Public Health Strategies to **Prevent** the Spread of Novel and Targeted Multidrug-resistant Organisms (MDROs)

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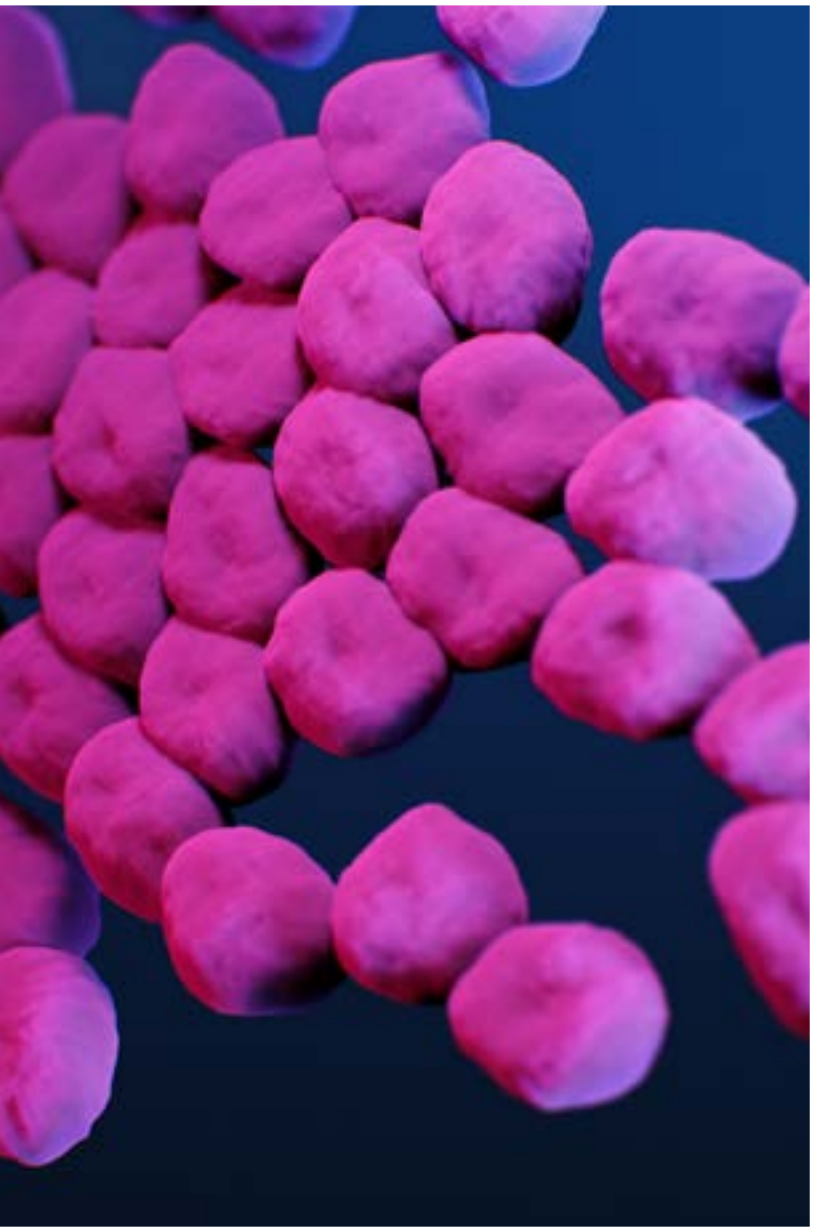

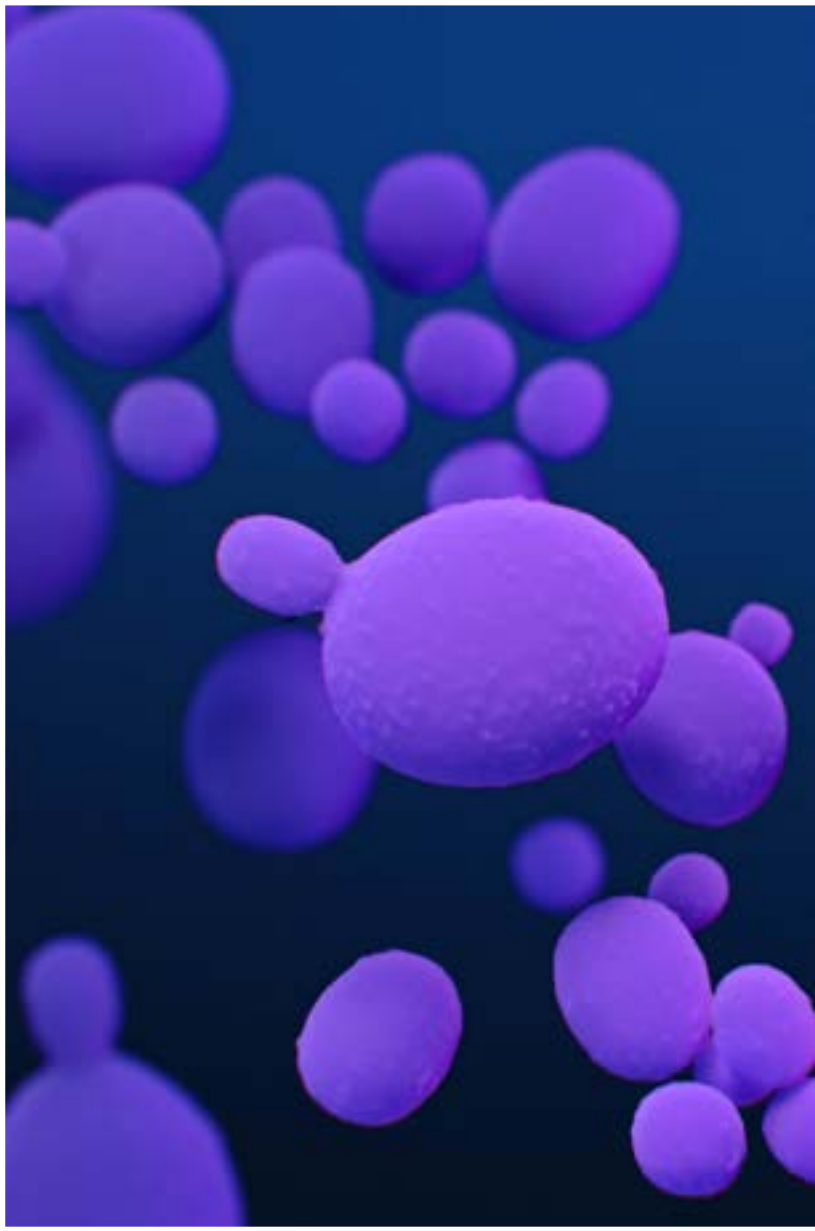

Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

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Introduction

This document is for use by state, local, territorial, and tribal health departments to support the development, implementation, and coordination of activities designed to prevent the spread of novel and targeted MDROs across multiple healthcare facilities within a jurisdiction. In contrast to the Interim Guidance for a Public Health Response to Contain Novel or Targeted MDROs, which provides response-driven strategies to contain individual cases as they are identified, this complementary guidance document outlines ongoing, long-term strategies to proactively identify patients/residents infected or colonized with, and reduce transmission of, novel and targeted MDROs across a region. Prevention activities should be developed in close collaboration with partners, such as other health departments, healthcare facilities, clinical and public health laboratories, regulatory agencies (e.g., State Survey Agency), and professional society chapters. Although MDRO prevention plans are intended to be long-term, multi-year endeavors, they are dynamic and subject to change to align with changes in resources and MDRO epidemiology.

Prevention strategies outlined here were informed by published evidence on prevention-focused interventions and mathematical modeling performed at CDC to estimate the relative population benefits for different bundles of prevention interventions.[1-3] Strategies included in the guidance are intended to reduce transmission of MDROs at all stages of spread, ranging from before a targeted MDRO is identified in a region, to endemicity. As the relative impact of different prevention activities varies by facility characteristics (e.g., patient/resident acuity and average length of stay) and the stage of MDRO spread, health departments should tailor their prevention activities based on the local epidemiology and available resources to maximize impact.

The guidance contains two sections:

Section I. Preparing to Implement an MDRO Prevention Plan: This section describes preparatory steps to inform development and implementation of an MDRO Prevention Plan. Steps include (1) determining the MDRO(s) that will be the focus of the prevention activities, (2) risk stratifying healthcare facilities within the jurisdiction, (3) prioritizing where to begin implementation, (4) evaluating jurisdictional laboratory capacity and surveillance, and (5) defining outcome and process measures.

Section II. Elements of an MDRO Prevention Plan: This section describes the four prevention strategies, (1) providing education, (2) improving general infection prevention and control (IPC) practices, (3) detecting colonized individuals, and (4) facilitating communication. The rationale and recommended activities are provided for each strategy.

Appendix 1 contains an overview of the sections and their individual components.

Definitions

Healthcare facilities:

For this guidance, the term 'healthcare facility' refers to all acute care hospitals and post-acute care facilities that care for patients or residents who remain overnight and require medical care, skilled nursing care, or rehabilitation services.

Residential Care Settings:

These facilities have staff that provide non-skilled personal care (i.e., assistance with activities of daily living like bathing, dressing, and cooking) to people with disabilities or older adults, similar to that provided by family members in the home. This includes settings like group homes, assisted living, and personal care homes. On-site healthcare services at high-risk congregate care sites are often provided by visiting or shared healthcare personnel (e.g., physical therapy, wound care, intravenous injections, or catheter care provided by home health agency nurses).

Novel MDRO:

An organism with a resistance phenotype (i.e., pattern of resistance to different antimicrobial agents) or a resistance mechanism that has never or very rarely been identified in the United States. Often, experience with these organisms is limited and a more extensive evaluation is needed to define the risk for transmission. In the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs), these are classified as Tier 1 organisms and mechanisms. Tier 1 organisms and mechanisms are uniform across the U.S.

Targeted MDRO:

An organism resistant to most or all available antimicrobials and with the potential to spread widely. Intensive public health actions are required to slow the spread of targeted MDROs. Current examples of targeted MDROs for much of the United States include pan-resistant organisms with potential for spread, carbapenemase-producing Enterobacterales (CP-CRE), carbapenemase-producing *Pseudomonas spp*. (CP-CRPA), carbapenemase-producing *Acinetobacter baumannii* (CP-CRAB), and *Candida auris*. In the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs), these are classified as Tier 2 and above; in some jurisdictions, targeted MDROs may be endemic. The organisms and mechanisms classified as targeted MDROs may vary among different U.S. regions.

Focus MDROs:

The subset of targeted MDROs that the area public health jurisdiction has identified as the focus of their MDRO Prevention Plan. These are the MDROs for which outcomes will be measured and interventions (e.g., educational materials or colonization screening) will be directed.

MDRO Prevention Plan:

A cohesive, comprehensive, and long-term (i.e., years) prevention strategy, coordinated by public health, intended to reduce the spread of novel and targeted MDROs among healthcare facilities.

Prevention-driven activities:

Activities such as infection control assessments or colonization screening that are planned and conducted independently of the detection of a case in a facility. These activities are described in this guidance document.

Definitions (Continued)

Response-driven activities:

Activities such as infection control assessments or colonization screening that are conducted in response to detection of a case (or cases) in a facility. These activities are described in the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs).

Epidemiologic Stages:

The general pattern of MDRO emergence and spread throughout a geographic area, adapted from the work of Grundmann and colleagues.[4] For the purposes of the complementary documents, **Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs**) and **Public Health Strategies to Prevent the Spread of Novel and Targeted Multidrug-resistant Organisms (MDROs)**, these stages are:

- No cases identified.
- Limited spread: Sporadic cases or sporadic clusters of epidemiologically-linked cases in single facilities or in pairs of facilities that frequently share patients (e.g., acute care hospital (ACH) and long-term acute care hospital (LTACH) or LTACH and skilled nursing facility (SNF)).
- Moderate spread: Cluster or clusters of epidemiologically-linked cases identified across multiple facilities that frequently share patients (i.e., cases are primarily limited to a single patient transfer network).
- Advanced spread: Clusters of cases identified across facilities in different patient transfer networks, suggesting transmission across networks.
- Endemicity: Cases are regularly identified in healthcare facilities across the region, including those in different transfer networks. Cases primarily occur in patients admitted from facilities in the region, suggesting that transmission is sustained without new importations from outside the area.

  When assessing the stage of an organism or mechanism, consider the most recent available information, such as the prior six months. The epidemiologic stage of an organism or mechanism may change due to rapid spread, or due to additional information gained from public health response or prevention activities.

Section I. Preparing to Implement an MDRO Prevention Plan

The steps below will inform development and implementation of a long-term MDRO Prevention Plan.

Step 1: Determine the focus MDROs

Although most prevention strategies are anticipated to reduce spread of all MDROs, health departments should select focus MDROs to inform selection of MDRO Prevention Plan activities, and process and outcome measures. Health departments should include multiple focus MDROs, aiming to include as many targeted MDROs as their resources allow. If resources initially allow for only one focus MDRO, jurisdictions should consider phased inclusion of additional focus MDROs in subsequent years. Health departments may wish to evaluate, on a yearly basis, whether additional focus MDROs should be added, based on the epidemiology of MDROs within their region and in surrounding regions. Focus MDROs may differ across areas in a single public health jurisdiction to reflect differences in local epidemiology.

Health departments should begin selection of focus MDROs by using available data to determine the epidemiologic stage(s) of targeted MDROs across their jurisdiction. Prevention strategies are most effective at slowing spread when started in early epidemiologic stages, including prior to an MDRO's introduction to the region.[1] Therefore if there are targeted MDROs in early epidemic stages (i.e., no cases identified or limited spread) in the jurisdiction, these should be included in the jurisdiction's focus MDROs, especially if they are at later epidemiologic stages in a neighboring jurisdiction. Additional considerations for choosing focus MDROs include leveraging preexisting prevention efforts, healthcare facility interest, and the ability to monitor impacts of the MDRO Prevention Plan on incidence or prevalence in the jurisdiction.

Step 2: Risk stratify the healthcare facilities within a jurisdiction

Certain healthcare facility characteristics (e.g., length of patient stay, acuity of care provided, admission and discharge patterns, and IPC program and practices) predict a healthcare facility's likely role in regional MDRO spread. Targeting prevention activities (described in Section II) to facilities based on their predicted role enables health departments to tailor interventions for greatest impact and efficiency. Therefore, one preparatory step, prior to making a prevention plan, is to risk stratify facilities based on their characteristics. Facilities may change categories as the local epidemiology changes or as more information about the local epidemiology becomes available.

Suggested Approach for Facility Risk Stratification (see Table 1)

1. **Inventory:** Create an inventory of healthcare facilities in the jurisdiction, labeled by facility type (i.e., long-term acute care hospitals [LTACHs], ventilator-capable skilled nursing facilities [vSNFs], skilled nursing facilities that do not care for ventilated residents [SNFs], inpatient rehabilitation facilities [IRF], acute care hospitals [ACHs]). Use the inventory for subsequent risk stratification steps.
2. **Identify influential facilities:** These are the facilities at highest risk of MDRO importation and transmission, usually due to their care of high-acuity patients/residents with long lengths of stay. Categorize these as "influential" facilities. These facilities have a large overall influence on regional MDRO prevalence, which can be positive or negative based on their efforts to prevent and respond to MDRO threats.[1,5,6]
    - At minimum, influential facilities include all LTACHs and vSNFs, which are at higher risk of importation and sustained transmission because they provide care to high-acuity patients/residents and have long average lengths of stay.
    - Facilities that are not vSNFs or LTACHs may also be influential; these are facilities that generally have had substantial transmission of a focus MDRO and are believed to impact regional prevalence. Because these do not have all the characteristics (i.e., long average length of stay and high-acuity population) of typical influential facilities, they are most frequently identified through response to novel and targeted MDROs, investigation of epidemiologically linked cases, and/or ad hoc point prevalence surveys (PPS).

3. **Identify facilities that are highly connected to influential facilities through patient sharing:** These facilities are the acute care hospitals and skilled nursing facilities that most frequently receive patients from influential facilities and are therefore likely to admit patients/residents with MDROs. Categorize these facilities as "highly connected."

   Among highly connected facilities, additional characteristics can further predict their potential role in MDRO spread:

   - Dispersal: Healthcare facilities with shorter lengths of stay, like ACH, can play a substantial role in MDRO dispersal – the spread of MDROs among facilities in a region – because relative to other facility types, they discharge patients at a higher rate and to many different facilities, including influential facilities.
   - Collection: Healthcare facilities with longer lengths of stay, such as skilled nursing facilities, are at risk of sustained MDRO transmission due to a higher risk of admitting MDRO colonized patients/residents, long average lengths of stay, and generally less resourced infection control programs compared to higher acuity settings. Compared to influential facilities, the transmission rates are typically lower due to the lower acuity of care provided; therefore, the overall influence on regional prevalence is less.

   When selecting prevention activities for facilities that have characteristics of both influential and highly connected facilities, such as vSNFs, follow recommendations for influential facilities.

   To identify highly connected facilities, informal methods (e.g., asking influential facilities about their transfer patterns) are likely sufficient, although formal network analysis based on patient sharing data could also be used. Additionally, examining transfer patterns across jurisdictional boundaries can help identify facilities that frequently receive patients/residents from influential facilities in other public health jurisdictions.

4. **Categorize all remaining facilities as "other":** "Other" can include a variety of healthcare facility types. These facilities generally have less influence on regional MDRO prevalence and are therefore not the focus of the most resource-intensive prevention interventions (i.e., proactive infection prevention assessments and colonization screening). However, they can benefit from prevention interventions such as education and communication. Additionally, like facilities in influential or highly connected categories, when cases of novel and targeted MDROs are identified in "other" facilities, a public health investigation should be performed in accordance with the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs).

Table 1. Facility categories for risk stratification

Facility categories	Characteristics	Examples of facility types
Influential	• Longer lengths of stay • Care for high-acuity patients/residents • Disproportionately influence regional MDRO prevalence relative to the number of patients/residents they serve • Can positively or negatively influence a region based on their efforts to both prevent and respond to MDRO threats	• Long-term acute care hospitals (LTACHs) • Ventilator-capable skilled nursing facilities (vSNFs)
Highly connected	• Facilities that most frequently receive transfers from influential facilities • May play different roles in MDRO spread based on their characteristics: o **Dispersal:** Facilities that discharge patients at a higher rate and to many different facilities can expand the spread of MDROs across a region (i.e., movement of persons with MDROs to different facilities in a jurisdiction) o **Collection:** Facilities with longer lengths of stay that are at risk of frequent MDRO importation, providing opportunity for low but sustained MDRO transmission	• Acute care hospitals (ACHs) • Critical access hospitals (CAHs) • Skilled nursing facilities that do not care for ventilated residents (SNFs)
Other	• Facilities that are not influential nor highly connected to an influential facility • Can care for patients with MDROs and experience MDRO-related outbreaks	• ACHs • CAHs • SNFs • Inpatient rehabilitation facilities • May include additional settings (e.g., wound care clinics, dialysis) and providers (e.g., home health) based on local epidemiology, as determined by the public health authority

Step 3: Decide where to begin MDRO Prevention Plan implementation

Prevention activities will be most impactful when they are implemented in all influential and highly connected facilities. Operationally, most health departments will implement prevention plans in phases, generally by piloting implementation in a subset of facilities and then expanding as experience and capacity grow. Selection of facilities for initial implementation should take into consideration local capacity, current epidemiology of focus MDROs, number and type of facilities in the jurisdiction, and health equity (i.e., ensuring the inclusion of facilities that serve populations experiencing health inequities or disparities in health outcomes in the jurisdiction's MDRO prevention initiatives).

Example approaches for initial implementation of prevention activities include selection by:

Geographic region: Begin implementation in facilities in a geographic region within a public health jurisdiction. Factors to consider when prioritizing regions for intervention include: the number of influential facilities, the local epidemiology of novel or targeted MDROs (e.g., prioritizing areas where the MDROs of interest are in early stages of emergence), and the presence of factors favorable to implementation (e.g., existing partnerships between facility and public health, ease of logistics).

Patient/resident-sharing network: Begin implementation in a subset of facilities that frequently share patients/residents.

Facility category: Begin implementation in influential facilities, then expand to highly connected facilities. This strategy can be applied across an entire jurisdiction, or implemented in combination with the geographic or patient-sharing network strategies above.

Approaches that maximize participation of influential facilities in highly impactful prevention activities (e.g., colonization screening and initiatives to improve infection control) are predicted to have the greatest and most rapid impact in the region.[1]

Step 4: Evaluate jurisdictional clinical laboratory surveillance

MDRO surveillance from both clinical cultures and colonization screening should guide prevention planning (**see Section I, Step 1-Focus MDROs**) and be used to monitor the impact of prevention activities (**see Section I, Step 5-Process and Outcome Measures**). Health departments should:

- Evaluate the current capabilities of clinical laboratories serving healthcare facilities in the public health jurisdiction to detect and report suspected or confirmed novel and targeted MDROs.
- Determine if expanded reporting, testing, and/or isolate submission may be beneficial.

Based on this evaluation, health departments should work strategically with clinical laboratories to improve detection and reporting of the focus MDROs and resistance mechanisms from both clinical cultures and surveillance testing to best meet their jurisdictional goals.

Including clinical cultures in MDRO detection efforts can augment colonization screening strategies used for early detection and increases opportunities to identify individuals with a targeted MDRO for implementation of appropriate infection control measures.

Example elements of a clinical laboratory surveillance evaluation and strategies to strengthen jurisdictional laboratory surveillance are described in the **FAQ**.

Step 5: Define process and outcome measures

Health departments should define an overall prevention goal and process and outcome measures for the MDRO Prevention Plan prior to implementation. Progress should be shared regularly (e.g., at least annually) with partners.

- The overall goal of MDRO Prevention Plans is to prevent the spread of targeted MDRO(s); health departments should develop goals based on the epidemiology of the focus MDRO(s) and available jurisdictional resources. For example, regions with low prevalence focus MDRO(s) might aim to maintain stable, low prevalence (e.g., prevalence at influential facilities remains stable, as determined by recurring point prevalence surveys) and regions with high prevalence focus MDROs might aim to decrease prevalence by a certain percentage.
- The jurisdiction should select outcome and process measures to measure progress towards overall goals and to assess the implementation and effectiveness of individual prevention activities, including:
  - An overall outcome measure to assess progress towards the overall goal. This measure should account for the influence of improved detection (e.g., increased laboratory submission and reporting, increased colonization screening) on the selected metric.
  - Additional outcome measures to evaluate the effectiveness of different prevention activities (e.g., measuring improvement in hand hygiene adherence rates during initial and follow-up IPC visits).
  - Process measures to assess the extent of implementation of specific activities. Example process measures for MDRO prevention interventions include the number of infection control assessments conducted, the number of facilities participating in proactive colonization screening, and the number of colonization screens performed. Ideally, each activity should have at least one associated process measure.

Section II. Elements of an MDRO Prevention Plan

MDRO Prevention Plans should include at least one activity from each of the four strategies described in this section: conduct education, improve IPC practices, detect colonized individuals, and facilitate communication. Activities can be implemented using a phased approach. The following overarching principles[1] may inform selection and prioritization of different prevention activities:

- **Starting MDRO prevention activities early is expected to avert the greatest number of transmissions relative to delayed intervention.**
  However, even after endemicity is reached, prevention can still decrease transmission.
- **The relative impact of different prevention activities varies by facility risk category and the epidemiologic stage of an MDRO.**
  Jurisdictions should prioritize activities expected to have the biggest regional impact on MDRO transmission. This may require limiting some resource-intensive activities (e.g., public health supported colonization screening) to influential facilities rather than pursuing broader implementation.
- **In non-endemic settings, MDRO prevalence is expected to continue to rise despite the use of prevention strategies, but at a slower rate compared to if these strategies are not implemented.**

This section describes each prevention strategy and provides example prevention activities aligned with the strategy. The strength of the recommendations (**Table 2**) in this section are informed by the published literature, public health agency field experiences, and CDC mathematical modeling. A more detailed description of the CDC mathematical model inputs and results can be found in the FAQ.

Table 2. Activity recommendation levels

Level	Activity
Highly recommended	Activities expected to have greatest relative impact in reducing MDRO prevalence. These should be the highest priority for implementation.
Recommended	Activities expected to have moderate impact in reducing MDRO prevalence when implemented. These should be prioritized below activities rated "highly recommended".
Consider	Activities expected to have some impact in reducing MDRO prevalence, but with lower relative impacts than "highly recommended" or "recommended" activities. Generally, these should be implemented if resources allow after implementing activities with higher recommendation levels.
Not routinely recommended	Activities not expected to have significant impact in reducing MDRO prevalence in most situations or jurisdictions.

Prevention Strategies

Strategy 1: Conduct education

Well-directed education can increase healthcare personnel and facility administration engagement and adherence to recommended interventions. Heath departments should educate healthcare personnel about strategies to detect and prevent the spread of novel and targeted MDROs, MDRO transmission fundamentals, IPC principles, and the characteristics of novel or targeted MDROs in their jurisdiction.

Education can be conducted using different approaches (e.g., webinars, in-person workshops, onsite visits, email communication) and include both broad-based, general education efforts and more individualized efforts tailored to facility-specific needs. Educational subject matter and audience can also be tailored based on the characteristics of the focus organism; for example, a region focusing on carbapenem-resistant *Acinetobacter baumannii* or *Candida auris*, organisms for which the healthcare environment plays an important role in transmission, may choose to develop educational materials for environmental services workers. Whenever

feasible, opportunities for active engagement (e.g., practicing learned skills followed by return demonstration of competency) should be incorporated into educational offerings.

Education should include expectations for facilities to promote staff education about MDROs and IPC.

Intensive, customized educational activities, such as onsite education, should be prioritized for influential facilities because of the potential for education to enhance the impact of other prevention interventions (i.e., colonization screening and infection control assessments) targeted to this facility type (Table 3).

Table 3. Recommended educational activities by facility category

Activities	Recommendation by Facility Category
Provide multidrug-resistant organism (MDRO) and infection prevention and control (IPC)-based education to healthcare facilities during planned infection control assessments (onsite or remote). *Objective:* To ensure recommendations made during assessments are understood and give healthcare personnel an opportunity to ask questions.	**All** – Highly recommended for any facility receiving an infection control assessment for prevention or response activities
Schedule IPC demonstrations or in-services using a "train-the-trainer" format or delivered directly to frontline staff. All trainings should include demonstrations of competency. *Objective:* To increase facility IPC knowledge and capacity tailored to a specific facility's needs.	**Influential** – Highly recommended **Highly connected**– Recommended **Others** – Consider
Provide healthcare facilities with group educational opportunities, such as a webinar series, educational symposiums, or workshops focused on MDROs and IPC practices. Consider inviting additional partners (e.g., state survey agencies, local health departments) to educational opportunities. *Objective:* To increase knowledge and shared purpose among a wider and more diverse group of partners including those who will participate in fewer prevention activities but should still be prepared to identify and care for individuals with MDROs.	**Influential** – Highly recommended **Highly connected** – Highly recommended **Others** – Recommended

Strategy 2: Improve infection prevention and control (IPC) practices

Core IPC practices are designed to reduce pathogen transmission and infections among patients and residents at healthcare facilities across the continuum of care.[7] Good adherence to these practices is predicted to limit transmission of novel and targeted MDROs overall, not just the focus MDROs.

Health departments can improve facility IPC through prevention-driven (i.e., conducted independently of identification of new targeted MDRO colonization or infection or infection control concerns) assessment of IPC practices, coupled with recommendations and coaching to mitigate identified gaps. Prevention-driven IPC activities are listed in Table 4 and complement response-driven infection control assessments described in the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs).

- In prevention-driven IPC assessments, practices should be assessed using a standardized tool that reviews facility policies and practices and includes direct observations of, at minimum, hand hygiene, personal protective equipment (PPE) use, environmental cleaning and disinfection practices, and measures to prevent transmission from sinks, drains, and plumbing. CDC infection control assessment and response (ICAR) tools are available for different healthcare settings and include these key areas for MDRO prevention-focused assessments.

After an initial assessment, follow-up with the facility's leadership and infection control program is crucial to review progress towards implementing recommendations, provide additional implementation assistance, if needed, and identify additional educational opportunities. Instituting IPC improvements prior to MDRO introduction at healthcare facilities is anticipated to prevent transmission once introduction occurs.

- Prevention-driven IPC assessments can be performed on a recurring or ad hoc basis.
  - Prioritize recurring IPC assessments for influential facilities, as IPC improvements in these facilities are expected to result in larger regional reductions in MDRO prevalence relative to these activities in highly connected and other facility types.
    - Perform recurring IPC assessments at least yearly, regardless of the presence or absence of targeted MDRO(s). This provides opportunity for ongoing conversation between the facility and health department to improve IPC practices and identify and address issues as they arise.
    - If there is also capacity for recurring assessments at highly connected facility types, select these facilities based on identified need or characteristics, such as prior MDRO outbreaks, prior IPC gaps, regulatory survey findings, health equity considerations, or ad hoc assessment results.
  - Ad hoc or as-needed IPC assessments are generally one-time IPC assessments that, for prevention, should be used to identify and correct infection control gaps in highly connected facilities that have not had a recent assessment or have a suspected high MDRO prevalence (as defined by the health department). Prioritize facilities with substantial IPC gaps identified on ad hoc IPC assessments for follow up and/or recurring visits, as determined by the local public health authority.

To improve IPC practices in skilled nursing facilities, MDRO Prevention Plans should include implementation of Enhanced Barrier Precautions (EBP). As EBP requires gown and glove use for certain residents during specific high-contact resident care activities that have been found to increase risk for MDRO transmission, it is a key intervention to prevent transmission of MDROs in skilled nursing facilities.

Table 4. Recommended infection prevention and control (IPC) activities by facility category.

The prevention-driven IPC activities listed in this table complement and do not replace response-driven infection control assessments described in the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs).

Activities	Recommendation by Facility Category
Conduct prevention-driven, recurring (at least yearly) MDRO-focused infection control assessments. These assessments should be conducted regardless of the presence or absence of the MDRO(s) of interest. More frequent assessments should be conducted based on available resources and facility need. *Objective:* To identify infection prevention and control (IPC) gaps and provide gap mitigation recommendations on a regular basis and not dependent on the identification of an MDRO.	**Influential** – Highly recommended **Highly connected** – Consider for facilities with limited IPC capacity **Others** – Consider for facilities with limited IPC capacity
Conduct prevention-driven, ad hoc infection control assessments. *Objective:* To identify IPC gaps and provide recommendations on gap mitigation on an as needed basis and not dependent on the identification of an MDRO. For response-driven infection control assessments, see the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs)	*Recommendations for ad hoc, prevention-based assessments are intended for facilities not receiving recurring IPC assessments* **Influential** – Highly recommended but recurring assessments strongly preferred. **Highly connected** – Highly recommended for facilities with limited IPC capacity; otherwise consider **Others** – Consider for facilities with limited IPC capacity

Activities	Recommendation by Facility Category
Provide follow-up and technical aid to mitigate identified gaps as needed. This could include more focused IPC assessments with objective observations (auditing) of certain practices such as hand hygiene and environmental cleaning. *Objective:* To aid with IPC gap mitigation, ensure gap mitigation is conducted, and build facility capacity.	**All** – Highly recommend for all facilities with identified critical IPC gaps **Influential** – Highly recommended even if critical IPC gaps were not identified

Critical IPC gaps are practices beyond the standard of care that require immediate correction to maintain patient and healthcare personnel safety. Examples include but are not limited to low adherence to hand hygiene or absence of alcohol-based hand sanitizer dispensers, breaches in cleaning and disinfection of shared medical equipment or device processing.

Strategy 3: Detect colonized individuals

Individuals with clinical MDRO infections represent only a small fraction of total individuals with a targeted MDRO as many more are colonized. Colonized individuals can be a source of transmission to others within healthcare settings, particularly when their colonization status is unknown and, as a result, recommended IPC interventions are not applied. Even under enhanced detection efforts, MDROs may spread substantially in a facility or region before the first clinical culture is detected.[8] Combining colonization screening with good adherence to core IPC practices will have a larger impact on limiting novel and targeted MDRO transmission than either of these strategies alone. Prevention-driven (i.e., not in response to a case) point prevalence surveys (PPSs) and admission screening are two strategies that can be used to detect colonized individuals.

Prevention-driven PPSs are colonization screenings performed unit- or facility-wide based on the healthcare facility (or unit-level) risk for MDRO importation and transmission (Table 5). These are pre-planned, and therefore distinct from the response-driven PPSs performed following identification of patient/resident with a novel or targeted MDRO and described in the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs). The goal of these surveys is to identify colonized individuals so recommended interventions can be applied and to regularly assess facility MDRO epidemiology.

- **Prevention-driven, recurring PPSs** are performed at a predetermined frequency (e.g., every four to six months). These are resource-intensive and should therefore be prioritized for influential facilities (or units), where they are expected to have the greatest impact on regional MDRO prevalence.

  Implementation considerations:

  - In facilities that care for patients/residents with a wide range of risk levels for MDRO acquisition, recurring PPSs should be limited to high-risk patients/residents or units (e.g., the ventilator unit in a vSNF), unless there is concern for high colonization pressure among other patients/residents. In a facility where all patients/residents are at high-risk for MDROs (e.g., LTACH), the PPS should generally be performed facility-wide.

  Maximizing efficacy:

  - CDC mathematical models suggest the more frequently PPSs are performed in influential facilities, the greater the predicted reductions in regional MDRO prevalence. However, the benefit of more timely detection must be balanced with available laboratory, public health, and facility resources and may also be informed by the MDRO's epidemiologic stage.
    - Increasing the frequency of PPS from twice yearly to quarterly is predicted to have greater benefits in regions with higher prevalence compared to those with limited spread of the MDRO. Screening less frequently than every six months is only predicted to be impactful in regions where the MDRO is pre-introduction.

- In areas that are pre-introduction or have limited spread of the targeted MDRO, the decreased impact of less frequent PPSs may be moderated by other activities, such as admission screening (described below) or enhanced laboratory surveillance of clinical cultures.
- The frequency of prevention-driven, recurring PPSs may change over time based on local epidemiology. Since even with effective prevention strategies the prevalence will slowly increase, in some areas an increase in PPS frequency may be necessary, for example, from twice yearly to quarterly as prevalence rises.
- Reductions in regional MDRO prevalence are not predicted to result from prevention-driven, recurring PPSs performed at non-influential facility types.

- **Prevention-driven, *ad hoc* PPSs** are performed once or intermittently to help define the regional epidemiology. These may identify facilities that lack typical characteristics of influential facilities but have high MDRO prevalence and/or unidentified MDRO transmission where additional IPC and/or screening efforts may be beneficial.

Recommended actions when cases are identified on prevention-driven PPS:

- If the number of cases identified is at or below the facility's baseline (i.e., prevalence is the same or lower than on previous PPS), then performing screening or IPC assessments beyond those already scheduled is not indicated.
- If the number of cases detected on prevention-driven PPS is above the baseline established by prior PPS, or otherwise suggestive of increased transmission in the facility, take actions to mitigate further spread:
  - Assess infection control practices.
  - Consider performing at least one additional PPS approximately 2-4 weeks after the prevention PPS, on the unit(s) where transmission is suspected.
  - The extent of screening (e.g., scope of individuals screened during follow up and number of follow up PPSs) depends on the stage of MDRO emergence, facility prevalence, facility infection control infrastructure, and jurisdictional capacity. Screening guidance in the Interim Guidance for a Public Health Response to Contain Novel or Targeted Multidrug-resistant Organisms (MDROs), can additionally inform the extent of screening for MDROs falling within the response tiers. For example,
    - Identification of a cluster of a targeted MDRO that has never or very rarely been identified in the region should prompt follow up screening and infection control support with the goal of eliminating, or at least greatly reducing, spread in the index facility and preventing spread at connected facilities.
    - An increase over baseline of an MDRO (e.g., potential outbreak) that is in stages of advanced spread in a region, in a facility with baseline low to moderate prevalence, may prompt one to two additional PPSs after gaps in infection control are addressed, to assess whether transmission is controlled (i.e., returned to or below baseline).
  - Screening performed in response to findings from a prevention-driven PPS should be performed with a clear goal, such as to assess whether infection control measures have reduced transmission. Outside of acute outbreaks, this goal should generally be able to be accomplished with 1-2 follow-up PPSs.
  - If the facility is engaged in recurring PPSs (see below), these should continue on the planned schedule (e.g., quarterly).

Admission Screening is the use of colonization screening to identify an MDRO at the time of admission to a new healthcare facility or unit within the same facility to ensure timely implementation of recommended interventions (e.g., use of Contact Precautions, placement in a cohort unit). In addition, admission screening can be useful to measure IPC effectiveness at a facility (i.e., parsing MDRO importation from intra-facility transmission

when coupled with repeat PPSs) and identify other facilities in the region with a high MDRO prevalence. Admission screening requires the facility to develop procedures to ensure screening is performed promptly for all intended patients/residents, with coordination between facilities and laboratories performing testing.

Implementation considerations:

- Facilities may perform universal or targeted admission screening. Targeting may be based on patient MDRO acquisition risk factors (e.g., those who are bedbound, require high levels of care, are receiving antibiotics, current mechanical ventilation, etc.), transfer from certain facilities (e.g., influential facilities, facilities with outbreaks), and/or admission into certain units (e.g., intensive care units). The approach to admission screening will depend on facility type and available resources; please see **FAQs** for additional admission screening considerations.

Maximizing efficacy:

- The benefit of admission screening is predicated on good adherence to IPC practices in the facility in which it is implemented. In the absence of good adherence to IPC practices, admission screening is not expected to reduce facility and regional transmission.
- CDC mathematical modeling indicates that the impact of admission screening on regional prevalence depends on facility risk category and epidemiologic stage of an MDRO.
  - At early epidemiologic stages, implementing admission screening in influential facilities (e.g., LTACH, vSNF) where the focus MDROs have not been identified or are low prevalence is predicted to have the greatest impact on regional prevalence. At this epidemiologic stage, admission screening in highly connected facilities that discharge to many different facilities (i.e. those identified as dispersal facilities in the risk stratification), such as ACHs, is also predicted to be impactful, but less so than in influential facilities.
  - At later epidemiologic stages, implementing admission screening in highly connected facilities that discharge to many different facilities (e.g., ACHs) is predicted to have the greatest impact on regional prevalence. At these stages, admission screening is predicted to have substantially less benefit in other settings, but could be beneficial for facilities with certain characteristics:
    - Influential facilities with demonstrated strong IPC programs and low rates of intra-facility transmission, for which admission screening results can be used to enhance certain IPC practices. For example, admission screening in such facilities could enhance timely placement of patients/residents in a cohorted unit or facilitate implementation of other measures that substantially disrupt transmission.
    - Highly connected facilities that regularly receive patients/residents from an influential facility that is experiencing unmitigated transmission or cares for many individuals with focus MDRO(s) (e.g., SNFs that do not provide care for mechanically ventilated patients/residents). In this scenario, admission screening should be implemented after a proactive, ad hoc PPS.
- In general, implement admission screening only after conducting a baseline PPS, particularly in long-term care settings; admission screening does not replace ongoing, recurring PPSs in influential facilities.
- In lieu of admission screening, ACHs and LTACHs in areas of high prevalence may implement empiric Contact Precautions based on a patient's/resident's individual MDRO risk factors and/or the characteristics of the transferring facility (e.g., high MDRO prevalence, characteristics of an influential facility).
- CDC continues to recommend admission screening for individuals with recent history of overnight stays or invasive procedures in healthcare facilities outside the United States.[9-11]

Table 5. Recommended prevention-driven colonization screening activities by healthcare facility category.

Additional screening may be recommended for purposes of public health response to identification of novel or targeted MDROs.

Activities	Recommendation by Facility Category
Prevention-driven, recurring point prevalence surveys (PPSs) at a predetermined frequency *Objective:* To routinely identify colonized individuals in facilities at highest risk for importation and transmission of MDROs to apply timely IPC interventions across the patient's/resident's continuum of care.	**Influential** – Highly Recommended **Highly connected** – Not routinely recommended **Others** – Not routinely recommended
Prevention-driven, ad hoc PPSs *Objective:* To define the extent of spread of the MDRO(s) of interest beyond influential facilities and identify facilities where additional interventions (e.g., infection control assessments, additional PPSs) should be applied.	**Influential** – Not recommended, as recurring PPSs are predicted to be more effective in this setting. **Highly connected** – Highly recommended for facilities that regularly receive patients/residents from an influential facility with an MDRO outbreak or with high MDRO prevalence (as defined by the health department), especially as applied to individuals who are: • Admitted to high-acuity units (e.g., ACH intensive care units). • Residing in skilled nursing facilities. PPSs could be limited to individuals at higher risk for MDRO acquisition (e.g., SNF residents with invasive devices or wounds) if screening resources are limited. **Others** – Consider depending on facility type, number of individuals at higher risk of MDRO acquisition, and regional epidemiology.
Admission screening *Objective:* To detect colonization status early during an individual's healthcare facility stay to facilitate early IPC interventions (e.g., Contact Precautions, placement in cohorting unit). **Note: Initiate admission screening on a unit or facility, particularly in long-term care, only after performing a baseline PPS.**	**Influential** – • Highly recommended in early epidemic stages (i.e., when there are no/few individuals with the focus MDRO(s) in the facility). • Recommended in facilities with higher prevalence and demonstrated high levels of adherence to recommended infection control practices. **Highly connected** – Recommended, especially in later epidemic stages or if the influential facility patients are received from has an MDRO outbreak or high MDRO prevalence (as defined by the health department). **Others** – Not routinely recommended.

Strategy 4: Facilitate communication

Communication between healthcare facilities and public health, and between facilities that share patients, is critical for maximizing the impact of other prevention strategies.

Communication between public health and healthcare facilities ensures situational awareness of MDRO epidemiology in the region and recommended measures to detect MDROs and prevent spread.

Effective communication whenever a patient/resident infected or colonized with an MDRO is transferred within or between healthcare facilities, increases the likelihood appropriate IPC actions will be implemented continuously through transitions of care, decreasing the likelihood of MDROs spreading to others. At a minimum, the type of MDRO and the necessary infection control actions to be taken (e.g., implementation of Transmission-Based Precautions) should be communicated. An example CDC interfacility transfer form is available here.

Prior to selecting communication-based activities to include in the MDRO Prevention Plan, health departments may wish to evaluate current communication practices between healthcare facilities and health departments, as well as between healthcare facilities, and between health departments (e.g., interjurisdictional health department communication or state and local health department communication) to identify gaps in practices. Interventions to improve interfacility communication and health department notification should engage facilities across all risk categories (Table 6).

CDC mathematical modeling indicates that the population-level impact of improved interfacility communication is modest relative to infection control improvements and active colonization screening within influential facilities. When allocating resources, priority should be given to these activities over large investments in interfacility communication, such as antibiotic resistance information exchanges.

Table 6. Recommended communication activities by facility category

Activities	Recommendation by Facility Category
Ensure all healthcare facilities and other providers (i.e., home health, medical transportation agencies, etc.) understand when, what, and how MDRO-related information is communicated to the health department. *Objective:* To ensure timely and accurate information is shared with health departments to inform public health action.	**All** – Highly recommended
Ensure all healthcare facilities and other providers (i.e., home health, medical transportation agencies, etc.) understand when, what, and how MDRO-related information should be communicated within and between healthcare facilities or providers. *Objective:* To ensure the timely application of appropriate IPC actions for those infected or colonized with MDROs to decrease the risk of spread to others within healthcare systems.	**All** – Highly recommended
Issue health alerts for clinicians and laboratories when novel or targeted MDROs are first identified in a region, or in response to changing epidemiology (e.g., large outbreaks, increasing prevalence). *Objective:* To increase awareness across healthcare systems on emerging or changing MDRO trends to encourage implementation of prevention and response actions.	**All** – Highly recommended

Activities	Recommendation by Facility Category
Support healthcare facilities to improve interfacility communication within a region. This could include forming a workgroup of healthcare facilities within the same patient/resident sharing network, with representation from different healthcare facility types (e.g., ACH, LTACH, IRF, SNF), to discuss and implement improvements in communication. *Objective:* To encourage healthcare facilities to identify barriers in communication with each other to innovate solutions to these barriers.	**All** – Highly recommended
Create Antibiotic Resistance Information Exchanges (ARIEs) **to support the multidirectional information flow between healthcare facilities and between healthcare facilities and health departments (e.g., a patient safety registry).** *Objective:* To track patients/residents who are colonized or infected with specific MDROs and alert healthcare providers when these patients are admitted to a facility to aid in the timely implementation of appropriate IPC practices.	**All** – Highly recommended
Mandate interfacility communication between healthcare facilities within a jurisdiction. *Objective:* To encourage a standard of communication practices between healthcare facilities.	**All** – Highly recommended

Appendix 1. At-A-Glance: Public Health Strategies to Prevent the Spread of Novel and Targeted Multidrug-resistant Organisms (MDROs)

Below are tables providing an overview of the elements described in the Public Health Strategies to Prevent the Spread of Novel and Targeted Multidrug-resistant Organisms (MDROs). Please see the full document for important definitions and for detailed descriptions.

Section I. Preparing to Implement an MDRO Prevention Plan

The following steps will help to develop the MDRO Prevention Plan. Steps may occur in a different order from the table and some steps may be completed iteratively with Section II: Elements of an MDRO Prevention Plan.

Step	Activity
Step 1. Determine the focus MDROs	• **Focus MDROs** are the subset of targeted MDROs that the area public health jurisdiction has identified as the focus of the MDRO Prevention Plan. • Consider including both targeted MDROs that are in later epidemic stages for which 'Containment' responses are not generally indicated (if applicable) and those in early epidemic stages (including prior to introduction) as focus MDROs.
Step 2. Risk stratify the healthcare facilities within a jurisdiction	• Create an inventory of all healthcare facilities in the jurisdiction. o *For this guidance, healthcare facilities are defined as all acute care hospitals and post-acute care facilities that care for patients or residents who remain overnight and require medical care, skilled nursing care, or rehabilitation services.* • Classify facilities according to acuity, average length of stay, and admission and discharge characteristics (see Table 1 for additional information) into the following categories: o **Influential** – high-acuity care, long lengths of stay (e.g., LTACH, vSNF) o **Highly connected** – frequently admit from influential facilities (e.g., ACH); role may be "dispersal" (move MDROs to new facilities in a region) or "collection" (admit lower acuity patients at risk of MDRO colonization for long-lengths of stay) o **Other** – neither influential nor highly connected • Activities in section II are targeted based on the facility category.
Step 3. Identify where to begin MDRO Prevention Plan implementation	Example approaches for initial implementation of prevention activities include selection by: • Geographic region. • Patient/resident-sharing network. • Facility category, starting with influential facilities.
Step 4. Evaluate jurisdictional clinical laboratory surveillance	• Evaluate the current capabilities of clinical laboratories serving healthcare facilities in the public health jurisdiction to detect and report suspected or confirmed novel and targeted MDROs. • Determine if expanded reporting, testing, and/or isolate submission may be beneficial.
Step 5. Define process and outcome measures	• Define outcome measures to assess progress towards the overall prevention goal. • Define outcome measures to assess impact of specific prevention activities. • Define process measures to assess implementation of activities.

Section II. Elements of an MDRO Prevention Plan

The following four strategies, and corresponding activities, are intended to form the core of a prevention plan. Public health jurisdictions should endeavor to incorporate at least one activity from each strategy into their MDRO Prevention Plan. Recommendation levels for implementation of example activities are tailored to the facility risk category:

Example activities for strategy 1: Conduct education	Risk Category: Influential	Risk Category: Highly Connected	Risk Category: Other
Provide MDRO and IPC-based education to healthcare facilities during planned infection control assessments (on-site or remote).	**Highly Recommended**	**Highly Recommended**	**Highly Recommended**
Schedule IPC demonstrations or in-services using a "train-the-trainer" format or delivered directly to frontline staff. All trainings should include demonstrations of competency.	**Highly Recommended**	**Recommended**	**Consider**
Provide healthcare facilities with group educational opportunities, such as a webinar series, educational symposiums, or workshops focused on MDROs and IPC practices. Consider inviting additional partners (e.g., state survey agencies, local health departments) to educational opportunities.	**Highly Recommended**	**Highly Recommended**	**Recommended**

Example activities for strategy 2: Improve infection prevention and control practices	Risk Category: Influential	Risk Category: Highly Connected	Risk Category: Other
Conduct prevention-driven, recurring (at least yearly) MDRO-focused infection control assessments. These assessments should be conducted regardless of the presence or absence of the MDRO(s) of interest. More frequent assessments should be conducted based on available resources and facility need.	**Highly Recommended**	**Consider**	**Consider**
Conduct prevention-driven, ad hoc infection control assessments.	**Highly Recommended** (for influential facilities not receiving recurring assessments; recurring assessments preferred)	**Highly Recommended** (for facilities with limited IPC capacity) **Consider** (for facilities with sufficient IPC capacity)	**Consider**
Provide follow-up and technical aid in the mitigation of identified gaps as needed. This could include more focused IPC assessments with objective observations (auditing) of certain practices such as hand hygiene and environmental cleaning.	**Highly Recommended** (follow up even if no critical gaps identified)	**Highly Recommended** (prioritize follow up for facilities with critical gaps)	**Highly Recommended**

Example activities for Strategy 3: Detect colonized individuals	Risk Category: Influential	Risk Category: Highly Connected	Risk Category: Other
Prevention-driven, recurring PPS at a predetermined frequency	**Highly Recommended**	**Not Routinely Recommended**	**Not Routinely Recommended**
Prevention-driven, *ad hoc* PPS	**Not Routinely Recommended**	**Highly Recommended**	**Consider**
Admission screening	**Highly Recommended** (in early epidemic stages) **Recommended** (in later stages in facilities with good IPC)	**Recommended** (in later epidemic stages or if regularly receive patients from influential facility with high MDRO prevalence)	**Not Routinely Recommended**

Example activities for Strategy 4: Facilitate communication *Recommendations apply to all facility risk categories because activities will improve communication across all facilities within the jurisdiction.*	Risk Category: Influential	Risk Category: Highly Connected	Risk Category: Other
Ensure all healthcare facilities and other providers (i.e., home health, medical transportation agencies, etc.) understand when, what, and how MDRO-related information is communicated to the health department.	**Highly Recommended**	**Highly Recommended**	**Highly Recommended**
Ensure all healthcare facilities and other providers (i.e., home health, medical transportation agencies, etc.) understand when, what, and how MDRO-related information should be communicated within and between healthcare facilities or providers.	**Highly Recommended**	**Highly Recommended**	**Highly Recommended**
Issue health alerts for clinicians and laboratories when novel or targeted MDROs are first identified in a region, or in response to changing epidemiology (e.g., large outbreaks, increasing prevalence).	**Highly Recommended**	**Highly Recommended**	**Highly Recommended**
Support healthcare facilities to improve interfacility communication within a region. This could include forming a workgroup of healthcare facilities within the same patient/resident sharing network, with representation from different healthcare facility types (e.g., ACH, LTACH, SNF), to discuss and implement improvements in communication.	**Highly Recommended**	**Highly Recommended**	**Highly Recommended**
Create Antibiotic Resistance Information Exchanges (ARIEs) to support the multidirectional information flow between healthcare facilities and between facilities and health departments (e.g., a patient safety registry).	**Recommended**	**Recommended**	**Recommended**
Mandate interfacility communication between healthcare facilities within a jurisdiction.	**Consider**	**Consider**	**Consider**

Acronyms: multidrug-resistant organism (MDRO); long-term acute care hospital (LTACH); ventilator-capable skilled nursing facility (vSNF); acute care hospital (ACH); infection prevention and control (IPC); point prevalence survey (PPS)

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