Texas Antibiotic Resistance Lab Network Response Plan and Epi-Lab Work Plan

Developed by:
Texas Department of State Health Services Laboratory and Healthcare Safety Unit

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Introduction

Background

According to the Centers for Disease Control and Prevention’s (CDC) *2019 Antibiotic Resistance Report in the United States*, more than 2.8 million antibiotic resistant infections occur each year, resulting in more than 35,000 deaths.\(^1\) CDC categorizes antibiotic resistant threats based on three levels of concern to human health: urgent, serious, and concerning. Urgent threats include Carbapenem-resistant Enterobacterales (CRE), Carbapenem-resistant *Acinetobacter baumannii* (CRAB), and *Candida auris*. Serious threats include extended-spectrum beta-lactamase (ESBL)-producing Enterobacterales and multidrug-resistant (MDR) *Pseudomonas aeruginosa*.\(^1\) Concerning threats include Erythromycin-resistant group A *Streptococcus* (GAS), and Clindamycin-resistant group B *Streptococcus* (GBS).\(^1\)

These organisms each represent emerging threats to public health because they can cause infections associated with high mortality, are highly transmissible, and have high potential for community spread. Treatment options against these organisms are limited, and it could be years before new compounds are available to treat them.

The Antibiotic Resistance Laboratory Network (AR Lab Network) was established by CDC in 2016 to expand antibiotic resistance (AR) testing capacity to detect and respond to emerging resistance in the United States.\(^2\) Prior to 2016, the CDC operated the only public health sentinel surveillance program for AR in the United States.

The inception of the AR Lab Network augmented the national public health laboratory infrastructure by connecting regional and local laboratories to better coordinate responses to the emerging resistance. The result has been an increase in testing capacity for all 50 states and five local jurisdictions.\(^3\) The AR Lab Network has provided faster detection of resistant organisms for a rapid and better coordinated public response, as well as created communication channels to engage clinical laboratory partners nationwide.

The Texas AR Laboratory, within the Texas Department of State Health Services (DSHS) in Austin, TX, has served as both the Mountain Region AR Laboratory (from 2016 to 2019) and the AR Lab Network state participating laboratory (from 2016 to present). The Laboratory has been performing AR testing and coordinating with Texas healthcare providers, other Mountain Region states, the City of Houston, and CDC programs since 2016. The Texas AR Laboratory has made significant
contributions to the AR Lab Network by expanding testing capacity and adopting new testing and reporting technologies. These contributions include testing thousands of specimens of CRE, CRAB, ESBL-producing Enterobacterales, Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA), *Neisseria gonorrhoea*, and performing colonization screening of CRE, CRPA and CRAB. In 2018, the Laboratory established a process to identify *C. auris* in isolates and colonization swabs. In 2021 alone, the Laboratory received and tested 3990 *C. auris* colonization swabs by Polymerase Chain Reaction (PCR). The Texas AR Laboratory provides testing for organism identification, antimicrobial susceptibility, carbapenemase production, and mechanism of resistance. In conducting these tests, it uses conventional and molecular methods but also state-of-the-art technology such as Matrix Assisted Laser Desorption/Ionization - Time of Flight (MALDI-TOF) and Whole Genome Sequencing (WGS).

In May 2017, the Texas AR Laboratory began testing isolates collected from Texas healthcare facilities. The Laboratory’s initial recruitment drive involved mailing letters to healthcare facilities to encourage them to submit isolates for testing to laboratories statewide. This mailer was followed up with recruitment via word-of-mouth, by discussing the recruitment drive at in-person laboratory and infection prevention meetings across the state. Additionally, isolates were requested by Healthcare Associated Infection (HAI) epidemiologists who conducted investigations of reportable multidrug-resistant organisms (MDROs) in Texas when the isolates met the criteria for AR Lab Network submission. Instructions for isolate submission were created by the Texas AR Laboratory and were shared by laboratory and epidemiology staff whenever a facility indicated an interest in submitting isolates.

The overall goal of an HAI epidemiology response is to slow the spread of all MDROs, with a specific emphasis on the rapid containment of novel or rare MDROs or resistance mechanisms isolated from healthcare facilities. From August 2019 through December 2021, Texas public health departments were involved in 922 public health responses as a result of AR Lab Network alerts. The CDC’s *Interim Guidance for a Public Health Response to Contain Novel or Targeted MDROs* document was used by the Laboratory as guidance in developing containment steps for retrospective surveillance, point prevalence studies, on-site infection control assessments, and prospective surveillance.

Containment steps include systematic, aggressive responses to single cases of high-concern antimicrobial resistance, and a focus on stopping transmission. To aid Texas health departments, Texas HAI epidemiologists worked with the Texas AR Laboratory to develop the *Texas AR Lab Network Response Plan*, which includes a statewide surveillance process for the detection of emerging resistance and a response process for AR Lab Network alerts. The response plan also includes
additional detailed steps not included in the CDC guidance document. Response activities have tiered approaches that are based on organism or mechanism attributes; responses may differ by geographic region. Texas HAI epidemiologists also collaborated with CDC and the Texas AR Laboratory to provide educational resources to facility staff and patients.

Purpose

The Texas AR Lab Network Response Plan (hereafter referred to as “the Texas Response Plan,” or “the Plan”) is used to solidify Texas’ strategies for identification and containment of MDROs and to increase the state’s capacity to respond to AR threats. The Texas Response Plan includes two components: a coordinated work plan and an outreach plan. The work plan specifies the communication and information flow between the Texas AR Laboratory and the Healthcare Safety Unit. The purpose of the outreach plan is to coordinate connection between the Laboratory and HAI epidemiologists and clinical laboratories, and provide education and technical assistance to care facilities, clinical laboratories, and other healthcare professionals to improve detection of targeted organisms across the state.

This Plan includes Texas response tiers for resistance mechanisms which include thresholds for conducting onsite infection-control assessments and colonization studies, as well as the events or results that would trigger ongoing follow-up visits. Feedback is solicited from internal and external partners annually to modify or update the Plan. This annual review supports an informed and effective public health and infection-prevention team to rapidly detect, report, and respond to individual cases and outbreaks of novel or high-concern MDROs.

To ensure response investigations are conducted thoroughly and rapidly to identify and contain organisms with novel and high-concern resistance, Texas HAI epidemiologists align the Plan with the CDC Containment Strategy. To help limit the negative effect the Plan could have on public health capacity, the HAI epidemiologists established parameters to determine triggers for single or repeated colonization studies. These parameters are incorporated into the Plan and education on the parameters is provided to public health partners and healthcare facilities so rapid detection and containment can occur. The parameters facilitate a more efficient and effective implementation strategy for colonization screening until the spread of novel or high-concern MDROs is tracked and controlled.
1. Roles and Responsibilities

This section includes a list of the roles and responsibilities of the team members involved in the implementation of the Texas Response Plan.

**AR Laboratory Expert/AR Laboratory Manager** The manager serves as the subject matter expert (SME) on the laboratory testing workflow, capability, and capacity and is the point of contact (POC) for all technical questions.

**Antibiotic Resistance/ Antibiotic Stewardship (AR/AS) Team** The AR/AS team, consisting of epidemiologists, ensures requests for testing, test results, and any pertinent information are communicated between the laboratories, CDC, and local epidemiologists. These Texas DSHS epidemiologists have a primary responsibility to communicate AR results from the Texas AR Laboratory to the regional and local health departments. The Antibiotic Stewardship (AS) Expert oversees and implements all activities related to antibiotic stewardship initiatives in Texas.

**HAI Coordinator and HAI Epidemiologists** The HAI coordinator is responsible for the implementation of epidemiology responses per the Texas Response Plan and manages the HAI Epidemiologists across the state. The HAI epidemiologists provide recommendations to health departments and healthcare facilities on control measures to take to prevent the spread of novel and targeted MDROs and communicable diseases. HAI epidemiologists also assist local health departments with obtaining supplies, implementing colonization screenings, and conducting onsite infection control assessments.

**Regional Health Department Epidemiologists** The DSHS HAI epidemiologists work alongside DSHS Regional epidemiologists who serve as the primary epidemiology contacts for all counties in their Public Health Region (PHR). DSHS HAI epidemiologists and Regional epidemiologists are also the primary epidemiology investigators for counties that do not have a local health department. They work directly with healthcare facilities and laboratories in their jurisdiction.

**Local Health Department Epidemiologists** Local health department (LHD) epidemiologists are the primary epidemiology investigators for their jurisdiction. They work directly with healthcare facilities and laboratories in their jurisdiction.

**Submitting Facilities** Submitting facilities include any healthcare facility or laboratory that submits isolates or surveillance samples to the AR Lab Network. Submissions may occur on a regular basis or due to a public health investigation.
Examples of submitting facilities include acute care hospitals (ACHs), long-term acute care hospitals (LTACHs), skilled nursing facilities (SNFs), outpatient clinics, or reference laboratories. These facilities send isolates collected at their own facility or those collected at another healthcare facility, in accordance with the Texas AR Laboratory submission guidance.

**Infection Preventionist** The healthcare facility designates an infection preventionist as the SME on methods for preventing and controlling the spread of infectious disease.

**Texas AR Laboratory** The Texas AR Laboratory is housed within the Texas DSHS Laboratory, which is the State Public Health Laboratory of Texas. The Texas AR Laboratory is responsible for receiving and testing samples to meet Clinical Laboratory Improvement Amendments (CLIA) requirements, forwarding specimens or isolates as appropriate to the Regional Laboratory or the CDC, issuing CLIA-compliant reports, and ensuring the submitter receives reports. The Texas AR Laboratory communicates regularly with the Regional AR Laboratory so that testing and reporting are performed according to current CDC AR Lab Network guidance. It also serves as a resource for proper collection, shipping, and storage of specimens. The Laboratory also requests and secures funding and creates and submits required progress reports.

**Regional Antibiotic Resistance Laboratory Network Laboratory** The Regional AR laboratory provides support to the Texas AR Laboratory and to public health department labs by providing additional testing capabilities and gathers data to detect existing and emerging types of AR, track changes in resistance, and identify outbreaks in the greater region. Currently, the Utah Public Health Laboratory serves as the Regional Laboratory for the Mountain Region AR Lab Network.

**AR Lab Liaison** The AR Lab Liaison facilitates communication between the Texas AR Laboratory, epidemiologists, healthcare facilities and laboratories, and the Regional AR Laboratory to coordinate specimen receipt, result reporting, submitter setup, portal access, recruitment, and education.

**AR Data Analyst** The data analyst collects, manages, and compiles data on specimen volume, results statistics, turnaround time, and other quality indicators.

**AR Laboratory Technologist** This laboratory technologist performs sample accessioning, testing, and results reporting.
2. Communication

The Texas AR Laboratory and the Healthcare Safety (HCS) Unit communicate on a regular basis to coordinate functions. The HCS Unit is responsible for leading and ensuring coordination and communication between the two groups. This is achieved by scheduling regular monthly meetings to discuss topics that include, but are not limited to, laboratory capacity, capability, timeline for colonization surveys, specimen submission criteria, specimen shipping and handling, turnaround time, result reporting, and improvement opportunities. Topic-specific meetings (e.g., ARLN Recruitment, AR Lab Network Response Plan, and Epi-Lab Workplan workgroup meetings) are held to focus on specific activities, as needed. When urgent issues arise, the Texas AR Laboratory and the HCS Unit communicate daily through emails or phone calls. To facilitate collaboration, past and current processes, shared activities, and communications are documented and archived electronically in a shared folder between the groups.

The Texas AR Laboratory and the HCS Unit collaborate with the regional and local health departments to recruit and educate facilities to submit isolates to the Texas AR Laboratory for testing. The HAI epidemiologists provide infection control recommendations to health departments and healthcare facilities to prevent the spread of novel and emerging MDROs. The AR Lab Liaison proactively initiates contact with healthcare facilities and laboratories to ensure testing and reporting are performed according to current CDC AR Lab Network guidance, and to identify and address other issues that may arise. The Texas AR laboratory and the HCS Unit update submitting facilities with new information and any changes in sample submission processes through ListServ notices, emails, and face-to-face meetings. The Texas AR Laboratory and the HCS unit regularly update the website with AR Lab Network-related activities and guidance.

The Texas AR Laboratory, as a member of the Mountain Region AR Lab Network, participates in all conference calls, meetings, and trainings organized by the Regional AR Laboratory. The Texas AR Laboratory communicates with the Regional Laboratory regarding sample submissions that require further testing such as whole genome sequencing, colonization screening, and targeted surveillance. The Texas AR Laboratory also contacts the Regional AR Laboratory for support with surge capacity. The Texas AR Laboratory communicates regularly with the Houston Health Department (HHD), which is an independent AR Lab Network laboratory, to compile statewide statistics. The HHD reports test results to the DSHS HCS Unit and collaborates with DSHS on outbreak investigations. The Texas AR Laboratory and HHD hold regular monthly meetings to ensure collaboration. More frequent
communication occurs when necessary, such as during outbreak investigations. HAI Investigation Team and AR/AS Team conduct frequent communication with CDC and Regional AR Laboratory during point-prevalence survey/colonization screening and outbreak investigations. More frequent notifications, email correspondences, meetings, and conference calls are required and scheduled to meet the requirement. The response activities include communication about specimen numbers and coordination with different teams.

The Texas AR Laboratory maintains regular communication with the CDC about AR Lab Network activities. Representatives of the Laboratory attend all meetings held by the CDC, including the meetings held at the beginning of each fiscal year to address expectations over the coming year, and bimonthly meetings that address new protocols and guidance. The Texas AR Laboratory notifies the CDC when submitting samples requested by the agency, which follows CDC processing and reporting protocols. The Texas AR Laboratory plans to participate in projects conducted by the CDC and intends to report data as requested.
3. Laboratory Testing Capabilities

Tests Conducted on Isolates

Texas AR Laboratory tests isolates for the following organisms:

- **Carbapenem-resistant Enterobacterales (CRE)** such as *Escherichia coli*, *Klebsiella oxytoca*, *Klebsiella pneumoniae*, and *Enterobacter* spp. that are resistant to imipenem, meropenem, doripenem, or ertapenem by standard susceptibility testing methods. Also accepted for testing are less-common genera of CRE, such as *Providencia*, *Proteus*, *Morganella*, *Citrobacter*, and *Serratia* that are resistant to carbapenems other than imipenem since many of these organisms are intrinsically resistant to imipenem.

- **Carbapenem-resistant *Pseudomonas aeruginosa* (CRPA)** resistant to imipenem, meropenem, or doripenem AND non-susceptible (intermediate or resistant) to cefepime or ceftazidime by standard susceptibility testing methods; only non-mucoid isolates are accepted for testing. CRPA isolates that are non-susceptible to all antibiotics tested should be submitted routinely to the Texas AR Laboratory.

- **Carbapenem-resistant *Acinetobacter baumanii* (CRAB)** that are resistant to imipenem, meropenem, or doripenem by standard susceptibility testing methods.

- Confirmed or suspected *C. auris* or *C. haemulonii* isolates, unidentifiable yeast isolates and any *Candida* isolates that are not *C. albicans* are also accepted for testing.

Texas AR Laboratory performs the following tests on isolates:

- Organism species identification
- Carbapenemase production (CRE and CRPA only)
- Antimicrobial susceptibility testing (AST) on bacterial isolates
- Mechanism testing for carbapenemase genes

Previously CRAB isolates received by the Texas AR Laboratory were forwarded to the Mountain Region AR Laboratory. Beginning February 2022, DSHS Laboratory performs CRAB isolate testing and does not send them to Mountain Region AR Laboratory. However, Texas AR Laboratory forwards isolates identified at the Texas AR Laboratory as *C. auris* to the Mountain Region AR Laboratory.
Colonization Testing Conducted

Carbapenemase producing organism (CPO) colonization screening: Specimens for colonization screening are sent directly from the submitter to the Mountain Region AR Laboratory. HAI epidemiologists coordinate with the Mountain Region AR Laboratory for specimen collection and shipping. The Texas AR Laboratory provides technical assistance as needed. Results from the Mountain Region AR Laboratory are sent to the HAI epidemiologists within one working day.

Candida colonization testing:

The Texas AR Laboratory performs Candida colonization testing using a real time polymerase chain reaction (PCR) method on ESwabs sampled from body sites such as axilla and groin. The testing capacity can accommodate up to 120 swabs per day with advance coordination. The Copan Transystem swab designed for CPO colonization testing cannot be used for PCR testing. See https://www.dshs.texas.gov/lab/ARLN/Antibiotic-Resistance-Testing-TX/ for additional guidance on specimen collection and shipping.

If a colonization specimen is unsatisfactory for testing, or the total specimen count received does not match the line listing of swabs collected by a facility, the HAI epidemiologist is notified by the Mycology Team as soon as possible after receipt of the specimens.

If colonization specimens are positive for C. auris by PCR, the submitter and HAI epidemiologist are notified by email or telephone that same day. The Texas AR Laboratory reports C. auris identifications to CDC through REDCap that same day.

Once the PCR testing is completed, a summary spreadsheet of the results is compiled by the Mycology Team and emailed to the HAI epidemiologist on that same day.

The Texas AR Laboratory provides swabs for testing. Submitting facilities can request swabs by coordinating the request with their regional HAI Epidemiologist.

Additional Testing

The Texas AR Laboratory can perform pulsed-field gel electrophoresis (PFGE) for CRE, CRPA, and CRAB upon epidemiologist request. The Texas AR Laboratory can also submit these isolates to the Mountain Region AR Laboratory for whole genome sequencing upon request.
4. Recruitment

Data Analysis

The HCS Unit and Texas AR Laboratory team reviewed the Texas AR Lab Network data from 2017 to 2019. The types of healthcare facilities that submitted isolates directly to the Laboratory included acute care hospitals, long-term acute care hospitals, and reference laboratories. The reference laboratories submitted isolates from a variety of healthcare settings, most often acute care, but also long-term care and outpatient settings. Acute care hospitals were the healthcare facilities with the most isolate submissions. Only 35 percent of long-term acute care hospitals (LTACHs) and 3 percent of skilled nursing facilities (SNFs) were represented in past submissions. Data were also reviewed to understand the geographical locations where isolates with resistance mechanisms were collected and where AR positive patients reside.

Criteria for Targeting Facilities

For CRE and CRPA isolates, the Texas AR Laboratory continues to recruit healthcare facilities in public health regions with historically low numbers of specimen submissions and laboratories serving high acuity settings such as LTACHs and SNFs. The Texas AR Laboratory will also target for recruitment laboratories who previously submitted isolates but have not submitted isolates in one year.

Effective January 1, 2021, *C. auris* is a reportable condition in Texas and requires isolate submission to the Texas AR Laboratory. To establish a baseline for *C. auris* presence in Texas, the Texas AR Laboratory will focus recruitment activities on facilities that have historically submitted the most MDRO isolates. Recruitment activities will also focus on regions that have reported *C. auris* in the past, which are also the most populous regions in the state. The HCS Unit and the Texas AR Laboratory have also worked to establish relationships with other facilities such as academic laboratories that receive fungal isolates.
Methodology

The HCS Unit will continue to update the previous list of laboratories to target based on the criteria identified above. This list will be used to recruit laboratories in targeted public health regions and laboratories used by the targeted LTACHs and SNFs.

HAI epidemiologists will recruit laboratories located within healthcare facilities.

Texas AR Laboratory will be provided a list of reference laboratories that the targeted LTACHs and SNFs utilize. Texas AR Laboratory will recruit these laboratories.

The HCS Unit and Texas AR Laboratory will develop materials to utilize in these recruitment efforts for consistency of methodology and information. Examples of the Texas approach include sending ListServ notices, making telephone calls, surveys of laboratories that perform or refer out mycology testing, holding webinars or in-person meetings, communicating via emails, and conducting onsite visits such as Point Prevalence Surveys. In addition, recruitment letters and flyers developed by the HCS Unit and Texas AR Laboratory will be emailed to healthcare laboratories and posted on the DSHS Laboratory website.
5. Laboratory Submission Process

To submit specimens to the Texas AR Laboratory, submitters must adhere to the following steps (Also see Appendix A):

**Create a Submitter ID Account**

Submitters of colonization swabs and/or isolates to the Texas AR Laboratory must have a Submitter ID Account with Texas DSHS Laboratory Services Section in Austin prior to submitting samples. New submitters (or current submitters needing to update previous account information) must complete a Submitter ID Request Form, which is located at Submitter-ID-Request-Form-Sept--2017.pdf (texas.gov).

**G-2E Specimen Submission Form**

All samples sent to the Texas AR Laboratory must be accompanied by a G-2E Submission Form. Specimen submission forms prepopulated with facility specific identification may be requested by emailing LabInfo@dshs.state.tx.us or by calling (512) 776-7578.

**FedEx Instructions**

The Texas AR Laboratory has an account set up with FedEx to ship specimens (See Appendix B). Instructions for logging into the FedEx account may be obtained by emailing TexasARLN@dshs.texas.gov.

**Specimen Collection and Shipment Instructions**

All samples must be shipped following UN3373 shipping guidelines and be accompanied by a completed G-2E form. There must be two unique identifiers on the G-2E form that exactly match the identifiers on the specimen label (Appendix C lists acceptable unique patient identifiers). See Appendix B and https://www.dshs.texas.gov/lab/ARLN/Antibiotic-Resistance-Testing-TX/ for more information on specimen collection and shipping.

**Technical Support**

The Texas AR Laboratory provides technical assistance and support for sample submission issues. Technical support may be obtained by emailing TexasARLN@dshs.texas.gov.
Specimens received by the Texas AR Laboratory are first processed by the Texas DSHS Specimen Acquisition Department. It is at this stage where specimens are reviewed for initial acceptance criteria and any issues with sample labeling, unique identifiers, and the G-2E Form. After this review, specimens are logged into the Laboratory Information Management System (LIMS), appropriate tests are ordered, and laboratory labels are printed and attached to the specimen and the attached G-2E Form. The specimens are then delivered to the testing areas of the Texas AR Laboratory for the initiation of testing. Testing of isolates for CRE, CRPA and CRAB are performed by the Molecular Biology Team. All *Candida* samples are tested by the Mycology Team.
7. Testing Process Workflow

Isolates for CRE, CRPA and CRAB

- **Day One** – CRE, CRPA and CRAB isolates are streaked on Trypticase Soy Agar (TSA) plates with 5% sheep’s blood and incubated overnight.
- **Day Two** – Streaked plates are checked for purity. Organism ID is confirmed by MALDI-TOF. Antibiotic susceptibility testing for CRE, CRPA and CRAB isolates is initiated with broth microdilution (BMD). Modified Carbapenem Inactivation Method (mCIM) is initiated for CRE and CRPA only.
- **Day Three** – BMD and mCIM results are interpreted. CRE and CRPA mCIM positive isolates as well as all CRAB isolates will have CDC Polymerase Chain Reaction (PCR) performed for *Klebsiella pneumoniae* Carbapenemase (KPC), New Delhi Metallo-beta-lactamase (NDM), Imipenemase (IMP), Verona Integron-Encoded Metallo-beta-lactamase (VIM), and Oxacillinase-48 (OXA-48) like genes. If mCIM result is positive or indeterminate and PCR result is negative, mCIM and CDC PCR tests are repeated for confirmation. After data review and results release in LIMS, PCR results are sent to the HAI epidemiologists. Specimen results that meet CDC alert guidance are entered into the REDCap alerts website. KPC positive alert emails are sent to the HAI epidemiologists.

**Candida Isolates for Identification**

- **Day One or Day Two** – *Candida* isolate is received in the lab and subcultured to fresh culture medium.
- **Day Two to Day Three** – Identification of *Candida* isolate is performed from fresh subculture by Bruker MALDI-TOF.

If identification is *Candida auris*, the submitter and HAI epidemiologist are notified by email or telephone that same day. The Texas AR Laboratory reports *C. auris* identifications to CDC through REDCap that same day.

**Candida Isolates for Antifungal Susceptibility Testing**

The Texas AR Laboratory ships identified *Candida* isolates to the Mountain Region AR Laboratory for susceptibility testing. The Mountain Region AR Laboratory sends results to the Texas AR Laboratory and the HCS Unit. The Texas AR Laboratory notifies submitting laboratories of results received by attaching the Utah report to the final Texas report.
Colonization for *Candida auris*

- **Day One** – Swabs are received in the lab, checked for compliance with CAP/CLIA regulations and stored overnight at refrigeration temperatures.

- **Day Two** – DNA is extracted from the swab transport solution and PCR for *C. auris* is performed. Note: if necessary, extracted DNA may be stored for PCR to be performed at a later date.

- **Day Two** – PCR Positive and PCR Indeterminate swab solutions are inoculated into a Salt Sabouraud Dulcitol Broth enrichment culture medium with chloramphenicol and gentamicin. Cultures are incubated in a shaking 40°C incubator.

- **Day Three to Day Seven** – Incubated culture broths are inspected each day for growth. When there is growth, or at Day Seven if no growth is detected, cultures are inoculated to CHROMagar plates and incubated for two additional days. Yeast colonies on CHROMagar are identified by MALDI-TOF. Note: a weekend may extend the timeline by two days.

- *C. auris* isolates are shipped to the Mountain Region AR Laboratory for susceptibility testing.
8. Texas Response Tiers

CDC defines three tiers for epidemiology responses to novel or targeted MDROs. The definitions for each tier are outlined below. According to an analysis of Texas data from 2017–2021, Texas established the following response tiers:

**Tier 1**
This category includes (1) organisms for which no current treatment options exist (pan resistant) and that have the potential to spread more widely within a region and (2) organisms and resistance mechanisms that have never (or very rarely) been identified in the United States and for which experience is extremely limited and a more extensive evaluation is needed to define the risk for transmission.

- Pan-nonsusceptible (CRAB, CRE, CRPA)
- Pan-resistant (C. auris, CRAB, CRE, CRPA)
- Other novel organisms and resistance mechanisms

**Tier 2**
Organisms in this group include MDROs that are primarily associated with healthcare settings and are not commonly identified in the region. These organisms might be found more commonly in other areas of the United States. Information is available about how transmission of these organisms occurs and the groups primarily at risk.

- C. auris
- CRAB (IMP, KPC, NDM, VIM, uncommon plasmid-mediated OXA)
- CRE (IMP, NDM, OXA-48, VIM)
- CRPA (IMP, KPC, NDM, OXA-48, VIM)
- mCIM+/PCR-

**Tier 3**
Organisms in this group include MDROs targeted by the facility or region that have been identified regularly but are not considered to be endemic. These organisms might be found more commonly in other areas of the United States. Information is available about how transmission of these organisms occurs and the groups primarily at risk.

- CRE (KPC, MCR)

Per CDC, OXA-23, OXA-24/40, and OXA-58 producing CRAB appear to be endemic in much of the United States. In Texas, 97 percent of CRAB isolates tested positive for either OXA-23 or OXA-24/40. Therefore, OXA-23 producing CRAB and OXA-24/40 producing CRAB are considered endemic in Texas.
9. Epidemiology Response

Notification and Confirmation of a Positive AR Lab Network Result

If the report comes from the Texas AR Laboratory, Houston AR Laboratory, or Mountain Region AR Laboratory within one workday, the HCS Unit will perform the following:

- Retrieve lab report from DSHS CITRIX/Labware or DSHS Lab Online Portal and confirm results match the notification.
- If the lab report cannot be retrieved in DSHS CITRIX/Labware or DSHS Lab Online Portal, request a copy from the Texas AR Laboratory (TexasARLN@dshs.texas.gov) or Houston AR Laboratory (HoustonARLN@houstontx.gov).
- Forward the confirmed result to the health department in the jurisdiction of the facility where the specimen was collected.

If the report comes from a facility or reference laboratory within one workday, the epidemiologist conducting the investigation will obtain the laboratory report to confirm the reported result:

- If the CRAB, CRE, CRPA, or C. auris isolate is still available, the epidemiologist will request that it be sent to the Texas AR Laboratory for additional testing as needed.
- It is highly recommended to send pan-resistant and pan-nonsusceptible isolates to the Texas AR Laboratory.
- If the laboratory has not submitted to the Texas AR Laboratory previously, they will need to create an account. The HAI epidemiologist will follow the steps listed in Section 5 above, provide facility the Submitter ID Request Form ([https://www.dshs.texas.gov/lab/forms/Submitter-ID-Request-Form-Sept--2017.pdf](https://www.dshs.texas.gov/lab/forms/Submitter-ID-Request-Form-Sept--2017.pdf)) and ask them to follow the instructions on the document.

Immediate Actions

- Determine response tier by utilizing the response tier definitions in this Plan.
- Notify the Infection Preventionist (IP).
  - It is important that the IP at the patient's current facility be notified of the result. The epidemiologist should provide education to the IP on the organism and resistance mechanism.
- Implement control measures at current facility.
  - Ensure contact precautions\(^5,6\) or enhanced barrier precautions\(^7\) are initiated, if not already implemented. Discuss the need for strict
adherence to precautions. Removal of the patient from precautions is discussed further below.

- Refer to the *DSHS Emerging and Acute Infectious Disease Unit’s Investigation Guidelines for control measures for carbapenem-resistant Enterobacterales (CRE)*\(^8\). These guidelines are applicable for novel or emerging multidrug-resistant organisms.

- For *C. auris* cases, refer to the *DSHS Emerging and Acute Infectious Disease Unit’s Investigation Guidelines for control of *C. auris*\(^8\) and use the guidance from CDC\(^9\) and EPA\(^10\) as listed on the CDC’s *C. auris* Infection Control webpage, found at [https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html](https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html). See references for EPA List P\(^10\), the current list of EPA-approved products for *C. auris* disinfection.

- Recommend the following minimum education be provided to the facility:
  - Since the resistance mechanism may be new to staff, provide information on antibiotic resistance for the facility to educate staff and patient/visitors. If additional educational information is needed, recommend the IP contact the epidemiologist.
  - IP should re-educate staff on appropriate moments and methods for hand hygiene, proper personal protective equipment (PPE) usage, and environmental cleaning and disinfection.
  - Request the facility or reference laboratory to notify the IP of any additional lab positives with similar organisms or resistance and save the isolate for potential submission to the Texas AR Laboratory. IP should be asked to inform the epidemiologist of results within one workday.

- Staffing and patient placement:
  - Place the patient in a private room. If a private room is not available and there are multiple patients with the same organism and resistant mechanism, cohort them accordingly. When possible, dedicate staff to care for positive patient(s) only.
  - Educate staff to complete duties for all other patients prior to caring for the patient(s) with an AR-relevant mechanism, when feasible (i.e., therapy staff, respiratory staff, housekeeping).

- Interfacility transfer communication:
  - If the patient is transferred to another healthcare facility, communicate MDRO history and isolation needs to the receiving facility.
• If the patient has been transferred to their current facility from another healthcare facility, please follow recommendations in the "Previous Facilities" section of this document.

• Notify leadership
  o Follow the health department jurisdiction’s protocols for notifying leadership of AR Lab Network alerts and investigations.
  o Collaborate with CDC as needed. During the investigation, the HAI epidemiologist may contact CDC for assistance or to collaborate on containment strategies, if needed or requested.

Obtain Patient History

Obtain the patient’s healthcare history, as outlined below. Use the DSHS Line List Template provided by the HAI epidemiologist to record and update obtained information.

Request medical records (or electronically review records) to identify possible risk factors for the infection. Historical information should be obtained from the facility where the specimen was collected, the current facility, and/or the transfer facility. Below are the items to be requested:

• History and physical (H&P)
• Discharge summary
• Reason for testing, and affiliated infectious disease/physician notes
• Control measures, including contact precautions, that have been implemented, including date(s) initiated and date(s) discontinued
• Bed/Room assignments (including roommates)
• Medical History:
  o Existing conditions
  o Positive cultures for the last month
  o Ongoing procedures/treatments such as hemodialysis, wound care, etc.
  o Existing indwelling devices or drains at the time of culture
• Was the patient admitted to an intensive care unit (ICU)?
• Healthcare Exposures:
  o In the 30 days prior to the collection date and in the time after the positive collection date, did the patient have any other healthcare admissions, outpatient visits, or medical procedures?
    • List facility names and location, the reason for the visit, and admission dates, discharge dates, and procedure dates.
• If the patient had roommates during these recent healthcare admissions, obtain the same information noted above for each roommate.
  o Follow recommendations in the “Previous Facilities” section of this document.
  o Notify the HAI epidemiologist of facilities identified outside of the LHD jurisdiction.

• Travel History:
  o Were there any trips, hospitalizations, or surgeries outside the United States. in the last 12 months?
    ▪ If so, obtain travel dates and locations.
    ▪ List healthcare visit information that occurred while traveling (including delineating outpatient versus overnight stay). If able, obtain the names of the healthcare facilities and the dates of care.

*Meet with Current Facility*

Meet with the patient’s current facility. Request assistance from the HAI epidemiologist if needed. This meeting may be via conference call or in person. The purpose of the meeting is to explain the organism and resistance mechanism, transmission methods, the importance of appropriate infection control measures, and to address questions from administration and staff. The facility press officer should be invited, as needed.

*Conduct Remote and Onsite Infection Control Assessments*

Either a remote or onsite Infection Control Assessment and Response (ICAR) should be conducted at the patient’s current facility, facilities where the patient has been admitted since the positive collection date, and facilities the patient was admitted to in the 30 days prior to the positive collection date. The ICAR aims to ensure that appropriate infection prevention and control measures are in place to prevent MDRO transmission. A remote ICAR can be conducted prior to the onsite ICAR, and findings may prompt an onsite ICAR.

An onsite ICAR is warranted if the patient was not on contact precautions, or the facility reports non-compliance or unknown compliance in the areas of hand hygiene, personal protective equipment (PPE) usage, or environmental cleaning and disinfection. The site visit is also an excellent opportunity to have a face-to-face meeting with facility administration, infection control practitioners, and laboratory management to provide education and address questions and concerns.
General guidelines for conducting ICARs include:

- Use of an appropriate CDC ICAR tool for the specific type of healthcare facility. Consult with an HAI epidemiologist for the most appropriate tool for the setting.

- Observations of the following:
  - Proper isolation precautions signage
  - Hand hygiene
  - PPE selection
  - Donning/doffing of PPE
  - Appropriate use of disinfectants
  - Cleaning/disinfection processes for the equipment (dedicated and shared equipment)
  - Cleaning/disinfection processes for the environment that are conducted by all staff (Environmental Services, nursing, etc.)
  - Processes for waste disposal (linen, trash, biohazard waste)
  - Proper handling of medical devices (central lines, urinary catheters, respiratory support, etc.)
  - Interfacility communication processes for MDROs

- Review of documentation of staff education (i.e., sign-in sheets, presentation, handouts).

- Assessment of staff knowledge and processes.

- Discussion of an action plan that will address any gaps identified at the conclusion of each site visit.

- Conduct a follow-up if additional cases occur after the initial visit.

Previous Facilities

- In general, healthcare exposures that occurred in the month prior to the positive specimen collection should be investigated unless the information is available about the time the mechanism was most likely acquired. The exception is C. auris, in which case healthcare exposures in the preceding three months may need to be investigated. Contact the HAI epidemiologist for guidance.

- Facilities should be encouraged to update medical records, per their internal protocol, for flagging patients with multidrug-resistant organisms.

- Conduct an onsite ICAR if the patient was not on contact precautions, or if the facility reports non-compliance or unknown compliance in the areas of hand hygiene, PPE usage, or environmental cleaning and disinfection.

- Depending on the infection control measures implemented at these healthcare facilities, implementation of colonization screening should be considered.
Prospective and retrospective surveillance should be implemented per the guidance in this document.

Colonization Screening and Point-Prevalence Survey

Colonization screening is recommended for roommates and other close contacts of the index patient who are identified as high-risk contacts based on their level of interaction with the index patient in the one-month period prior to the identification of the mechanism or prior to the implementation of the appropriate control measures. If indicated, the epidemiologist will:

- Identify high-risk contacts at patient’s current and previous facilities.
  - High-risk contacts are defined as patients or residents at the highest risk for acquisition.
  - Refer to the CDC’s *Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs)* for screening recommendations according to the Response Tier of the organism. See Appendix E for a summary table of containment elements from the guidance document.
  - For Tier 1, family members may be considered for testing, depending on the patient’s and family members’ medical history. Consult with the HAI epidemiologist.
  - Screening may be necessary for high-risk contacts who have been discharged from the facility prior to the implementation of control measures. This should be implemented in consultation with the HAI epidemiologist.
  - Screening healthcare workers is generally not recommended. For Tier 1, healthcare workers may be considered for testing, depending on the epidemiology factors identified in the investigation. The epidemiology is usually more consistent with transmission occurring through contamination of healthcare worker’s hands and clothes, shared medical equipment, or the environment, rather than through a colonized healthcare worker.

- Obtain specimens
  - The HAI epidemiologist will provide the investigating epidemiologist with the appropriate laboratory submission form to be used for each specimen collected.
  - Request the appropriate swabs be shipped for the specific pathogen or mechanism being tested. Coordinate with the HAI epidemiologist to obtain the appropriate swabs.
    - Once the specimen is collected on the swabs, they should be shipped within one day of collection. Note: Laboratory testing must be performed within four days of collection.
- Resources for collection, packaging, and shipping can be provided by the HAI epidemiologist upon request.
- If needed, a sample verbal consent script can be provided by the HAI epidemiologist.
  - Check with the HAI epidemiologist to verify the laboratory’s testing capability for other resistance mechanisms.
  - Coordinate with facility’s IP to schedule a date for collecting swabs.
  - Coordinate with the HAI epidemiologist, who will ensure the collection date of the specimens correlates with the AR laboratory’s schedule for receiving and setting up of specimens for testing. The swabs should be shipped within one day.
- The Texas AR Laboratory does not receive shipments on the weekend, holidays, or DSHS holidays. Do not ship specimens to the Texas AR Laboratory on Fridays or Saturdays.
  - Ensure that employees tasked with packaging and shipping swabs are properly trained to ship infectious substances. If they are not trained, request assistance from public health partners for training.
  - Complete the DSHS Colonization Screening Line List, which will be provided by the HAI epidemiologist. Email the completed list to the HAI epidemiologist on the day the swabs are collected.
  - Once shipped, obtain the FedEx tracking number and email it to the HAI epidemiologist.
  - Two patient identifiers are required for submission on both the submission form and the swabs. Patient identifiers on both should match.

- If a colonization screening patient tests positive, a new round of contact tracing and testing will be done. To allow infection control measures to be implemented quickly, results will be sent to the local health department epidemiologist and healthcare facility by the HAI epidemiologist the same day they are received.

A point prevalence survey should be implemented if there is evidence or suspicion of ongoing transmission in a facility. In a point prevalence survey, every patient on a given unit or floor where transmission is suspected should be screened. Consider doing a point prevalence survey even if all known cases have been discharged.

- Screening should continue until two rounds of no new positive results are obtained.
- Contact precautions should be initiated for patients who are waiting for screening results and for all positive patients. If a patient with pending results is transferred to another facility, the pending result status should be
communicated to the new facility admitting the patient. Test results should be provided to both facilities.

Retrospective Review of Lab Results

- Clinical laboratories that perform culture isolations on specimens from healthcare facilities where the index patient received care in the previous 30 days should be targeted for retrospective surveillance in order to identify organisms with similar resistance profiles from other clinical cultures. Retrospective surveillance of results from such clinical laboratories should be performed to identify the presence of organisms with similar resistance patterns; the period under surveillance should extend six months prior to identification of the index case. If available, these retrospective isolates should be sent to Texas AR Laboratory for testing.
  - Coordinate with the HAI epidemiologist to ensure the Texas AR Laboratory or the Mountain Region AR Laboratory has the capacity to test the specimens.
  - Ensure the sending laboratory receives information from the Texas AR Laboratory on how to submit specimens using their Texas AR Laboratory account. If the laboratory has not submitted to the Texas AR Laboratory previously, the submitter can send an email to LabInfo@dshs.texas.gov for account setup assistance.
  - The HAI epidemiologist can download final Texas AR Laboratory results from the DSHS Lab Portal.
- *C. auris* can be misidentified depending on the identification method used by the laboratory. In order to identify which organisms to include in the retrospective review, refer to the CDC’s webpage Identification of Candida auris | Candida auris | Fungal Diseases | CDC. Consider submitting *C. auris* isolates, *C. haemulonii* isolates, and yeast isolates to Texas AR Laboratory when unable to identify their species after identification has been attempted, consider also submitting Candida isolates that cannot be identified and were isolated from invasive infections in normally sterile body sites.
- Depending on patient history, consider requesting historical data at the patient’s other healthcare facilities to identify patients with similar diagnoses for potential case findings.

Prospective Surveillance

- Prospective surveillance involves testing isolates from clinical laboratories that performed cultures from the healthcare facilities where the index patient received care in the previous 30 days before the positive specimen collection and after the positive specimen collection. The purpose of this testing is to
identify organisms with similar resistance patterns from clinical cultures. This surveillance will continue for three months after the last positive specimen.

- Coordinate with the HAI epidemiologist to ensure the Texas AR Laboratory or the Mountain Region AR Laboratory has the capacity to test the specimens.
- Ensure the sending laboratory receives information on how to submit specimens using their Texas AR Laboratory account. If the laboratory has not submitted to the Texas AR Laboratory previously, the submitter can send an email to LabInfo@dshs.texas.gov for account setup assistance.
- Ensure the IP at the facility is aware of new suspect cases.
- The HAI epidemiologist can download final AR Laboratory results from DSHS Lab Portal.

**Outbreak Considerations**

If an outbreak is suspected, additional measures may need to be taken beyond what is listed for the specific Response Tier.

**Pulsed-Field Gel Electrophoresis (PFGE)**

- If there is more than one case of the same organism and mechanism at the facility or in the geographical area, consider the value of PFGE for the investigation. PFGE can yield a genetic fingerprint for a bacterial isolate, helping to detect and combat outbreaks. Whether PFGE is useful depends on the facility and community history, and it may not be necessary for all investigations.
- If PFGE is warranted, request the testing by contacting the HAI epidemiologist.
- The PFGE results and dendrograms(s) will be sent to the HAI epidemiologist, who will forward the information to the investigating epidemiologist.

**Whole Genome Sequencing (WGS)**

- If there is more than one case of the same organism and mechanism at the facility or in the geographical area, WGS may be helpful in determining the presence of transmission and relatedness to positive results in other areas of the state or country. Use of WGS is dependent on the facility and community history and may not be necessary for all investigations.
- WGS may be performed without prior PFGE testing and will be considered on a case-by-case basis.
- If WGS is warranted (WGS provides more precision than PFGE), request the testing by contacting the HAI epidemiologist.
• The WGS results, including Single Nucleotide Polymorphism (SNPs) counts and a phylogenetic tree, will be sent to the HAI epidemiologist, who will forward the information to the investigating epidemiologist.

Removal of Patient from Contact Precautions

There is currently not enough information for CDC to make a general recommendation on when isolation may be discontinued for patients colonized or infected with CRE, CRAB, CRPA, or \textit{C. auris}. With HAI epidemiologist and CDC guidance, a process for removing a patient from contact precautions will be established on a case-by-case basis.
10. Texas AR Laboratory Data

Lab Report Dissemination

When testing is complete for a specimen, the final report is sent back to the submitting lab via mail, fax, or web portal within two business days.

If the result includes an alert value (See Appendix D), a notification is sent to CDC and the HAI epidemiologist.

- All alerts are sent to the CDC through REDCap within one business day.
- All alerts are sent to the MDRO Inbox for public health action through an email within one business day.

Data Storage

All test results for samples received by the Texas AR Laboratory are stored in LIMS. Along with test results, patient demographic information and submitters of the samples are logged to facilitate the generation of laboratory reports and data files.

Shared network space has been created so that both the laboratory and epidemiology staff can easily store, share, and retrieve data as needed.

Data Management

When Texas AR Laboratory data are requested by the laboratory, the HCS Unit epidemiologists, or CDC, the data are queried from the LIMS and reformatted in Microsoft Access or Microsoft Excel to meet the needs of the requestor.

The Mountain Region AR Laboratory provides data to DSHS for all Texas isolates tested at their lab on a quarterly basis. The Mountain Region AR Laboratory also provides data to the Texas AR Laboratory and the MDRO Inbox, upon request.

Data Summary Reports

- CDC: CRPA and CRE are queried monthly from the LIMS and shared with CDC through the APHL Informatics Messaging Services (AIMS) Portal (via CSV file upload). *Candida* identification data are sent to CDC through REDCap and shared by epidemiologists through monthly spreadsheets/Excel files.

- Texas AR Laboratory: Monthly turnaround time reports are queried from the LIMS and used for internal purposes. These reports are put on the shared drive and a summary is shared during epidemiology-laboratory meetings.
• HCS Unit epidemiologists: Data from the Texas AR Laboratory are saved to the shared lab and epi folder for the HCS Unit epidemiologists each month. HCS Unit epidemiologists review and analyze the data for trends and produce data summary reports, as needed.

Data Analysis

The HCS Unit analyzes Texas AR Laboratory data quarterly and graphs and organizes data to track trends. This information has been historically shared within DSHS and with public health epidemiologists and other stakeholders at local and state level meetings.

Data from Texas AR Laboratory, Mountain Region AR Laboratory, and Houston AR Laboratory from May 2017 through March 2021 were analyzed to determine the MDRO response tiers for Texas. Alongside this analysis, these data were also used to create maps of Texas that show the distribution of resistance mechanisms by county. Data will be reviewed annually to determine if a change in the response tiers is necessary.

Using Data for Action

A Data Workgroup was developed in August 2019. The workgroup consists of representatives from the laboratory and epidemiology teams. Meetings occur as needed to discuss various data needs and requirements, with an emphasis on data governance, stewardship, and quality.

AR Lab Network testing has led to the characterization of antibiotic resistance mechanisms across Texas. One limitation of the AR Lab Network data in Texas is that except for *C. auris*, isolate submission is voluntary. By comparing AR Lab Network data to reportable MDRO data, specifically CRE and multidrug resistant *Acinetobacter* (MDRA), DSHS identified facilities from areas reporting high MDRO burden and with no or limited isolate submission to target for recruitment. The addition of *C. auris* as a Texas reportable condition provides an opportunity to further characterize resistance mechanisms in Texas.

Texas counties that show high incidence rates of resistance mechanisms are targeted for educational initiatives, such as encouraging the adoption of the Texas Interfacility Transfer Form.
# List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Name</th>
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<tbody>
<tr>
<td>AIMS</td>
<td>APHL Informatics Messaging Services</td>
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<tr>
<td>APHL</td>
<td>Association of Public Health Laboratories</td>
</tr>
<tr>
<td>AR</td>
<td>Antibiotic Resistance</td>
</tr>
<tr>
<td>ARLN</td>
<td>Antibiotic Resistance Laboratory Network</td>
</tr>
<tr>
<td>BMD</td>
<td>Broth Microdilution</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>CPO</td>
<td>Carbapenemase-Producing Organism</td>
</tr>
<tr>
<td>CRAB</td>
<td>Carbapenem-Resistant <em>Acinetobacter baumannii</em></td>
</tr>
<tr>
<td>CRE</td>
<td>Carbapenem-Resistant Enterobacterales</td>
</tr>
<tr>
<td>CRPA</td>
<td>Carbapenem-Resistant <em>Pseudomonas aeruginosa</em></td>
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<tr>
<td>DSHS</td>
<td>Department of State Health Services</td>
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<tr>
<td>ESBL</td>
<td>Extended-Spectrum Beta-Lactamases</td>
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<tr>
<td>HAI</td>
<td>Healthcare-Associated Infection</td>
</tr>
<tr>
<td>ICAR</td>
<td>Infection Control Assessment and Response</td>
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<tr>
<td>IMP</td>
<td>Imipenemase</td>
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<tr>
<td>KPC</td>
<td><em>Klebsiella pneumoniae</em> Carbapenemase</td>
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<tr>
<td>LHD</td>
<td>Local Health Department</td>
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<tr>
<td>LIMS</td>
<td>Laboratory Information Management System</td>
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<tr>
<td>LTACH</td>
<td>Long-Term Acute Care Hospital</td>
</tr>
<tr>
<td>MALDI-TOF</td>
<td>Matrix Assisted Laser Desorption/Ionization-Time of Flight</td>
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<tr>
<td>mCIM</td>
<td>Modified Carbapenem Inactivation Method</td>
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<tr>
<td>MCR</td>
<td>Mobilized Colistin Resistance</td>
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<tr>
<td>MDRA</td>
<td>Multidrug-Resistant Acinetobacter</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>MDRO</td>
<td>Multidrug-Resistant Organism</td>
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<tr>
<td>NDM</td>
<td>New Delhi Metallo-beta-lactamase</td>
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<tr>
<td>OXA</td>
<td>Oxacillinase</td>
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<tr>
<td>PCR</td>
<td>Polymerase Chain Reaction</td>
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<tr>
<td>PFGE</td>
<td>Pulsed-Field Gel Electrophoresis</td>
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<tr>
<td>PPS</td>
<td>Point Prevalence Survey</td>
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<tr>
<td>SNF</td>
<td>Skilled Nursing Facility</td>
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<tr>
<td>TSA</td>
<td>Trypticase Soy Agar</td>
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<tr>
<td>VIM</td>
<td>Verona Integron-Encoded Metallo-beta-lactamase</td>
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<tr>
<td>WGS</td>
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Appendix A

General Shipping Guidance
General Shipping Guidance

LABELING REQUIREMENTS

All Submitters MUST Have a Submitter ID Number with DSHS. If you do not already have an account or submitter ID number or you need to update information already on file, please download a Submitter ID Number Request Form and fill it out. Complete all applicable fields and email the completed form to labinfo@dshs.texas.gov, or fax it to (512) 776-7533. Once a facility’s information is verified, a submitter ID account is created.

Specimens must be clearly labeled with

1. **A minimum of two unique patient identifiers.** Acceptable identifiers include the
   - patient’s full name
   - patient’s date of birth
   - patient’s medical record number
   - specimen ID number

2. The information provided on the specimen label **must exactly match the information provided on the G-2E specimen submission form.**

3. Master G-2E specimen submission forms may be obtained by contacting LabInfo@dshs.state.tx.us.

Biological Substance, Category B, UN3373 Shipping Requirements

Submitters are responsible for shipping specimens in accordance with all safety and labeling regulations. Per federal law, submitters follow the federal regulatory standards for the transport of biological specimens, such as those of the International Air Transport Association (IATA), the U.S. Department of Transport (DOT), and the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA). 49 CFR parts 171 through 179 shipping and packing regulations are available online at the PHMSA’s website at http://hazmat.dot.gov/.

**Biological substances must be triple packaged for shipping.**

**Required Packaging: Primary Receptacle**

- Primary receptacles must be leakproof and must be able to maintain their shape during shipping.
  - Swab collection/transport tubes qualify as a primary receptacle.
- The screw cap of swab collection containers must be sealed tightly to avoid leakage.
  - Container caps may also be wrapped in laboratory film to prevent leaks.

**Required Packaging: Secondary Receptacle**

- Secondary receptacles must be sealable, watertight, and leak-proof.
- Sealable plastic bags are acceptable as secondary receptacles.
- Multiple collection tubes may be placed in the same secondary receptacle.
  - To minimize cross-contamination of specimens, individually bag each collection tube before combining into one large secondary container.
- Do not overfill the secondary receptacle as it **MUST** be securely closed.
- Secondary container should be placed within strong, outer mailer before shipping.
Required Packaging: Absorbent Material

- Enough absorbent material (e.g., cellulose wadding, paper towels, or cotton balls) to soak up the entire contents of the primary receptacle(s) must be placed around the primary container(s) in the secondary container, in case of leakage.

Required Packaging: Sturdy Outer Container/Outer Mailer

- Once swabs are secured in a sealed secondary receptacle such as a sealable plastic bag, place the secondary receptacle into a sturdy outer container.
- FedEx shipping requires the outer container be made of a sturdy material such as corrugated fiberboard or wood, (Figure 1).
- Foam boxes, paper bags, and envelopes are not acceptable as an outer package for FedEx shipping of these specimen types as they are too easily damaged.
- The box should be an appropriate size to completely enclose the sealed bag of swabs (secondary receptacle); not too big and not too small.

Acceptable Outer Container

![Corrugated Fiberboard](image1)

![Wood](image2)

Unacceptable Outer Container

![Styrofoam Boxes](image3)

![Plastic Bags](image4)

![Paper Envelopes](image5)

*Figure 1. Outer packaging/mailers for shipping Category B Biological Substances must be able to withstand being dropped from a height of 1.2 meters (4 feet) without breaking.*

**SHIPPING AND TRANSPORT**

The guidelines below are specific to FedEx requirements under the International Air Transport Association’s (IATA) for the shipping of “Biological Substances, Category B”. A Category B biological substance is defined as “an infectious substance not in a form generally capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs”\(^1\). The IATA guidelines require Category B biological substances to be triple contained for shipping, which is identified in these guidelines. Please note however that shipping guidelines may vary among transport/courier services.

A special permit/certification is not required to ship Category B biological substances, however, to ensure proper packaging of shipments and to reduce risks of exposure during transportation, federal regulations require training for all personnel who handle and ship Category B specimens. Training may be informal, consisting of a documented review of Category B biological substances shipping practices.

**Please note:** The DSHS Laboratory cannot take responsibility for improperly shipped specimens.
General Considerations for Shipping

- Employers/leadership must ensure that employees tasked with packing and/or shipping swabs are properly trained on how to handle them.
- **Cold packs should be considered if shipping temperatures are expected to exceed 28°C.** It is best to use an insulated box with an inner polystyrene liner to prevent ice from melting.
- Shipment must include a line list/manifest of specimens being shipped.
- Multiple secondary containers/bags of swabs can be placed in one box, but the weight should **not exceed 4Kg.**
- **Specimen Submission Form(s)** Must be placed between the secondary receptacle and the outer package, in a sealable plastic bag to prevent it/them from getting wet.
- All identifying information on a specimen must match the identifying information on its accompanying specimen submission form.
- Packages containing Category A or Category B biological specimens should **NEVER** be dropped off at a FedEx Express® Drop Box.
- The outer mailer must have at least one surface with a minimum area of 3.9 inches by 3.9 inches (100 mm by 100 mm) for the required labeling. The surface of the outer container should be clearly and durably marked/labeled with **UN 3373 label** (See below the specification of UN 3373 label)
Label Specs: At least 6-mm-tall text stating “Biological Substance, Category B” that is adjacent to the diamond-shaped label UN 3373. All required label dimensions are shown below in Figure 2:

![Figure 2. Biological substance, Category B dimensions and marking requirements.](image)

- **Sourcing a UN 3373 Label** Labels may be purchased from Fisher Scientific, catalog numbers 22-130-067 or 22-130-069. Alternatively, the UN3373 label shown below may be sized to the required specification, printed, and affixed to the outer mailer with clear packing tape.
  
  - The shipper’s and recipient’s names, addresses, and telephone numbers must be displayed clearly on the box, as shown in Figure 3, below.
Figure 3. Above: A completely labeled outer mailer/package for a Category B biological substance specimen. When used, dry ice requires its own label, as seen in the bottom left corner. Below: A labeled outer mailer with a FedEx freight label.

Figure 4. Biological substance, Category B label. Each side of the diamond must be a minimum of 2 inches (50 mm) long, with a border of at least 2 mm width. “Biological Substance Category B” and “UN3373” must be a minimum of 6 mm tall.
Appendix B

Guidance for Use of AR Lab Network FedEx Account
PURPOSE.
State, territory and large city public health labs (PHL) supported by the AR Solutions Initiative funding for antimicrobial resistance (AR) laboratory capacity will have access to a CDC funded AR Lab Network FedEx account. This includes the AR Lab Network and Foodborne Diseases Active Surveillance Network (FoodNet). This account may be used for shipping and includes the shipping of isolates and samples between clinical labs, state labs, regional labs and CDC.

GENERAL CONSIDERATIONS.
Each state, territory and large city PHL, supported by the AR Solutions Initiative under ELC or other Cooperative Agreement, will be provided access to the AR Lab Network FedEx account under a unique Department ID and will be responsible for complying with the Terms and Conditions for the use of the account. An AR Lab Network FedEx user agreement must be signed prior to using the FedEx account.

Additional Considerations:
- Submitting labs may batch shipments and include non-AR Lab Network or FoodNet specimens in the shipment to the PHL.
- PHLs are not required to use this method of shipping for AR Lab Network and FoodNet specimens, however additional funding for shipping using other methods (such as couriers) may not be provided.
- There may be differences between jurisdictions regarding shipping procedures and this may impact work with large commercial labs that perform multi-state testing. Please feel free to contact CDC regarding any concerns or unexpected issues related to multi-state testing and shipping.

Please note that Internet Explorer is not a supported browser for FedEx. Microsoft Edge is recommended to avoid login issues.

FEDEX SHIPPING.
Administration
- A point of contact (local administrator) from each funded PHL will receive an invitation to create a FedEx website login (username and password) under that state/city/territory’s unique Department ID for the AR Lab Network account.
- The local administrator for the FedEx account may then provide the department’s login information to clinical labs to ship isolates/samples to the local/state Public Health Lab, the AR lab Network Regional Lab, or to CDC. Alternatively, the local administrator may create shipping labels and send to clinical
labs via email.

- This local administrator will be responsible for signing the AR Lab Network FedEx user agreement
- Any suspected misuse of the account should be reported to CDC immediately (ARLN@cdc.gov), and the password for the account should be changed.

Shipping

- Labs that wish to ship samples for AR Lab Network activities use login information (provided by PHL) to log on to FedEx.com and follow attached instructions for shipping
- PHLs may choose to provide labels to clinical labs rather than account information. This can be done using the “create return shipment” function.
  - This option is used to send a customer an email containing a link to retrieve their return label(s).
  - The customer prints the label, applies it to the package, and ships the package.
  - Up to 10 labels can be created and emailed to a customer at once and there is no limit to the total amount of return labels that can be created.
  - The shipper also has the ability to select the date range (up to two years) for which labels are accessible.
- Shipping services are limited to FedEx Priority Overnight
- Domestic shipping only (except Puerto Rico, which is considered International)

CONTACT INFORMATION.

For questions or further information, please contact CDC’s AR Lab Network Team at ARLN@cdc.gov.
Domestic Shipping on fedex.com

➢ Step by Step

1. Verify the address you are shipping from or change it by clicking the Edit link.

2. Enter the recipient’s information or choose an address from your FedEx address book or your Microsoft Outlook address book.
3. Choose any of the available options.

4. Priority Overnight is only available option for AR Lab Network account
5. Indicate the package type.

![Image of package details]

- Service type: Priority Overnight
- Package type: Your Packaging
- No. of packages: Select
- Weight: Your Package
- Declared value: U.S. Dollars
- Ship date: 01/23/2016

Please note:
- Click the Ship button only once. Each click may cause a duplicate shipment transaction to occur.
- By clicking the Ship button, you agree to the FedEx Terms of Use, Terms of Use and the FedEx terms of shipping in the applicable FedEx Service.
- By clicking the Ship button, you agree that this shipment contains Dangerous Goods. If you are uncertain of whether your shipment contains Dangerous Goods, see the Help for more information. To ship FedEx Express Dangerous Goods, you must select "Dangerous Goods" in the special services section.

6. Enter the number of packages.

![Image of package details]

- Service type: Priority Overnight
- Package type: FedEx Box
- Declared value: Dollars
- Ship date: 01/23/2016

Please note:
- Click the Ship button only once. Each click may cause a duplicate shipment transaction to occur.
- By clicking the Ship button, you agree to the FedEx Terms of Use, Terms of Use and the FedEx terms of shipping in the applicable FedEx Service.
- By clicking the Ship button, you agree that this shipment contains Dangerous Goods. If you are uncertain of whether your shipment contains Dangerous Goods, see the Help for more information. To ship FedEx Express Dangerous Goods, you must select "Dangerous Goods" in the special services section.
7. If more than one package, indicate whether the packages are identical or not.

8. Enter the total weight.
9. Verify the ship date or change it by clicking on the calendar icon.

10. Verify the account number you would like to bill your transportation cost to.
11. Click the *Edit* link in Special Services to view and/or choose any special services related to your shipment.

12. Click the *Edit* link in Schedule a Pickup/Drop-off to view your Pickup/Drop-off options.
13. Click the **Edit** link in E-mail Notifications to send shipment, exception or delivery notifications to yourself, the recipient and two others.

14. Click **Calculate** to view rates and transit times related to your shipment.
15. Indicate if you would like to save this shipment for future use as a Shipment Profile (formerly known as FastShip).

16. Or complete this shipment at a later time by clicking the **Save for Later** button.
17. Click the Ship button.

18. Print the label(s) displayed below, along with a receipt.
This information is provided to you and its use is subject to the FedEx Automation Agreement under which you obtained or have been authorized to use FedEx Ship Manager at fedex.com. No warranties are extended and all warranties, including without limitation, the implied warranties of merchantability and fitness for a particular purpose, are disclaimed, regarding this information. Any conflict between this information and the Automation Agreement, the transportation agreement between you and FedEx, or between this information and the FedEx Service Guide will be governed by the Automation Agreement and the FedEx Service Guide, in that order. Your use of this information constitutes your agreement to these terms.
Terms and Conditions for Use of Federal Express Shipping Administration Username and Password

The undersigned, by his/her signature on this document, certifies that he/she has read and understands the “terms and conditions for use of the Federal Express Shipping Administration Username and Password,” and agrees to abide by the terms and the following conditions:

I understand that I am being provided with a username and password for use with FedEx Shipping Administration exclusively for the purpose of supporting the Antibiotic Resistance Solutions Initiative.

I acknowledge and consent that I will use the assigned username and password exclusively for the shipment of isolates to authorized locations.

I understand and consent that shipments processed with my assigned username and password will be audited by the U.S government. Requests for audits will be complied with in a timely manner.

At any time, the U.S Government may collect, inspect and seize data affiliated with this username and password. Communications associated with my assigned username and password are not private, and are subject to routine monitoring, search, and may be disclosed or used for any U.S. Government authorized purpose.

I acknowledge and understand that I will be held responsible for misuse and/or negligence related to my assigned username and password.

Responsibility for assuring that shipments are authorized rest with the undersigned. In cases where doubt exists over the legitimacy of an authorized shipment, the undersigned is responsible for seeking advice from the account administrator.

Abuse and/or fraud associated with the username and password for this Federal Express Shipping Administration Account are violations of 18 United States Code Section 641, which prohibits misuse or theft of public funds and U.S. Attorney’s Manual 1661 – Protection of Government Property. Violations are punishable by up to 10 years imprisonment and/or a fine equal to the amount taken, or double that amount.

I have read and understand this document and agree to accept responsibility on these terms.

Organization

Printed Name

Signature

Date
Appendix C

Specimen Identification Guidelines
Specimen Identification Guidelines

- A submission form is required for each specimen submitted.
- Each specimen must have **at least two patient-specific identifiers** attached to the primary specimen container at the time of collection.
- Patient-specific identifiers on specimen and submission form must match.

  Note: The primary specimen container is the innermost container that holds the original specimen before processing and testing (e.g., specimen collection tube, swab, or cup).

**Acceptable specimen identifiers include but are not limited to the:**

1. Patient’s Name
2. Patient’s Date of Birth
3. Patient’s Medical Record Number
4. Specimen ID Number
5. CDC Number

  Note: Location-based identifiers such as hospital room number or street address are NOT acceptable.

**Submission Forms must contain:**

1. **At least** two patient-specific identifiers
2. The Submitter’s Texas Provider Identifier (TPI) number
3. The Date of Collection
4. The Specimen Source/Type
5. The Test(s) Requested
6. The Ordering Physician’s (when applicable), Name and National Provider Identifier (NPI) number

- When sending isolates, please submit a copy of your lab’s report along with the sample.
Appendix D

AR Lab Network AR/HAI Alert Findings and Reporting for Public Health Laboratories
Title

ARLN AR/HAI Alert Findings and Reporting for Public Health Laboratories

Purpose

As part of the Antibiotic Resistance (AR) Regional Lab Network activities, state and local public health laboratories will conduct antimicrobial susceptibility testing and molecular assays for resistance mechanisms on a number of organisms recognized as important antibiotic resistance threats. For some findings, state and local HAI coordinators and CDC should be notified immediately so that appropriate infection control measures may be implemented. The table below summarizes the findings that should trigger these alerts.

Contact Information

Alerts should be sent to:
Your jurisdictional HAI epi program [HAI COORDINATOR/DESIGNEE NAME] at [email address] and
CDC AR/HAI staff using REDCap (https://rdcp.cdc.gov)

Please be prepared to include: state of specimen origin, state lab ID of isolate(s); specimen source; collection date; age of patient(s) (not DOB); and description of testing completed and results of those tests. If the result is part of colonization screenings, please also include that information along with the state lab ID of the index isolate(s) that initiated the screening (though if point prevalence survey is not initiated in response to an index patient, write “not applicable”).

<table>
<thead>
<tr>
<th>Alert Type</th>
<th>State/Jurisdiction of Specimen Origin</th>
<th>Public Health Lab ID</th>
<th>Specimen Source</th>
<th>Patient Age (yrs)</th>
<th>Date of Isolate Collection (mm/dd/yyyy)</th>
<th>Description of Testing Completed and Results (including Organism ID)</th>
<th>Colonization screening</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alert Type</td>
<td>Findings</td>
<td>Organism</td>
<td>Send Alert To</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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</tr>
<tr>
<td>Pan-not susceptible suspected</td>
<td>Non-susceptible to all drugs tested by the submitting clinical laboratory and your public health laboratory</td>
<td>Any</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pan-resistant suspected</td>
<td>Resistant to all drugs tested by the submitting clinical laboratory and your public health laboratory</td>
<td>Any</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Novel carbapenemase suspected</td>
<td>Tests positive for carbapenemase production but PCR-negative</td>
<td>Enterobacterales&lt;sup&gt;4,5&lt;/sup&gt; &lt;br&gt;Pseudomonas aeruginosa</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-KPC carbapenemase in Enterobacterales</td>
<td>non-KPC carbapenemase in Enterobacterales</td>
<td>Enterobacterales</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KPC carbapenemase in Enterobacterales&lt;sup&gt;6&lt;/sup&gt;</td>
<td>KPC carbapenemase in Enterobacterales</td>
<td>Enterobacterales</td>
<td>HAI Coordinator (sending alert to CDC is not required)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbapenemase-producing/-positive Pseudomonas aeruginosa</td>
<td>Tests positive for carbapenemase production (mCIM or CarbaNP) and/or &lt;br&gt;blaKPC, blaNDM, blaVIM, blaOXA-48-like, or blaIMP genes by PCR</td>
<td>Pseudomonas aeruginosa</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbapenemase-positive Acinetobacter baumannii (Big 5)</td>
<td>Tests positive by PCR (Cepheid or other) for blaKPC, blaNDM, blaVIM, blaOXA-48-like, or blaIMP genes</td>
<td>Acinetobacter baumannii</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbapenemase-positive Acinetobacter baumannii (other OXAs)&lt;sup&gt;8&lt;/sup&gt;</td>
<td>Tests positive by PCR (Cepheid or other) for other blaOXA genes, including &lt;br&gt;blaOXA-23-like, blaOXA-24/40-like, or blaOXA-58-like</td>
<td>Acinetobacter baumannii</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbapenemase detected from colonization screen</td>
<td>Tests positive for carbapenemase by PCR&lt;sup&gt;9&lt;/sup&gt;</td>
<td>Enterobacterales; &lt;br&gt;Pseudomonas aeruginosa; &lt;br&gt;Acinetobacter</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevated aztreonam-avibactam MIC (Expanded Antimicrobial Susceptibility Testing for Hard-to-treat infections)&lt;sup&gt;10&lt;/sup&gt;</td>
<td>Aztreonam-avibactam MIC ≥8/4 µg/mL.</td>
<td>Enterobacterales</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mcr-type resistance</td>
<td>Detection of any mcr- gene by PCR or WGS</td>
<td>Any&lt;sup&gt;11&lt;/sup&gt;</td>
<td>CDC, HAI Coordinator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspected hypervirulence</td>
<td>Isolates carrying ≥1 targeted carbapenemase genes (blaKPC, blaNDM, blaVIM, blaOXA-48-like, or blaIMP) AND ≥1 of the following suspected genetic marker of hypervirulence :peg-344, pmpA, and pmpA2&lt;sup&gt;12,13&lt;/sup&gt;, detected by analysis of WGS conducted for other priorities.</td>
<td>Klebsiella spp. and E. coli</td>
<td>CDC (These findings may require a public health response. Please discuss with CDC before initiating a response)&lt;sup&gt;14&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Concerning resistance in Gram positive organisms

<table>
<thead>
<tr>
<th>Plasmid mediated linezolid resistance (cfr, optrA and poxtA)</th>
<th>Enterococcus&lt;sup&gt;15&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated MICs to daptomycin MIC≥8 µg/mL and linezolid MIC≥8 µg/mL in vancomycin resistant <em>Enterococcus</em> (VRE)</td>
<td></td>
</tr>
<tr>
<td>Vancomycin resistant (MIC≥8 µg/mL) <em>Staphylococcus aureus</em> (VRSA)</td>
<td><em>Staphylococcus aureus</em></td>
</tr>
</tbody>
</table>

Other

<table>
<thead>
<tr>
<th>Other new or known but rare AR threats in HAI pathogens not covered above</th>
<th>Any</th>
</tr>
</thead>
</table>

1 For any isolates that are being whole genome sequenced, please select the radio button beside “Is this isolate being sent for whole genome sequencing?” in the REDCap alert form and enter the HAI WGS ID and the NCBI HAI-Seq SRR ID associated with the isolate when sequencing is completed.

2 Colistin susceptibility results will not be included in the definition for pan-not susceptible because of revised colistin breakpoints will only have intermediate and resistant interpretative categories. **This category excludes isolates that are resistant to all drugs tested (which should trigger a pan-r alert instead).**

3 For confirmed novel carbapenemase alerts, please see additional guidance below regarding **immediate follow up actions**.

4 Please exclude *Serratia* spp. resistant to carbapenems and susceptible to 3rd generation cephalosporins. This resistance profile indicates an SME gene, not novel resistance. Please also exclude *Enterobacter* isolates that are cefotaxime, ceftriaxone, and ceftazidime resistant but cefepime susceptible. This AST profile is consistent with false positive mCIM+ results, likely because of high levels of AmpC beta-lactamase(s).

5 Please include isolates that are resistant to carbapenem(s) but susceptible to cefotaxime, ceftriaxone, and ceftazidime. This AST profile is indicative of a possible IMI or NMC gene (both class A carbapenemases).

6 Report all KPC-CRE to your HAI coordinator. Some jurisdictions, such as those where KPC is rarely identified, might choose to report KPC-CRE to CDC; this is acceptable but not required. Note that in most of the United States, KPC meets criteria for a Tier 2 (not regularly found in the region) or Tier 3 (identified before in the region but not endemic) organism for which each identification requires a public health response, as outlined in the **Interim Guidance for a Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs)**. Your local epidemiology should inform your response activities. Note that the containment response guidance is not intended to be applied to endemic MDROs. Questions about strategies for KPC response or response to specific cases should be sent to haioutbreak@cdc.gov.

7 *bla*<sub>OXA-48-like</sub> has not been identified in *Pseudomonas aeruginosa* therefore routine testing for *bla*<sub>OXA-48-like</sub> is not recommended. However, if *bla*<sub>OXA-48-like</sub> is identified in this organism, an alert should be sent.

8 Jurisdictional public health labs should discuss reporting of *Acinetobacter baumannii* with *bla*<sub>OXA-23</sub>, *bla*<sub>OXA-24/40</sub>, *bla*<sub>OXA-58</sub> to their HAI coordinator. If these organisms are not endemic or routinely identified in the region, an alert should be sent to the HAI coordinator and to CDC. For regions where these organisms are endemic or routinely identified, an alert does not need to be sent to CDC.

9 For any organism isolated from a screening swab, please send a new alert for the isolate testing results.

10 Alerts will be generated by testing regional lab, who will alert state/local jurisdictions when testing is performed and when an isolate with an alert value is detected.
Detection of mcr genes has been de-escalated from AR Lab Network priorities, and therefore testing for mcr genes is no longer requested by DHQP. If labs prefer to continue testing, please still report positive findings to CDC for situational awareness. Note: Proteus, Providencia, Serratia, or Morganella have intrinsic resistance to colistin and do not require mcr testing. 


At this time, there is no set definition for hypervirulence markers or phenotype. Note that mucoviscosity of isolates is not a sufficient indicator of hypervirulence.

Please contact CDC (haioutbreak@cdc.gov) to discuss implementation of containment responses related to the detection of suspected hypervirulence markers.

If you have confirmed the presence of a novel carbapenemase gene (excluding bla_KPC, bla_NDM, bla_VIM, bla IMP, bla_OXA-48-like, bla_MEF, bla_NMC, bla_SME), please:
- Immediately notify CDC and your jurisdictional health department of any preliminary findings of novel carbapenemase genes.
- Select the radio button beside “Is this isolate being sent for whole genome sequencing?” in the REDCap alert form.
- If you have sequenced the isolate, return to the alert form in REDCap to enter the HAI WGS ID and the NCBI HAI-Seq SRR ID associated with the isolate when sequencing is completed.
- Note: Unless WGS activities are CLIA approved in your laboratory, we do not recommend reporting sequencing findings to submitting clinical laboratories.

If you detect the presence of ≥1 targeted carbapenemase gene (bla_KPC, bla_NDM, bla_VIM, bla IMI, bla_OXA-48-like) AND ≥1 suspected hypervirulence marker (peg-344, prmpA, and prmpA2) using WGS data please:
- Update your REDCap entry to specify the gene(s) detected.
- Implement appropriate containment responses for the carbapenemase gene(s) detected and contact CDC for appropriate guidance and recommendations related to suspected detection of hypervirulence marker(s).

If you detect isolates with plasmid mediated linezolid resistance (cfr, optrA and poxtA), or there is a notable change in epidemiology (e.g. an increase in VRE bacteremia that might point to a concerning strain emerging), please contact CDC (haioutbreak@cdc.gov) to discuss implementation of containment responses.
Appendix E

Summary of Response
Recommendations for MDRO Containment by Tier
## Appendix E: Summary of Response Recommendations for MDRO Containment by Tier

<table>
<thead>
<tr>
<th>Description of Activity</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pan nonsusceptible (CRAB, CRE, CRPA)</td>
<td>Candida auris</td>
<td>CRE (KPC, mcr)</td>
</tr>
<tr>
<td></td>
<td>Pan resistant (Candida auris, CRAB, CRE, CRPA)</td>
<td>CRAb (IMP, KPC, NDM, VIM, uncommon plasmid mediated OXA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other novel organisms and resistance mechanisms</td>
<td>CRE (IMP, NDM, OXA 48, VIM)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CRPA (IMP, KPC, NDM, OXA 48, VIM)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>mCR+/PCR</td>
<td></td>
</tr>
<tr>
<td>Healthcare Investigation¹</td>
<td>Review the patient’s healthcare exposures prior to and after the positive culture</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td>Contact Investigation¹</td>
<td>Screening of healthcare roommates</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td>Broader screening of healthcare contacts²</td>
<td>Always³</td>
<td>Sometimes⁴</td>
</tr>
<tr>
<td></td>
<td>Prospective lab surveillance⁵</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td>Retrospective lab surveillance⁶</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td>Household Contact Screening</td>
<td>Sometimes</td>
<td>Rarely</td>
</tr>
<tr>
<td></td>
<td>Environmental Sampling</td>
<td>Sometimes</td>
<td>Rarely</td>
</tr>
<tr>
<td></td>
<td>Healthcare Personnel Screening</td>
<td>Sometimes</td>
<td>Rarely</td>
</tr>
<tr>
<td></td>
<td>Evaluate potential spread to Healthcare Facilities that regularly share patients with the index healthcare facility⁷</td>
<td>Sometimes</td>
<td>Sometimes</td>
</tr>
<tr>
<td>Infection Control Measures</td>
<td>Prompt notification of healthcare providers and patient and implementation of appropriate transmission-based precautions</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td>Clear communication of patient status with transferring facilities</td>
<td>Always</td>
<td>Always</td>
</tr>
<tr>
<td></td>
<td>Onsite Infection Control Assessment with observations of practice, such as Epidemiology and Laboratory Capacity (ELC) Infection Control Assessment and Response (ICAR)</td>
<td>Always</td>
<td>Always</td>
</tr>
</tbody>
</table>

¹For Tier 1 and 2 organisms/mechanisms, healthcare exposures and healthcare contacts over the preceding 30 days should be investigated unless information is available about the time the organism was most likely acquired. This includes any healthcare facility where the patient had an overnight stay during that time period. In some investigations, outpatient facilities and emergency departments might also be included. For Tier 3 organisms, investigation of healthcare exposures and healthcare contacts is generally limited to the current and sometimes prior admission.

²This may include targeted screening of contacts at highest risk for acquisition and/or unit point prevalence surveys.

³If the MDRO is a novel organism for which data on the frequency and modes of transmission are not known, or if the index patient was not on Contact Precautions during their entire stay in a healthcare facility, then additional screening (beyond roommates) is recommended. Broader screening, including patients on the same ward as the index patient and/or patients that shared healthcare personnel, might be particularly important for detecting novel MDROs when data on the frequency and modes of transmission are lacking.

⁴If the index patient was not on Contact Precautions during their entire stay in a healthcare facility, then broader screening (beyond roommates) is recommended. Screening can initially be limited to the contacts at highest risk for acquisition, such as those still admitted who overlapped on the same ward as the index patient and who have a risk factor for MDRO acquisition (e.g., bedbound, high levels of care, receipt of antibiotics, or mechanical ventilation). Alternatively, facilities may choose to screen entire units using point prevalence surveys.

⁵Prospective surveillance of clinical cultures should be conducted for 3 months after the last identified case.

⁶Conduct a laboratory lookback covering at least 6 months prior to identification of index case.

⁷A public health investigation should also be initiated at healthcare facilities known to regularly share patients with healthcare facilities where transmission has occurred, such as post-acute care facilities. At a minimum, this should include notification of the facility and a request to retrospectively and prospectively evaluate clinical cultures for the phenotype of interest. This could also include admission screening of patients at the facility (e.g., transfers from the index facility) and/or point prevalence surveys of high-risk patients or units.
Appendix F

References
References

1. Antibiotic Resistance Threats in the United States 2019
2. CDC’s Antibiotic Resistance (AR) Laboratory Networks
   https://www.cdc.gov/drugresistance/laboratories.html
3. CDC ARLN’s Connection with Local AR Capabilities
   https://www.cdc.gov/drugresistance/ar-lab-networks/domestic.html
4. CDC’s Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs):
   https://www.cdc.gov/hai/containment/guidelines.html
5. CDC’s Guidelines for Isolation Precautions, 2007:
6. Management of Multidrug-Resistant Organisms in Healthcare Settings, 2006:
7. CDC Implementation of Personal Protective Equipment (PPE) in Nursing Homes to Prevent Spread of Novel or Targeted Multidrug-resistant Organisms (MDROs) https://www.cdc.gov/hai/containment/PPE-Nursing-Homes.html
8. Texas Department of State Health Service Emerging and Acute Infectious Disease Guidelines: https://dshs.texas.gov/IDCU/investigation/Investigation-Guidance/
9. Recommendations for Infection Prevention and Control for Candida auris:
   https://www.cdc.gov/fungal/candida-auris/c-auris-infection-control.html
12. Recommendations for Identification of Candida auris:
    https://www.cdc.gov/fungal/candida-auris/recommendations.html