Global Action in Healthcare Network Antimicrobial Resistance Module (GAIHN-AR) Core Principles

Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

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Contents

1. GAIHN-AR Mission

The Global Action in Healthcare Network-Antimicrobial Resistance Module (GAIHN-AR) is a global network of healthcare facilities, laboratories, and infection prevention and control (IPC) teams with the mission to protect patients and healthcare workers from critical or emerging antimicrobial resistance (AR) threats by working at the forefront of laboratory detection, communication, and IPC action within healthcare settings.

2. GAIHN-AR Goals

- Advocate for sustainable programs that limit the spread of critical or emerging AR threats through prevention, detection, communication, and response at the healthcare facility with coordination and assistance as appropriate from national, regional, or global levels.
- Build relationships globally to facilitate sharing of experience, findings, resources (e.g., protocols, tools, trainings), and assistance, when appropriate.
- Implement harmonized laboratory and IPC methods and standardized data collection across the GAIHN-AR network.
- Empower partners to use data locally and facilitate GAIHN-AR data-sharing with the CDC to measure the progress and impact of the network, assist with detection and characterization of AR threats, and support partner preparedness to detect, prevent, and respond to these AR threats.
- Reduce prevalence and incidence of critical or emerging AR organism infection and colonization in participating healthcare facilities.

3. GAIHN-AR Core Principles

3.1 Introduction

This document provides a framework to establish GAIHN-AR as a global network with sites implementing harmonized strategies for prevention, detection, communication, and response. Operationalization of the Core Principles may require strategically phased steps accounting for the diverse capacities and unique challenges of each site.

Currently, GAIHN-AR's activities are focused on carbapenem-resistant Enterobacterales (CRE) with prioritization of CRE carrying mobile carbapenemase genes (CP-CRE) due to their high propensity for spread and difficulty to treat. The scope of GAIHN-AR may expand in the future depending on capacities across sites and priorities.

While GAIHN-AR is primarily focused on actions for CP-CRE, **many of the principles reviewed in this document are considered best practices for management of AR organisms overall. Additionally, GAIHN-AR should not detract from actions that would otherwise be taken by a facility** such as the use of Contact Precautions for other AR organisms.

A short summary of each category of GAIHN-AR's activities are listed below; however, further detail on each is available below in **Section 3.4**.

Prevention

The GAIHN-AR Prevention Strategy is focused on infection prevention and control (IPC) quality improvement including for hand hygiene, Contact Precautions, and environmental cleaning and disinfection in select units that are high risk for AR organism transmission. The quality improvement cycle includes assessment of IPC practices, development and execution of action plans to address opportunities for IPC improvement, and monitoring impact to provide data-driven feedback on improvement efforts.

Detection

Clinical and reference laboratories work together to detect and characterize critical or emerging AR organisms from isolates identified from clinical cultures (e.g., cultures obtained as part of routine patient care such as blood cultures) and colonization screening specimens (e.g., specimens collected in patients without signs or symptoms of infection) in order to facilitate a timely response from healthcare facility clinical care and IPC teams upon their identification.

Response

The GAIHN-AR Response Strategy encompasses actions taken after laboratory detection of critical or emerging AR organisms, with a current focus on CP-CRE. At a minimum, response to patients with infections or colonization due to CP-CRE should be the initiation of Contact Precautions (although some facilities may choose to also initiate for non-carbapenemase producing CRE as well).

Additionally, based upon laboratory and IPC resources, facilities may also respond to even a single patient infected or colonized with CP-CRE carrying novel or non-targeted carbapenemases requiring aggressive, coordinated laboratory and IPC activities to contain their spread (i.e., containment). A tiered system was developed to help facilities prioritize which carbapenemases to consider responding to with containment (see **Table 1** next page).

More information on containment is available in the document, "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Interim Guidance for Containment Activities."

Table 1. Definitions of Response Tiers

Footnote references within individual tables are located immediately following each table.

Tiers	Definition
Tier 1 (highest level of response)	Organisms[1] with a confirmed or non-targeted carbapenemase[2] that has never or very rarely been identified in the healthcare facility and for which a more extensive investigation is needed to define its epidemiology (e.g., routes of transmission).
Tier 2	1. Organisms[3] with a targeted carbapenemase which is never or rarely detected in the healthcare facility. These "targeted" carbapenemases are KPC, NDM, VIM, IMP, and OXA-48-like. 2. Organisms with a targeted carbapenemase which is commonly detected in a healthcare facility and have or develop pan-resistance.[4] The pan-resistance and targeted carbapenemase combination should never or rarely be detected in the healthcare facility. For example, KPC-producing CRE may be common and would not trigger containment, but if pan-resistant KPC-producing CRE is uncommonly found in the healthcare facility, it should trigger Tier 2 containment.
Non-Tier 1 or 2[5]	Organisms with targeted carbapenemases and antibiotic susceptibility patterns that are commonly identified in a healthcare facility and for which containment should not be routinely used.

[1] Organisms for Tier 1 response are not limited to CP-CRE and may include other AR organisms which contain novel or rare resistance patterns.

[2] Non-targeted carbapenemases are carbapenemases other than KPC, NDM, VIM, IMP, and OXA-48-like. Examples of non-targeted carbapenemases include but are not limited to rare metallo-β-lactamases such as SPM, SIM, and DIM.

[3] GAIHN-AR's activities are focused on carbapenemase-producing carbapenem-resistant Enterobacterales (CP-CRE), but the scope of GAIHN-AR may expand in the future depending on capacities across sites and priorities.

[4] Pan-resistance refers to organisms which are resistant to all relevant antibiotics tested at the clinical laboratory that serves the healthcare facility. Relevant antibiotics for CP-CRE are those that have activity against Enterobacterales and are available for treatment in the healthcare facility.

[5] While not considered "containable", IPC measures to prevent non-Tier 1 or 2 spread within healthcare settings is still essential.

Communication

Communication should be maintained throughout prevention, detection, and response activities, including but not limited to immediate communication of AR organism detection by the laboratory to IPC teams, patient care teams, and public health authorities; and communication during transfer of a patient with an AR organism to a new unit or a new healthcare facility in order to sustain IPC actions throughout the continuum of care. However, good communication with healthcare workers on topics such as IPC practice performance results, updates or creation of new policies and procedures, and success and challenges of quality improvement projects are also essential.

3.2 Selection of New Sites During Expansion

When considering expansion to new healthcare facilities or laboratories, implementing partners should consider the additional cost and staffing capacity necessary for expansion and conduct capacity assessments at any new sites under consideration. Implementing partners should prioritize sites meeting the minimum requirements outlined in the **Appendix** as well as **Table 2** and **Table 3** in Section 3.4.1 Laboratory Detection. Please refer to the "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Module IPC Facility Capacity Survey" and "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Module Laboratory Capacity Survey", which are capacity assessment tools designed to assist with site selection.

If minimum requirements cannot be met, implementing partners should work with the site to construct a plan to meet the minimum requirements, and sites should demonstrate timely progress toward this before fully

committing to participate in GAIHN-AR. Sites should be able to feasibly launch activities and demonstrate impact within the life of the Cooperative Agreement and must be able to report on GAIHN-AR indicators.

New sites selected may be public or private institutions, and **no sites participating as of May 2023 will be eliminated based on minimum requirements in the Appendix**.

3.3 Implementation Planning

Once sites are selected, implementing partners should work with each site to:

- Identify and engage with relevant leaders needed to sustain commitment and support for implementation (e.g., healthcare facility leadership, Ministry of Health, relevant professional societies).
- Select Targeted Prevention Units (TPUs) (see key terms).
- Plan conference calls and site visits to assess readiness and needs for implementation of GAIHN-AR, including baseline assessments of IPC practices in the TPUs and laboratory practices.
- Provide and discuss written feedback and recommendations to address the requirements and identified opportunities for strengthening prevention, detection, communication, and response activities.
- Develop implementation plans to include action plans and a roadmap (see key terms) for all GAIHN-AR activities. CDC can provide examples of action plans and roadmaps, if requested.

Key Terms

Targeted prevention units (TPUs) are units with a higher likelihood of AR organism transmission due to care of many patients with higher risk for AR organism acquisition and/or transmission (e.g., multiple invasive devices, prolonged lengths of stay, etc.) such as intensive care units or units with a previous history of AR organism outbreaks.

Action Plans are implementation planning documents outlining the necessary activities required to mitigate the identified gaps, summarize a timeframe for completion, and designate a responsible party.

Roadmaps are plans that should guide a facility's implementation of GAIHN-AR over time and should account for necessary IPC, laboratory, communication, and data reporting activities.

Implementation planning is best supported by early site visits, including visits to the selected clinical and reference laboratories and proposed TPUs, with the initial site visits ideally conducted within 6 months of choosing the site. Early site visits help facilitate understanding of:

- Laboratory methods, workflows, and capacities
- Laboratory and IPC equipment and consumable needs
- Baseline healthcare worker IPC practices (not just facility policies) within the TPUs
- Personnel needs for conducting GAIHN-AR activities
- Communication and informatics gaps and opportunities
- Barriers or sensitivities to data sharing
- Feasibility of implementing prevention and response strategies (including the use of containment) based on current infrastructure, practices, capacities, and previous laboratory findings

Implementing partners should also work with facilities to develop laboratory and IPC data systems and processes that are automated, sustainable, and scalable to make it easier for new sites to join. Avoid introducing systems and processes that would add unnecessary work burden on existing staff whenever possible.

Finally, while funds for the network can be used to hire personnel and support procurement of essential items such as personal protective equipment (PPE) or laboratory kits, sites should not become dependent upon network funds for day-to-day operations. It is essential that any workflows and practices introduced during implementation of GAIHN-AR receive support and commitment from relevant local leaders to ensure that changes in practice are acceptable and could be sustainable locally over time without external support.

3.4 Ongoing Network Activities

The section below describes the full scope of GAIHN-AR activities. Laboratories and IPC Teams should be working toward implementing all activities, but this may require capacity building and phased implementation. Facilities should strive to build IPC, laboratory, and communication activities in tandem. For instance, there is limited value in conducting admission screening if the laboratory is unable to effectively communicate the results with IPC teams or if healthcare workers are not prepared to implement Contact Precautions in response.

3.4.1 Laboratory Detection

GAIHN-AR sites should currently possess or have the ability to build laboratory testing capacity for detection and characterization of AR organisms, with an initial focus on CP-CRE.

Clinical and reference laboratories collaborate to identify and characterize CP-CRE from clinical and colonization screening specimens. Therefore, laboratory assessments should be performed at both clinical and reference laboratories to consider their capacities together, and assessments should cover the following topics:

- Availability of laboratory equipment, supplies and reagents
- Testing workflows
- Written standard operating procedures (SOPs)
- Quality control and quality assurance performed and documented
- Verifications and validations performed for testing methods related to GAIHN-AR
- Isolate storage space and conditions
- Staffing
- Laboratory data systems
- Communication of laboratory results to clinical care and IPC teams

After assessments are conducted, written recommendations and a Laboratory Action Plan for increasing laboratory capacity and mitigating identified gaps should be created. The Laboratory Action Plan outlines the necessary activities required to mitigate the identified laboratory gaps, summarizes a timeframe for completion, and designates a responsible party.

Methods, workflows, and processes for clinical and reference laboratories should be tailored with the goal of minimizing turnaround time of results and communication for IPC action; maximizing sensitivity, accuracy, and precision of results; and sustainability based upon available capacities and resources.

Implementation of recommendations and Laboratory Action Plan steps should be monitored to ensure timely progress and identify any further challenges.

When conducting laboratory assessments, keep the following requirements in mind:
Clinical laboratories should maintain capacity for detection and characterization of CP-CRE from clinical isolates and colonization screening specimens. Capacities for phenotypic detection of carbapenemase production should be available. Capacities for detection of carbapenemase genes/enzymes is ideal but not required.

Reference laboratories should maintain capacities for detection and characterization of CP-CRE clinical isolates using reference methods, including capacity for carbapenemase mechanism testing and ideally whole genome sequencing. Reference laboratories should also maintain capacity for rapid detection of CP-CRE from colonization screening specimens, if required to support the clinical laboratory.

For clinical isolates:

- All GAIHN-AR targeted Enterobacterales isolates should be tested by at least organism ID and AST.
- All CRE isolates should be tested to determine if one or more carbapenemases are present. CRE should be tested using one of the following workflows.
  Either
  All CRE isolates are first tested for all targeted carbapenemase genes/enzymes using a method such as ICT or PCR; and then all CRE isolates that test negative for all targeted carbapenemases are tested for phenotypic carbapenemase production using a method such as mCIM, BlueCarba, or CarbaNP.
  Or
  All CRE isolates are first tested for phenotypic carbapenemase production testing using a method such as mCIM, BlueCarba, or CarbaNP; and then all CRE positive for phenotypic carbapenemase production are tested for all targeted carbapenemase genes/enzymes using a method such as ICT or PCR.
- All isolates found to be carbapenemase production positive but negative for all targeted carbapenemase genes/enzymes (i.e., all isolates suspected to carry a Tier 1 resistance mechanism) and select Tier 2 isolates should undergo at least short-read whole genome sequencing.

For admission and routine colonization screening in Targeted Prevention Units (TPUs):

- It is recommended that this testing is performed in the clinical laboratory using a culture-based method.
- All CRE isolates should be characterized using either phenotypic carbapenemase production testing OR carbapenemase mechanism testing.
- Mechanism testing is ideal but not required.
  Decisions about phenotypic carbapenemase production testing versus carbapenemase mechanism testing should be tailored based upon available capacities, resources, and IPC goals of this activity.

For colonization screening of contacts during containment:

- Culture-based or culture-independent molecular methods (e.g., GeneXpert) may be used.
- When using a culture-based method, at least organism ID and carbapenemase mechanism testing is required.
- When using a culture-independent molecular method (e.g., GeneXpert), reflexive culture and organism ID is recommended for at least a subset of positive colonization screening swabs to aid in interpretation of results (e.g., when multiple carbapenemases are detected).
- This testing may be performed by the clinical or reference laboratory if rapid turnaround of testing and testing results communication is ensured.
- When an organism carrying a Tier 1 mechanism of resistance is detected, appropriate detection workflows and methods will need to be determined based on the screening target.

The required and ideal methods in clinical and reference laboratories are summarized in **Table 2** and required and ideal methods employed for admission and routine screening in the TPUs and for contact screening during containment are summarized in **Table 3**.

Quality of Testing:

To ensure quality testing, all laboratory methods listed for CP-CRE detection and characterization should have written SOPs available and be validated or verified as applicable. Routine Quality Control (QC) of all methods should be performed in accordance with manufacturer recommendations and/or local regulations. Routine Quality Analysis (QA) should be performed by laboratories in the form of participation in external quality assessments (EQA) or proficiency testing (PT) programs.

Isolate Storage:

Clinical laboratories must store all CP-CRE isolates for a minimum of 2 years or refer these isolates to the reference laboratory for storage. If there is not sufficient capacity at the clinical or reference laboratory to store all CP-CRE isolates, then laboratories should communicate this to CDC/implementing partner so that a subset of isolates can be prioritized for storage.

Table 2. Required and ideal laboratory testing methods in clinical and reference laboratories:

Footnote references within individual tables are located immediately following each table.

Testing Type	Clinical Laboratory Capacity	Reference Laboratory Capacity
Bacterial culture	Required	Required
Organism ID	Required	Required
Antimicrobial susceptibility testing[1]	Required	Required
Phenotypic carbapenemase production testing[2]	Required	Required
Mechanism testing[3]	Ideal; if unable to perform, establish plan for isolate testing at reference laboratory	Required
Whole genome sequencing and informatic analysis[4]	Not required; if unable to perform, establish plan for isolate sequencing at reference laboratory	Ideal to have at least next-generation short-read sequencing capacity required (long-read platforms should complement existing short-read capabilities, not to be used in place of); if unable to perform, establish plan for isolate sequencing at another reference laboratory

[1] AST is conducted ideally for ertapenem and at least 1 other carbapenem, aztreonam, cefepime, ceftazidime, and cefotaxime or ceftriaxone to rule out false-positive broad phenotypic carbapenemase production test results.

[2] Modified carbapenem inactivation method (mCIM), BlueCarba, CarbaNP or equivalent test

[3] Detection of carbapenemase genes/enzymes using immunochromatographic tests (ICT), real-time polymerase chain reaction (PCR), or another equivalent method

[4] Perform for isolates with Tier 2 or suspected Tier 1 resistance mechanism, with isolates with suspected Tier 1 carbapenemases being the highest priority

Table 3. Required and ideal laboratory testing methods employed for admission and routine colonization screening in TPUs and for colonization screening of contacts during containment:

Footnote references within individual tables are located immediately following each table.

Testing Type	Admission and Routine Screening	Contact Screening for Containment[3]
Culture-based screening for carbapenem-resistant organisms	Required	Required
Organism ID	Required	Required
Phenotypic carbapenemase production testing[1]	Required if mechanism testing not performed	Not Required
Mechanism testing[2]	Ideal; if unavailable, perform phenotypic carbapenemase production testing	Required
Whole genome sequencing	Not required	Not required

[1] Modified carbapenem inactivation method (mCIM), BlueCarba, CarbaNP or equivalent test

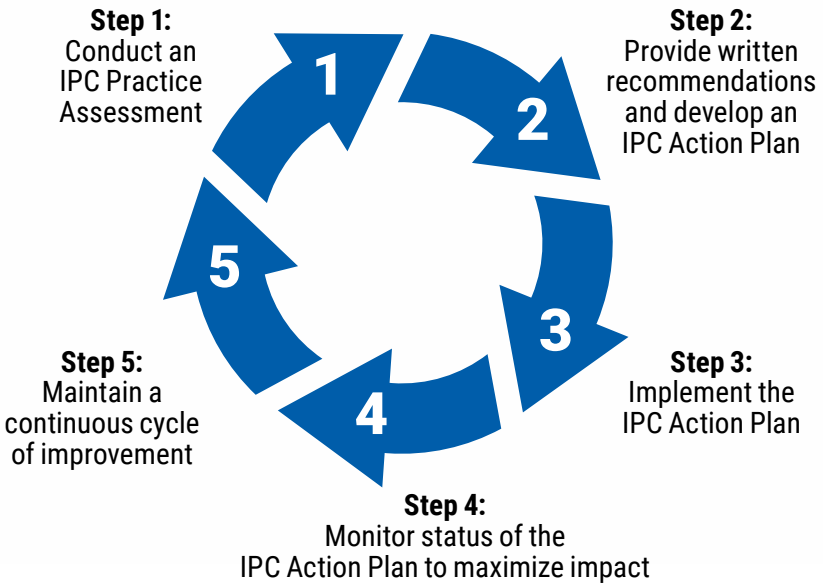
[2] Detection of carbapenemase genes/enzymes using ICT, real-time PCR, or other equivalent method

[3] When an organism carrying a Tier 1 mechanism of resistance is detected, appropriate detection workflows and methods will need to be determined.

3.4.2 IPC Prevention Strategies

All GAIHN-AR facilities should continually assess and improve their IPC practices to prevent the spread of all AR organisms.

The GAIHN-AR IPC Prevention Strategy, adapted from the World Health Organization's continuous cycle of improvement, is focused on practical IPC quality improvements within a facility's Targeted Prevention Unit(s) (TPUs). This Prevention Strategy is an iterative process composed of continual assessments, IPC action plan development, and implementation of practices to fill gaps and make improvements towards best practices. These steps are diagramed and summarized below.



Step 1. Conduct an IPC practice assessment.

An IPC practice assessment provides an in-depth understanding of a unit's current IPC practices, with an effort to assess the use and implementation of multimodal strategies. It is not just a review of a facility's policies and procedures but rather focuses on how those policies are implemented through direct observations and healthcare worker interviews. At a minimum, practice assessments of the three GAIHN-AR priority domains (hand hygiene, environmental cleaning and disinfection, and implementation of Contact Precautions) should be conducted. CDC has developed IPC practice assessment tools that can be adapted to the facility's needs. Please refer to the "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Module IPC Practices Assessment Tools."

Assessments can be conducted by an external assessor or completed as a self-assessment if the assessor possesses the appropriate IPC skills and knowledge and can provide an unbiased analysis of practices.

Additional IPC practices can be assessed based on individual unit priorities and gaps (e.g., device reprocessing, injection safety, etc.).

Step 2. Provide written recommendations and develop an IPC Action Plan.

Written recommendations outlining how the gaps identified in Step 1 can be mitigated should be provided to the unit. In addition an IPC Action Plan should be constructed. An IPC Action Plan is an implementation planning document outlining the activities required to mitigate the identified IPC gaps, summarize a timeframe for completion, and designate a responsible party.

Since multiple gaps in practices may be identified on a practice assessment, the IPC Action Plan can also help facilities list actions to prioritize first. This prioritization should be unique to the facility's needs but ideally is a combination of activities across all 3 assessment domains and a mixture of quick wins (high impact/low effort) and major projects (high impact/high effort). However, **correction of any gaps that could endanger staff or patients (e.g., mixing of environmental cleaning chemicals) should always be taken immediately**.

Step 3. Implement the IPC Action Plan.

For most facilities, the development or improvement of facility-specific IPC policies and standard operating procedures, education and training on these policies, and monitoring with feedback to healthcare workers on their adherence to these policies will play a key role in successful implementation.

If not already conducted prior to the initiation of work duties, annually, and as needed such as during an outbreak, HCW education on the three GAIHN-AR priority domains should comprise a part of the IPC Action Plan. Education that is competency-based is preferred as it allows healthcare workers to demonstrate skill mastery.

Strongly consider developing or improving the system for routine monitoring of hand hygiene, environmental cleaning and disinfection, and PPE use for those under Contact Precautions as part of your Action Plan. Quick audits of hand hygiene infrastructure (e.g., alcohol-based hand rub dispensers are functional, sinks are free of clutter, etc.) and Contact Precautions implementation (e.g., signage is in place, PPE is near the point of care, etc.) are highly encouraged as a starting point.

Step 4. Monitor status of the IPC Action Plan to maximize impact.

Facilities should strive to monitor the status of the selected actions included within the IPC Action Plan, to ensure that progress is being made and sustained during the improvement cycle.

Step 5. Maintain a continuous cycle of IPC improvement

Continually repeat this cycle of improvement through repeat IPC practice assessments and modifications to the IPC Action Plan.

Using colonization screening in Targeted Prevention Units to reduce and monitor impact on transmission of AR organisms including CP-CRE

Regardless of the baseline prevalence of an AR organism such as CP-CRE in a facility, IPC prevention efforts can be enhanced by the routine use of colonization screening for early identification and implementation of IPC action for colonized patients who may otherwise go undetected. Colonization screening can also allow for calculation of hospital-acquired CP-CRE rates, which could be a useful measure of IPC improvement efforts.

TPUs with adequate laboratory and IPC capacity should strive to initiate proactive colonization screening ideally at patient admission and on some routine basis thereafter (i.e., routine surveillance screening) during their stay in the TPU.

Admission screening should be conducted on all patients upon admission to the TPU unless the patient is already known to be infected or colonized with CP-CRE and for whom Contact Precautions would already be utilized. If a patient has a known CRE without prior phenotypic/genotypic testing, rescreening should occur. If this is not possible, facilities should develop prioritization schemes to direct how best to use this resource (e.g., limiting to screening patients at highest risk of colonization, https://www.cdc.gov/hai/organisms/cre/cre-clinicians.html).

Routine surveillance screening should be conducted on all TPU patients after admission unless they are already known to be infected or colonized with CP-CRE. If a patient has a known CRE without prior phenotypic/genotypic testing, rescreening should occur. In TPUs where there is consistent evidence of patient acquisition of organisms carrying multiple carbapenemases, TPUs should consider screening even those patients previously known to be infected or colonized with CRE/CP-CRE to assess for this.

The ideal frequency of routine surveillance screening is not known (e.g., weekly, biweekly, etc.). Facilities will want to consider factors such as average length of stay, pre-existing data on hospital acquisition rates, laboratory capacity, and human resources to conduct screening when determining frequency. Development of prioritization schemes may be required to direct how best to use this resource (e.g., limiting screening to patients at highest risk of colonization).

3.4.3 IPC Response Strategies to the Laboratory Detection of CRE/CP-CRE

IPC response to the laboratory detection of CRE/CP-CRE can range from initiating Contact Precautions to a more aggressive containment response upon identification of a single Tier 1 or 2 carbapenemase.

More extensive information on containment can be found in the document "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Interim Guidance for Containment Activities."

Contact Precautions Considerations

Although GAIHN-AR's current focus is on CP-CRE, ideally healthcare facilities are prepared to respond with IPC action, such as the initiation of Contact Precautions, upon laboratory identification of any epidemiologically significant AR organism based upon local data (e.g., non-carbapenemase producing CRE, carbapenem-resistant Acinetobacter).

Due to limited resources such as inadequate PPE supplies, some facilities may choose to only initiate Contact Precautions for a subset of high-priority organisms and mechanisms of resistance such as those with lower baseline prevalence until access to resources can be improved.

Containment Considerations

All GAIHN-AR facilities should be prepared to initiate a containment response upon detection of a CP- CRE with a Tier 1 mechanism of resistance as confirmed by laboratory testing and for which a more extensive investigation is needed to define its epidemiology (e.g., modes of transmission).

Some GAIHN-AR facilities will also initiate containment response for the identification of CP-CRE with a Tier 2 mechanism of resistance depending on local epidemiology and laboratory/IPC capacity.

Note: GAIHN-AR guidance does not address outbreak response (e.g., multiple cases of the same organism and/or mechanism of resistance identified above an expected baseline); however, CDC staff members are available to aid when requested.

3.4.4 Communication (i.e., Notification) After the Identification of Antimicrobial Resistant Organisms

All GAIHN-AR facilities should establish clear communication pathways between relevant partners (e.g., lab team, IPC team, medical unit staff, public heath) to ensure notification when patients infected or colonized with an AR organism such as CP-CRE is identified.

Laboratory detection of an AR organism should be rapidly communicated to relevant partners, ideally in an automated way whenever possible. This includes but is not limited to:

- Laboratories, patient care teams, and IPC focal persons within a healthcare facility
  - Laboratories should ideally communicate isolate-level and other summary information to IPC/patient care teams within 24 hours of detection of patients infected or colonized with an AR organism.
  - Communication can be greatly facilitated by a laboratory information system; however, if one does not exist, healthcare facilities should adopt communication solutions, such as phone calls and encrypted messaging, that protect patient privacy according to local regulations.
- Units within the same facility or at a different healthcare facility to which a patient infected or colonized with an AR organism is transferred
  - Methods used may range from technological solutions to paper transfer forms; however, selected methods should be based upon local needs and realities and protect patient privacy according to local regulations.
- Public health authorities as required by local regulation
- GAIHN-AR CDC and implementing partners

3.5 Requirements and Use for Data and Isolates Shared to CDC

This section describes the requirements for sharing data and isolates to CDC and the ways that those data and isolates will be used at CDC to support network partners. Specifically, this section addresses:

1. Indicator Reporting
2. Notification for detection of Tier 1 organisms
3. Additional reporting and isolate sharing requirements

By implementing harmonized activities across all sites, we can use indicators and other data reported to CDC to:

- Measure progress and impact of GAIHN-AR activities over time
- Provide situational awareness of the activities on the ground
- Support continuous quality improvement efforts through feedback, recommendations, and identification of areas for targeted support
- Understand successes and challenges of our partners
- Advocate for additional resources for the network
- Inform improvement of GAIHN-AR strategies and guidance

Data obtained through GAIHN-AR will also improve partners' understanding of AR organisms and mechanisms locally and globally, their awareness of emerging AR threats, and their ability to detect and respond to them.

Data and isolate sharing are critical to network goals. All data shared to CDC will be:

- **Deidentified**
- **Shared and stored in databases with security and privacy protection measures including log-ins and appropriately defined data access groups**

However, CDC recognizes that some sites may have barriers to sharing isolates and certain isolate level data. CDC will work with partners and countries to establish any necessary data use agreements and to adapt processes as is feasible to help them meet these requirements.

3.5.1 Indicator Reporting

CDC will provide a list of indicators to be electronically reported to implementing partners and the CDC every 6 months. All sites participating in GAIHN-AR are required to report on these indicators.

Indicator data will be used to:

- Monitor progress and impact of the GAIHN-AR over time
- Support quality improvement efforts for laboratory, IPC, and communication
- Identify and advocate for network resources
- Provide feedback and recommendation reports to each site

3.5.2 Notification for detection of Tier 1 Organisms

When a Tier 1 resistance mechanism is found, sites should be willing to:

- Notify CDC within 24 hours of detection
- Share isolates, whole genome sequencing (WGS) data, and necessary de-identified epidemiologic patient data (as feasible given patient privacy laws) with CDC

3.5.3 Additional reporting and isolate sharing requirements

Laboratory

As a global network that aims to be on the forefront of detecting emerging AR in healthcare, sharing and analysis of isolate/specimen-level data, WGS data, and isolates is essential.

The CDC's GAIHN-AR Global Laboratory requests that sites share to CDC:

- Isolates and WGS data for isolates with a Tier 1 resistance mechanism soon after its identification and select isolates with a Tier 2 resistance mechanism. We recommend sharing WGS data via an accessible repository (e.g., the GAIHN-AR BioProject: ID 962934 - BioProject - NCBI (nih.gov), a component of the CDC International HAI/AR Seq NCBI Umbrella Project).
- De-identified isolate-level data for all GAIHN-AR CRE targeted isolates tested, at least every six months, including results generated by:
  - ☐ Organism identification
  - ☐ Antimicrobial susceptibility testing
  - ☐ Phenotypic carbapenemase production testing
  - ☐ Carbapenemase identification
  - ☐ WGS, if performed

- Annually, a survey of testing methods used, available equipment, and infrastructure needs

For sites performing WGS:

- Deposit WGS data meeting the required quality standards in a recommended accessible repository (e.g., the GAIHN-AR BioProject: ID 962934 - BioProject - NCBI (nih.gov), a component of the CDC International HAI/AR Seq NCBI Umbrella Project), with minimum levels of metadata to protect patient privacy.
  - Ideally within 7-10 business days from confirmed identification for CP-CRE isolates with suspect Tier 1 mechanism of resistance
  - Ideally within 7-10 business days from sequence completion for all other CP-CRE isolates sequenced
- Implement standardized bioinformatic workflows and pipelines whenever possible to facilitate rapid turnaround of reproducible WGS analysis results.
  - CDC support is available for the implementation of PHoeNIx pipeline for interested sites.

These isolates and data will be used to better prepare participating sites to prevent, detect, and respond to emerging AR threats through:

- Monitoring for emerging AR threats
- Collaborating with network laboratories to develop and validate new detection assays for emerging AR
- Identifying profiles associated with targeted and emerging resistance to help streamline workflows and identify accurate testing platforms
- Identifying and advocating for resources needed to support detection of AR threats
- Facilitating understanding of sequence types, gene variants, plasmid types, and other key information about novel and emerging AR threats
- Helping to shape global and local response and prevention strategies

IPC

When CP-CRE with Tier 1 resistance mechanisms are found, facilities will also be asked to share de-identified epidemiological information about the affected patient(s) to facilitate characterization and awareness of emerging AR threats as well as information on the Tier 1 containment response. CDC will be available to offer technical assistance if requested.

For partners and sites who are willing to share more detailed data beyond the GAIHN-AR indicators such as de-identified information on Tier 2 containment responses or epidemiological descriptions of case patients, this data will be used to help shape further guidance and direction of the GAIHN-AR network.

3.6 Other Considerations for Data Reporting to Implementing Partners and CDC

When preparing for data collection and reporting, implementing partners should work with each site to assess reporting and informatics gaps, determine solutions to mitigate those gaps, and generate an Informatics Action Plan for how those gaps will be addressed.

When determining and addressing these needs, please consider the following:

- Building and improving upon existing electronic data systems is encouraged over introducing new systems that are GAIHN-AR specific, whenever possible.
- Establish or adapt existing electronic data collection and reporting systems to allow for:
  - Standardized and consistent capture of data elements required locally or by CDC for implementation of GAIHN-AR.
  - Export of a structured and consistent electronic file format.
  - Simplified analyses and ingestion of exports into other databases.
- Data should be used to help guide quality improvement within the facility and thus should be displayed in a manner that is understandable to laboratory and healthcare workers and shared frequently with them and other partners.
- Data quality should be monitored routinely ahead of data submission to confirm observed frequencies and findings, detect novel findings, and resolve discrepancies and duplicates.
- Each participating healthcare facility and laboratory should work with implementing partners and CDC to close out network laboratory and IPC data annually.
- Any aggregated data needs to be accompanied by a commitment to have a person locally with the needed data management and analysis skills who can, guided by CDC, perform additional explorations as needed, including providing additional information or ad hoc analyses based on unusual or unexpected findings or trends.
- Whenever possible, strive for automated data reporting, including reporting of routine isolate testing data to CDC and implementing partners in real-time to facilitate real-time global awareness of, and preparedness for, emerging AR threats.

4. Appendix: Table of Minimum Requirements for Site Selection

The following are minimum requirements for site selection for GAIHN-AR. The below table can be used during the process of initial site selection.

The "Prerequisite" rows describe the minimum capacities required at baseline for a healthcare facility or laboratory before fully committing to participate in GAIHN-AR. The "Have or be willing to implement/establish" rows describe additional capacities that are advantageous for early success in implementing GAIHN-AR. Sites meeting as many of these criteria as possible should be prioritized for participation.

If sites do not have these recommended capacities at baseline, they should at least be able and willing to establish these capacities as part of their implementation plan. Ideally sites should be able to establish the prerequisite capacities within 1 year and be able to feasibly launch activities and demonstrate impact within the life of the Cooperative Agreement.

When selecting sites for participation in GAIHN-AR, please also refer to the "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Module IPC Facility Capacity Survey" and "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Module Laboratory Capacity Survey."

Appendix Table 1. Requirements for All Laboratories and Healthcare Facilities

Prerequisites	Site Meets Requirements?
Basic infrastructure to support best laboratory and IPC practices ■ Continuous supply of running water ■ Capacity to consistently procure adequate supplies (e.g., PPE or laboratory reagents and consumables) ■ Continuous source of electricity ■ Laboratory temperature conducive to instruments and equipment	❑ Yes ❑ No
Willing to report all requested GAIHN-AR indicators and establish any data use agreements necessary to do so	❑ Yes ❑ No
Electronic data management systems with: ■ Consistent structure, good organization, and documentation ☐ The data should be stored in tabular databases like structured query language (SQL) or comma-separated values (CSV) ■ Ability to export data to a structured electronic file format that would simplify analyses and ingestion of exports into other databases. ☐ Example file formats could include SQL or CSV ☐ Ideally, database should allow for automated data transfers through an application programming interface (API) OR Commitment to a clear plan for sustainable implementation of such a system if none exists	❑ Yes ❑ No
Willing to make any necessary updates to laboratory and IPC information systems to capture and export CDC required data elements	❑ Yes ❑ No

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Have or be willing and able to implement	Site Meets Requirements?
Adequate refrigeration and freezer units for specimen and isolate storage.	❑ Yes ❑ No
Communication pathways for notifying relevant partners about patients who are infected or colonized with targeted AR organisms (e.g., CRE/CP-CRE) including: ■ Immediate communication of AR threat detection to IPC teams, clinicians, and appropriate public health authorities ■ Communication during transfer for a patient with an AR threat to a new unit or a new healthcare facility	❑ Yes ❑ No
When a Tier 1 organism is detected: ■ Notify CDC within 24 hours ■ Share isolate and WGS data with CDC ■ Share relevant deidentified epidemiological information on the case patient and Tier 1 containment response	❑ Yes ❑ No

Appendix Table 2. Requirements for Infection Prevention and Control (IPC) at Healthcare Facility Level

Prerequisites	Site Meets Requirements?
One full-time IPC focal person	❑ Yes ❑ No

Have or be willing and able to implement	Site Meets Requirements?
Hiring of additional IPC focal persons if facility does not meet minimum of 1 full-time IPC focal person per 250 beds	❑ Yes ❑ No
Facility-specific IPC guidelines/policies for Standard and Transmission-Based Precautions, hand hygiene, and environmental cleaning and disinfection	❑ Yes ❑ No
IPC-related trainings for all front-line healthcare workers, including cleaning staff, at hire and at least annually	❑ Yes ❑ No
Regular monitoring of healthcare worker adherence to IPC practices with feedback on performance to healthcare workers, facility leadership, and other relevant partners	❑ Yes ❑ No
Containment activities for at least Tier 1 resistance mechanisms. More information on containment is available in the document, "Global Action in Healthcare Network Antimicrobial Resistance (GAIHN-AR) Interim Guidance for Containment Activities."	❑ Yes ❑ No
Colonization screening (i.e., admission screening and/or routine surveillance screening) for CP-CRE in at least TPUs	❑ Yes ❑ No

Appendix Table 3. Requirements for Clinical and Reference Laboratories

All Clinical and Reference Laboratories

Prerequisites	Site Meets Requirements?
Demonstrated routine performance of quality control for all test methods	❑ Yes ❑ No

Have or be willing and able to implement	Site Meets Requirements?
Perform verification or validation for methods used for CP-CRE detection	❑ Yes ❑ No
Participation in external quality assurance (EQA) and/or proficiency testing (PT) of methods used for CP-CRE detection	❑ Yes ❑ No
Sharing deidentified isolate-level data for testing completed as a part of the GAIHN-AR network, including organism identification, antimicrobial susceptibility testing, phenotypic carbapenemase production testing, resistance mechanism testing, and WGS, if performed	❑ Yes ❑ No
Share select isolates and data with Tier 2 resistance with CDC	❑ Yes ❑ No
Deposit WGS data in a recommended accessible repository (e.g., NCBI), with minimum levels of metadata to protect patient privacy, within specified time frames	❑ Yes ❑ No

Clinical Laboratories

Prerequisites	Site Meets Requirements?
Capacity for testing clinical isolates in accordance with CDC guidance, including: ■ Bacterial culture ■ Organism identification ■ Antimicrobial susceptibility testing	❑ Yes ❑ No

Have or be willing and able to implement for testing of clinical isolates	Site Meets Requirements?
Capacity for antimicrobial susceptibility testing of: ■ ertapenem and at least one other carbapenem ■ aztreonam ■ cefepime ■ ceftazidime ■ cefotaxime or ceftriaxone	❑ Yes ❑ No
Capacity for broad phenotypic carbapenemase production testing (e.g., mCIM, Carba NP, or BlueCarba test)	❑ Yes ❑ No

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Have or be willing and able to implement for testing of clinical isolates	Site Meets Requirements?
Capacity for mechanism testing for targeted carbapenemase genes/enzymes OR Ability to ship isolate(s) to a reference laboratory for this testing within a recommend time frame	❑ Yes ❑ No
Ability to ship prioritized isolates to reference laboratory for whole genome sequencing (WGS) OR Ability to perform short-read WGS in-house, as needed	❑ Yes ❑ No
Available space and equipment (-70°C freezers) to store all CP-CRE isolates for minimum 2 years OR Communication to CDC/implementing partner if storage space for all CP-CRE isolates is unavailable so a subset can be prioritized for storage	❑ Yes ❑ No

Have or be willing and able to implement for colonization screening	Site Meets Requirements?
Capacity for culture-based screening for CP-CREs for admission and routine screening in TPUs, which includes: 1. Organism identification AND 2. Depending on local carbapenemase-producing organism (CPO) prevalence, testing resources available, and IPC goals either: Mechanism testing for targeted carbapenemase genes/enzymes (ideal) OR Broad phenotypic carbapenemase production testing	❑ Yes ❑ No
Capacity for contact screening during containment response using: 1. Culture-independent molecular screening to identify carbapenemase mechanisms (preferred, if sustainable) with the ability to conduct subsequent cultures of at least select positives for organism identification and characterization. OR Culture-based screening for CP-CRE to identify organism and mechanism testing to identify carbapenemase genes/enzymes OR 2. Access and ability to ship isolates to a reference lab that can perform this testing within a recommend time frame (Note: When an organism carrying at Tier 1 mechanism of resistance is detected, appropriate detection workflows and methods will need to be determined.)	❑ Yes ❑ No

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Reference Laboratories

Prerequisites	Site Meets Requirements?
Located within the same country as healthcare facilities they support (the exception being regional reference labs) and formally engaged in network OR Able to demonstrate rapid turnaround of testing and results reporting if not local/regional	❑ Yes ❑ No
Ability to support testing requested by the healthcare facility with rapid turnaround of testing and rapid reporting of results, within 24 hours of result	❑ Yes ❑ No
Capacity for testing of clinical isolates in accordance with CDC guidance, including: ■ Bacterial culture ■ Organism identification ■ Antimicrobial susceptibility testing ■ Broad phenotypic carbapenemase production testing ■ Mechanism testing for targeted carbapenemase genes/enzymes	❑ Yes ❑ No

Have or be willing and able to implement	Site Meets Requirements?
Routine use of reference methods such as Matrix-assisted laser desorption/ionization-time of flight (MALDI-TOF), antimicrobial susceptibility testing by broth microdilution, and real-time PCR	❑ Yes ❑ No
If needed to support clinical laboratories: Capacity for colonization screening using a molecular screening method to identify carbapenemase genes AND/OR Culture-based screening method for CPOs to identify organism and mechanism	❑ Yes ❑ No
Capacity for implementing detection of additional PCR targets for supplementary characterization (i.e. SME, GES, IMI, NMC carbapenemase genes/enzymes)	❑ Yes ❑ No
Mechanism for facilitating and receiving rapid shipping of isolates or specimens from the clinical laboratory to the reference laboratory	❑ Yes ❑ No
Capacity for at least short-read WGS OR Ability to send isolates to another reference laboratory for WGS, as needed	❑ Yes ❑ No
Use and compliance with CDC-specified WGS quality metrics	❑ Yes ❑ No
Expedited sequencing for CP-CRE with suspected Tier 1 carbapenemases, ideally within 7-10 business days from isolate identification	❑ Yes ❑ No

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