and disinfecting environmental surfaces on a more frequent schedule
- Changing PPE (if worn) and performing hand hygiene when switching care from one roommate to another

During an outbreak, if possible, consider dedicating staff to patients/residents with a CPO for the entire shift.

Personal Protective Equipment (PPE)

Supplies

- Ensure you have:
 - A designated area to put on and take off PPE
 - Sufficient PPE supplies available
 - Appropriate signage in place on the door that directs healthcare workers and visitors about what they need to do when entering the room.

Training

- Have staff received an annual in-service on how to put on and take off PPE?
 - If yes, a reminder of proper technique may be useful.
 - If no, all staff should receive an inservice on how to put on and take off PPE which includes direct observation of technique (competency validation) as soon as possible.

Auditing

- Audits of PPE use should be done on all shifts. Observations should include:
 - Does hand hygiene occur prior to putting on PPE?
 - Is PPE put on prior to entering the room (or prior to high-contact care activity, if resident is on EBP)?
 - Is the right PPE used?
 - Is the sequence for putting on and taking off PPE done correctly?
 - Does the healthcare worker avoid performing other job tasks outside the room while wearing PPE?
 - Is PPE removed inside the room?
 - Does hand hygiene occur after PPE has been removed?

Hand Hygiene

Supplies

- Make sure all supplies for hand hygiene are available and easily accessible.
 - Are hand sanitizer products in date?
 - Who is responsible for filling soap and alcohol-based hand sanitizer (ABHS) dispensers?
 - Are ABHS dispensers located in convenient locations for patient/resident care?
 - Are hand washing sinks clear of obstructions? Keep patient/resident care items out of the splash zone (~3 ft on each side of the sink).

Training

- Have all staff received hand hygiene inservices which includes observation of technique (competency) in the past year?
 - If yes, a reminder of proper technique would be beneficial. Try posters, roving inservices, or other strategies that meet your facility's needs.
 - If no, schedule an inservice for all staff with competency validation as soon as possible.

Auditing

- Conduct hand hygiene audits on all shifts for
 - **Correct technique** - use the correct product, cover all surfaces of the hand including the thumbs.
 - **Proper time** – if soap and water, 15-20 seconds; if hand rub, until product evaporates
 - **Right opportunity** - before touching the patient/resident, after contact with patient/resident or surroundings, before putting on PPE, after contact with body fluids, before assisting with an aseptic procedure, after taking off PPE, and upon exiting the room.
- Just-in-time teaching: Correct the action when you see it. Gentle coaching is an effective way to change poor practices.
- Share audit results on a routine basis with frontline staff and facility leadership.

Environmental Cleaning and Disinfection

Actions for Environmental Cleaning

- Check all disinfectant products currently in use to determine if they are effective against CROs/CPOs.
 - Refer to the disinfectant's label to see if it has kill claims for CROs like Enterobacteriales (e.g., *E. coli*, *Klebsiella pneumoniae*), *Acinetobacter baumannii*, or *Pseudomonas aeruginosa*.
- Identify high-touch surfaces, any area where the patient/resident or the staff would have frequent contact with during daily activities and are most likely to be contaminated.
 - Use a risk assessment approach within each clinical area of your facility. Add all high-touch surfaces to your cleaning responsibility grid and review with staff.
 - Patient/resident rooms would include surfaces such as bed controls, bed rails, light switches, bedside tables and tables and surfaces touched by healthcare personnel (doorknobs, light switches, sink handles, medical equipment).
 - The nurses station would include commonly touched items by multiple personnel throughout the workday like phones and computer keyboards.
- Establish clear responsibilities for who cleans what and how often it must be cleaned.
 - This should distinguish between what the Environmental Services (EVS) department cleans and what nursing or other departments clean.

Example of Cleaning Responsibility Grid

Item	Cleaning Frequency	Responsible Discipline	Disinfectant used and contact time
Floors	Once per day	EVS	
Hand rails	Once per day	EVS	
Isolation carts	Once per shift	Nursing	
Door handles	Once per day	EVS	
Medication dispense system	Once per shift	Nursing	
Medication carts	Once per shift	Nursing	
Privacy curtains	Terminal clean or when visibly soiled	EVS	
Keyboards	Once per shift	Staff member using the computer or if taken into a patient/resident's room	
Shared medical equipment (scales, lift equipment, BP cuffs, gait belts, exercise bands, etc.)	After each use	Staff member using equipment	

An editable version of an environmental cleaning and disinfection responsibilities chart is available on the [VDH website](#).

- Provide inservices for all staff on cleaning and disinfection
 - Do staff understand the difference between cleaning and disinfection?
 - Do staff know the contact time for all products they use?
 - Do staff know what the high-touch surfaces and frequency of cleaning and disinfection are?
- Round with the EVS director and conduct audits of environmental cleaning. Share audit results with frontline staff and facility leadership.
 - Is the room cleaned systematically - clean to dirty?
 - Are cleaning rags replaced when moving to a clean area?
 - Do EVS staff wear PPE when cleaning in an isolation room?
 - Do EVS staff perform hand hygiene appropriately?
 - If an isolation room is cleaned, is the mop head replaced and clean water placed in the bucket?
 - If the room is double occupancy, cleaning should occur as if each bed were a different room, including changing clean cloths, cleaning equipment, and replacing mop heads between each bed area.
- Ensure you have you have a method to determine between clean and dirty equipment
 - If not in place, establish a protocol.
 - If a protocol is in place, is it being followed? Consistently on all shifts? Can staff speak to the protocol if questioned?

Water Exposure Safety to Prevent CPO Risks

Water can carry germs that threaten patient safety and spread antimicrobial-resistant pathogens or cause healthcare-associated infections (HAIs). Sinks, drains and plumbing can become contaminated with MDROs, like CPOs. When the drug-resistant bacteria stick to pipes, they form biofilms. These biofilms can persist for a long period of time and are often difficult to remove.

Since different pathogens may contaminate the same pipe or drain, they can often be a site where antibiotic resistant genes transfer between bacterial species. Healthcare facilities can reduce these water-based MDRO risks through infection prevention practices and the [water management](#) program.

Infection prevention practices to help reduce exposure risks of CPOs in sinks and drains:

- Avoid placing patient care or personal items on counters next to sinks.
- Do not discard patient/resident waste down sinks and minimize discarding beverages down sinks or toilets.
- Clean and disinfect surfaces near the drain, including the sink basin, faucet, faucet handles, and surrounding counter-top daily.
- Close hopper and toilet lids before flushing. If lids are not available or allowed due to local plumbing codes, close any door that separates the hopper or toilet from other patient care areas.
- Install splash guards on sinks next to medication preparation areas.
- Use an EPA-registered biofilm disinfectant for wastewater drains during an outbreak.
- Refer to the CDC [Considerations for Reducing Risk: Water in Healthcare Facilities](#) for additional water management program components.

Communication: To Residents, Healthcare Workers, and Other Facilities

Patient/Resident Communication

Ensure that the patient/resident (or their medical decision maker, when appropriate) is aware of a CRO/CPO diagnosis. Here is an example of a notification:

To the resident and those authorized to receive health information:

“You (or your loved one) have tested positive for a CRO/CPO. CRO/CPO is a drug-resistant germ (bacteria) that can spread from person to person.”

If the patient/resident has a CRO/CPO infection: “The CRO/CPO is currently causing an infection in your [wound/blood/urine] and we will be treating this infection.”

If the patient/resident tested positive for colonization of CRO/CPO: “You are not sick from a CRO/CPO right now but the germ could still spread to other residents or staff.”

“We will be taking extra precautions like wearing gowns and gloves [and giving you care in your room, whenever possible (if patient/resident is on Contact Precautions)] to make sure the germ doesn’t spread to others. We will also be cleaning our hands a lot and encourage you to do the same.”

- Emphasize the importance of informing other healthcare providers of their history of having a CRO/CPO so that interventions can be implemented to prevent spread in the healthcare environment.

Healthcare Worker Communication

- Add a flag or alert to the patient/resident’s medical record to heighten awareness of their CRO/CPO infection or colonization.
- The Emergency Department Care Coordination (EDCC) system also has alerts for Virginia residents who have a confirmed case (infection or colonization) of *Candida auris* or a carbapenemase-producing organism. Healthcare facilities are encouraged to participate in this system and enable these alerts. For more information about this system, refer to the [EDCC website](#).
- Make sure the patient’s/resident’s CPO status is communicated to ensure healthcare workers understand how to care for a patient/resident with a CRO/CPO. This is important if the patient/resident is transferred within the facility. Here is an example of how to talk to a healthcare worker about a patient/resident with a new CRO/CPO diagnosis:

“This patient/resident is now positive for CRO/CPO and requires [Contact Precautions or Enhanced Barrier Precautions]. You must wear gown and gloves [every time you go into the room (if Contact Precautions) / every time you are doing a high-contact resident care activity (if Enhanced Barrier Precautions)], clean equipment after use, and always do good hand hygiene. CRO/CPO can cause healthcare outbreaks. This puts all our patients/residents at risk so it is important to be consistent with these infection prevention measures.”

Communication to Other Facilities

- When transferring a patient/resident to another healthcare facility, the patient/resident’s history of a CRO/CPO (colonization or infection) should be clearly communicated to the receiving facility. CDC has an example of an [interfacility communication form](#).
- It is also important to communicate the patient/resident’s CRO/CPO status to outside providers such as dialysis, wound care, and physician offices.

Virginia Department of Health Response

Reporting

In Virginia, a systematic public health response and investigation occurs upon identification of every CPO case. CPOs were added to the [Virginia Reportable Disease List](#) in 2018 and responsibility for reporting the presence of these organisms rests with physicians, directors of medical care facilities, and directors of laboratories. Because of the special laboratory testing needed to identify and confirm these organisms, it is expected that laboratories will be the primary responsible party for reporting these organisms.

Refer to the [HAI/AR CRO](#) webpage for additional reporting information.

Investigations

Upon confirmation of a carbapenemase-producing Enterobacterales or carbapenemase-producing *Pseudomonas aeruginosa* organism, the local health department will work with the facility/provider to implement the [CDC Containment Strategy for Novel or Targeted Multidrug-resistant Organisms](#). Goals of this investigation include:

1. Identifying if transmission is occurring;
2. Identifying affected patients/residents, such as roommates and high-risk healthcare contacts;

3. Ensuring appropriate control measures are promptly initiated/implemented to contain potential spread; and
4. Characterizing the organism or resistance mechanism to guide additional response actions, patient management, and future responses.

What you can expect when collaborating with your [local health department](#) on the investigation:

1. **Gathering and sharing information** about the patient/resident. The health department will need to know details of the patient/resident's medical history, healthcare facility stay, and infection prevention measures that have been in place. Information requested may include:

- Admission information (Date; admitted from another facility? If so, which one?)
- Placement in a private vs semi-private room?
- Was the patient/resident on Contact Precautions or EBP? If so, when?
- Movement through your facility during their stay
- Discharge information (Date; If discharged – where?)
- General medical history questions
- Does the patient/resident have any indwelling medical devices?

This information will help determine risk factors for spread within the facility and if there are any affected patients/residents.

2. Discussing plans for an **onsite visit**, including an infection prevention assessment.
 - An onsite visit is typically a part of the VDH investigation to help the facility respond to the case using the best infection prevention practices and decrease risk to other patients/residents.
3. Discussing plans for **colonization screenings**
 - Colonization screening is a CDC-recommended intervention that can help stop the spread of CPOs within a healthcare facility.
 - The health department may request screening of close contacts (e.g., roommates, shared bathrooms) to determine if the CPO has spread to other patients/residents in the facility.
 - VDH may also recommend screening a larger number of patients/residents to determine if the CPO has spread to other patients/residents in the facility as well.
 - For patients/residents who are awaiting colonization screening results, refer to [CDC guidance](#) to determine room placement and whether to use Contact Precautions (or Enhanced Barrier Precautions, for nursing home residents when Contact Precautions do not otherwise apply). Contact your [local health department](#) if guidance on determining appropriate precautions is needed.

Colonization Screening

Free colonization screenings are available to facilities through public health laboratories.

- The preferred specimen source for CPO colonization screening is a rectal swab.
 - When screening for carbapenem-resistant *Acinetobacter baumannii* (CRAB) or carbapenem-resistant *Pseudomonas aeruginosa* (CRPA), health departments may recommend sampling additional body sites to increase sensitivity; these may include respiratory specimens, wounds, and the skin (e.g., axilla, groin).
 - When considering colonization screening for CPOs at non-rectal sites, consult with public health and the laboratory to identify which sites are best.
 - When screening for carbapenemase-producing *Acinetobacter baumannii* (CRAB) or carbapenem-resistant *Pseudomonas aeruginosa* (CRPA), health departments may wish to sample additional body sites to increase sensitivity; these sites can include respiratory specimens, wounds, and the skin (e.g., axilla/groin; for CRAB only).
 - The epidemiology of known cases and the performance characteristics of the available tests should inform the choice of additional sites.
 - For example, if several clinical cases were found from respiratory cultures from patients on a ventilator unit, the addition of respiratory screening cultures could be considered.
 - When considering colonization screening for CPOs at non-rectal sites, consult with the laboratory that will conduct the screening to determine what specimen types are validated for testing and the recommended approach based on the context for screening (e.g., acute outbreak vs prevention, setting in which screening will be performed).
 - In general, CDC does not recommend screening individuals with a history of CPO colonization or infection to assess for decolonization to inform discontinuation of infection prevention measures (e.g., Contact Precautions in acute care settings and EBP in nursing homes).

Educational Resources and References

CDC

- Facility Guidance for CRE
 - <https://www.cdc.gov/cre/hcp/infection-control>
- Frequently Asked Questions for CPO Screenings and Example Verbal Scripts
 - <https://www.cdc.gov/healthcare-associated-infections/media/docs/Screening-FAQs-verbal-consent-example.docx>
- Information for Facilities
 - CRAB: <https://www.cdc.gov/healthcare-associated-infections/media/pdfs/CRAB-handout-V7-508.pdf>
 - CRE: <https://www.cdc.gov/healthcare-associated-infections/media/pdfs/CRE-handout-V7-508.pdf>
 - CRPA: <https://www.cdc.gov/healthcare-associated-infections/media/pdfs/CRPA-handout-V7-508.pdf>
- Multidrug-Resistant Organism Containment Strategy Guidelines
 - <https://www.cdc.gov/healthcare-associated-infections/php/preventing-mdros/mdro-containment-strategy.html>
- Water Management
 - Considerations for Reducing Risk: Water in Healthcare Facilities
 - <https://www.cdc.gov/healthcare-associated-infections/php/toolkit/water-management.html>
 - Healthcare Facility Water Management Program Checklist
 - <https://stacks.cdc.gov/view/cdc/80910>
 - Infection Control Assessment and Response Tool: Water Exposure Facilitator Guide
 - <https://www.cdc.gov/infection-control/media/pdfs/IPC-mod11-water-exposure-508.pdf>
 - Water Infection Control Risk Assessment for Healthcare Settings
 - <https://www.cdc.gov/healthcare-associated-infections/media/pdfs/water-assessment-tool-508.pdf>
- Vital Signs: Carbapenem-Resistant Enterobacteriaceae (2013)
 - <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6209a3.htm>

VDH

- Carbapenem-Resistant Organisms Website
 - <https://www.vdh.virginia.gov/haiar/cro/>
- CPO Case Counts in Virginia
 - <https://www.vdh.virginia.gov/haiar/carbapenemase-producing-organisms-quarterly-report/>
- CRE Fact Sheet
 - <https://www.vdh.virginia.gov/epidemiology/epidemiology-fact-sheets/carbapenem-resistant-enterobacteriaceae-cre/>

- CRO/CPO Infection Prevention in Acute Care and Long-Term Acute Care Facilities
 - <https://www.vdh.virginia.gov/content/uploads/sites/174/2023/04/Carbapenem-Resistant-and-Carbapenemase-Producing-Organisms-Infection-Prevention-in-Acute-Care-and-Long-Term-acute-Care-Facilities.pdf>
- CRO/CPO Infection Prevention in Long-Term Care Facilities
 - <https://www.vdh.virginia.gov/content/uploads/sites/174/2023/04/Carbapenem-Resistant-and-Carbapenemase-Producing-Organisms-Infection-Prevention-in-Long-Term-Care.pdf>
- CRO/CPO Quick Guide for Nursing Home Infection Preventionists
 - https://www.vdh.virginia.gov/content/uploads/sites/174/2023/09/Quick-Guide_CROs-and-CPOs_FINAL.pdf
- CPO Colonization Screening Information
 - https://www.vdh.virginia.gov/content/uploads/sites/174/2019/11/Attach_F1_CPO-Colonization-Screening-Recommendations-11.22.19.pdf
- CPO Containment Strategy
 - <https://www.vdh.virginia.gov/content/uploads/sites/13/2019/08/CPO-Containment-Strategy.pdf>
- CRPA Fact Sheet
 - <https://www.vdh.virginia.gov/epidemiology/epidemiology-fact-sheets/carbapenem-resistant-pseudomonas-aeruginosa-crpa/>
- Frequently Asked Questions About Onsite Infection Control Assessments
 - https://www.vdh.virginia.gov/content/uploads/sites/174/2019/11/Attach_G2_-Infection-Prevention-Assesments-FAQ_final.pdf
- HAI/AR Program Newsletter: CPO Special Edition
 - https://www.vdh.virginia.gov/content/uploads/sites/13/2018/09/HAI-High-Sign_CPO-Special-Edition.pdf
- Virginia Reportable Disease List
 - <https://www.vdh.virginia.gov/content/uploads/sites/134/2023/03/VIRGINIA-REPORTABLE-DISEASE-LIST.pdf>

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- Rossow, Stephanie. (2019). CDC/Antibiotic Resistance Coordination and Strategy Unit <https://phil.cdc.gov/Details.aspx?pid=23241>