

# OREGON MULTIDRUG-RESISTANT ORGANISM AND *CLOSTRIDIoidES* *DIFFICILE* TOOLKIT

## Purpose Statement

The purpose of this toolkit is to provide recommendations to Oregon healthcare facilities about strategies to prevent transmission of multidrug-resistant organisms (MDROs) and *Clostridioides (formerly Clostridium) difficile* during patient care. The toolkit recommendations provide general guidance and are not meant to replace facility-level policy or procedure. Local epidemiology as well as pertinent facility- or patient-level factors may affect the likelihood of MDRO transmission, and these factors should be taken into account when making decisions about transmission prevention strategies.

The toolkit is intended to be a working document addressing high-impact organisms in Oregon hospitals. Given the continually evolving infection prevention and control landscape, including novel and emerging pathogens, this document will be updated as needed.

## Methods

This toolkit was drafted by members of the Oregon Drug-Resistant Organism and Coordinated Regional Epidemiology (DROP-CRE) Network. To inform toolkit development, we convened a statewide Hospital Epidemiology Task Force to assist with two main objectives: 1) Optimize a practical approach to methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococci (VRE) infection prevention and control; and 2) Establish statewide definitions for Gram-negative organisms in order to harmonize facility definitions, primarily for the purpose of uniform infection control practices.

Over the course of 18 months, the Hospital Epidemiology Task Force reviewed existing drug-resistance definitions as published by collaboration of the European Centre for Disease Prevention and Control (eCDC) and the US Centers for Disease Control and Prevention (CDC).<sup>(1)</sup> In particular, the Task Force called attention to “possible extensively drug-resistant (XDR)” bacteria as those organisms harbor sufficiently broad drug resistance to substantially alter and limit treatment options. By current epidemiology, such XDR bacteria are relatively rare in Oregon; the intent of uniform infection control practices is that they remain so. The Task Force modified the eCDC/CDC definition to create the “Oregon XDR” definition for practical use in the context of clinical microbiology laboratory antibiotic susceptibility testing and reporting in Oregon.

Recommended infection prevention practices and definitions proposed by the Task Force were presented at several stakeholder venues, including the regional Oregon-Southwest Washington

Association for Professionals in Infection Control and Epidemiology (OSWAPIC) chapter meetings in 2017-2018 and the Oregon Health Authority (OHA) Healthcare Acquired Infection Advisory Committee (HAIAC) in 2019.

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## Executive Summary

This toolkit intends to:

- Define high-impact pathogens and multi-drug resistant organisms (MDROs) in order to facilitate a unified approach to infection prevention across the healthcare spectrum;
- Harmonize the approach to infection prevention and control of these organisms across Oregon, while recognizing the interconnectedness of healthcare across state lines and across the globe;
- Provide recommendations to Oregon healthcare facilities about strategies to prevent transmission of MDROs and *Clostridioides difficile* during patient care;
- Advocate for timely, effective communication during transfer of patients within and between facilities of high-impact pathogens and MDROs in order to prevent their spread.

### Highlights:

- MDRO risk assessment should take into account patient's travel history, MDRO history, and chronic associated medical conditions.
- Inherent differences exist between acute, long-term care, and outpatient settings in the level of patient care, capabilities, and resources available for infection prevention. These differences should be taken into account when creating an MDRO prevention plan.
- Standard precautions are the cornerstone of infection prevention and control. This includes the use of personal protective equipment as needed, based on the anticipated exposure as well as routine hand hygiene, respiratory etiquette, injection safety and more. [Oregon Administrative Rule 333-019-0061](#) requires healthcare providers to observe standard precautions. Standard precautions are necessary in ALL ENVIRONMENTS OF CARE.[\(2\)](#)
- Transmission-based precautions are intended to further impede spread of documented or suspected organisms based on what is known about the organism. Transmission-based precautions are a component of the bundle of interventions used for MDRO and *C. difficile* control.
- The duration of transmission-based precautions for MDROs has previously not been standardized. This document standardizes a minimum duration for MDROs discussed in acute settings and can be adapted to long-term care. For most organisms, one year from the last positive test is the minimum recommended duration. Exceptions include:

carbapenemase-producing, pan-drug resistant, and novel drug-resistant organisms where the recommended duration of contact precautions is indefinite (at the time of this writing).

- Visitors and animals (e.g. service animals) in healthcare facilities require different, individualized consideration. This document offers recommendations on how to approach these populations.
- Previously, multi-drug resistant Gram-negative organism definitions have not been standardized, complicating inter-facility communication. This document establishes an Oregon MDRO definition, which is labeled as “Oregon XDR” for selected drug-resistant Gram-negative organisms including *Enterobacteriaceae*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, and *Stenotrophomonas maltophilia*.
- Methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant enterococcus (VRE): The strategies of Active Surveillance Testing (AST) and MRSA decolonization are reviewed. Local epidemiology, the setting (e.g., ICU), patient factors (e.g., transplant recipient, presence of central venous catheter) and the occurrence of MRSA or VRE outbreaks should inform the use of these strategies. *S. aureus* screening and decolonization prior to certain high-risk surgeries is recommended. We recommend the use of contact precautions to control endemic MRSA and VRE in acute care facilities. However, in the endemic setting there is conflicting evidence on the safety and effectiveness of contact precautions. As such, we offer key considerations for facilities not employing contact precautions as part of a prevention strategy for MRSA or VRE.

## MDRO Risk Assessment

At present, there is no nationally-accepted quantitative clinical prediction screening calculator or algorithm to determine a patient's level of risk for being colonized or infected with an MDRO. However, the following risk factors should be taken into account when determining risk:

- **Recent travel or healthcare exposures outside of Oregon:** Several case investigations have revealed that many of the Oregonians infected or colonized with highly drug-resistant organisms have travelled to and often received healthcare in other regions of the country or world. Examples include recent travel to Southeast Asia, Eastern Europe, the Mediterranean, and many U.S. urban centers including New York, Chicago, and Los Angeles. One useful resource to help determine risk of MRDO acquisition within the United States is the [CDC Antibiotic Resistance Patient Safety Atlas](#) which provides state-specific antibiotic resistance data from more than 4,000 facilities across the country.<sup>(3)</sup>
- **History of past infection with an MDRO:** Patients with prior infections caused by MDROs can remain colonized with these organisms for prolonged periods of time. Thus, when a patient is admitted with a presumed or confirmed bacterial infection, it is prudent to ask the patient if s/he has ever had a prior infection with an antibiotic-resistant organism.
- **Chronic conditions that require frequent visits to healthcare facilities or impair immunity:** Patients with chronic conditions such as cancer or kidney disease requiring dialysis, or residents of long-term healthcare facilities, are at higher risk of MDROs.
- **Chronic indwelling devices:** Patients requiring devices such as central venous catheters (CVCs), peripherally-inserted central catheters (PICC), ostomy tubes, and indwelling urinary catheters are at higher risk for MDROs.

## Differences in Healthcare Settings Can Affect MDRO Approach

- Goals in acute vs. long-term care.** Whereas treatment in acute care hospitals (ACH) & Long-term Acute Care Hospitals (LTACHs) is focused on addressing acute or critical medical conditions, treatment for residents in long-term care facilities (LTCFs) need to take into account the goal of maintaining or restoring the independence of the resident while promoting socialization. This requires balancing the resident psychosocial needs with infection prevention guidelines to provide a safe environment while optimizing quality of life. Steps should be taken to prevent spread of MDROs while recognizing that the LTCF is the resident’s home.

An important example of different approaches to infection control by setting is a 2019 CDC guidance document, “Implementation of Personal Protective Equipment in Nursing Homes to Prevent Spread of Novel or Targeted Multidrug-resistant Organisms (MDROs)”; herein a new approach called [Enhanced Barrier Precautions \(EBP\)](#) is introduced, which refers to the use of gown and gloves during high-contact resident care activities that provide opportunities for transfer of MDROs to staff hands and clothing.<sup>(4)</sup>

Table 1 (below) is an adopted from that document:

<b>Precautions</b>	<b>Applies to</b>	<b>PPE used for these situations</b>	<b>Requirements</b>
<b>Enhanced Barrier Precautions</b>	All residents with any of the following: <ul style="list-style-type: none"> <li>Wounds and/or indwelling medical devices regardless of MDRO colonization status.</li> <li>Infection or colonization with a novel or targeted MDRO <i>when Contact Precautions do not apply.</i></li> </ul> Facilities may consider applying Enhanced Barrier Precautions to residents infected or colonized with other epidemiologically-important MDROs based on facility policy.	During high-contact resident care activities: <ul style="list-style-type: none"> <li>Dressing</li> <li>Bathing/showering</li> <li>Transferring</li> <li>Providing hygiene</li> <li>Changing linens</li> <li>Changing briefs or assisting with toileting</li> <li>Device care or use: central line, urinary catheter, feeding tube, tracheostomy/ventilator</li> <li>Wound care: any skin opening requiring a dressing</li> </ul>	Gloves and gowns prior to the high-contact care activity  No room restriction

PPE = Personal protective equipment.

- **Ambulatory care settings often provide elective services.** In ambulatory care settings such as ambulatory surgery and outpatient clinics, triage, standard precautions, and general infection prevention practices are the fundamental cornerstones in providing a safe environment for all patients.



## General Principles in Infection Prevention and Control

### Standard Precautions and Personal Protective Equipment

Oregon healthcare workers (HCWs) are required to adhere to Standard Precautions ([OAR 333-019-0061](#)).<sup>(2)</sup> Standard Precautions refer to the bundle of interventions that should be followed by HCWs for every patient encounter in all settings and include (but are not limited to) hand hygiene, appropriate use of personal protective equipment (PPE), respiratory hygiene and cough etiquette, injection safety, and environmental and reusable medical equipment cleaning and disinfection. Standard precautions assume that all patients are potentially infected or colonized with transmissible infectious pathogens. Appropriate use of PPE refers to the various barriers such as gowns, gloves, surgical masks, and face shields used alone or in combination to protect the HCW from anticipated contact with infectious microorganisms.

**Thus, PPE recommendations in Standard Precautions require HCW judgment on the anticipated extent of exposure, such as wearing gloves while changing a wound dressing or manipulating an indwelling urinary catheter, regardless of culture results.**

Additional categories of precautions to prevent transmission of infectious pathogens include **Contact Precautions (various types), Droplet Precautions, and Airborne Precautions** (Table 2). When the etiologic agent of an individual's infection is unknown, HCWs should choose PPE to prevent transmission of all possible pathogens based on the differential diagnosis until diagnostic test results are available, such as in the case of suspect tuberculosis (TB) when airborne precautions should be employed. In some situations, a combination of precaution categories is required (e.g., contact plus droplet precautions for adenovirus bronchiolitis).

**Table 2: Infection Control Precautions**

Precautions	Definition	PPE Required	Examples
<b>Standard Precautions</b>	Prevents potential transmission of pathogens in various situations, dependent on the HCW-patient interaction. Before each patient encounter, the HCW should consider what potential exposure may occur. This is basic infection control practice and is required during all patient care.	Dependent on anticipated exposure(s) during patient care	HCW wearing goggles and mask during aerosol-generating procedure or gloves when performing indwelling urinary catheter care
<b>Contact Precautions</b>	Prevents transmission of pathogens that are spread by direct or indirect contact with the patient or his/her environment and/or	Gloves and gown for all patient care	MDROs (e.g., methicillin-resistant <i>Staphylococcus aureus</i> , vancomycin-resistant enterococcus),

	contaminated items. Necessary when pathogens that warrant contact precautions are identified or suspected.		respiratory syncytial virus
<b>Contact-Plus* Precautions</b>	Prevents hardy pathogens resistant to typical disinfectants. Necessary when pathogens that warrant contact-plus precautions are identified or suspected.	Glove and gown for all patient care PLUS sporicidal disinfectant and hand hygiene with soap and water after patient care	Norovirus, <i>Clostridioides difficile</i>
<b>Droplet Precautions</b>	Prevents transmission of pathogens spread via close contact with respiratory droplets within short distance (<3–6 feet). Necessary when pathogens that warrant droplet precautions are identified or suspected.	Surgical mask for all patient care	Pertussis, Seasonal Influenza
<b>Airborne Precautions</b>	Prevents transmission of pathogens that remain infectious while suspended in small particle aerosols, potentially over prolonged time and distance. Necessary when pathogens that warrant airborne precautions are identified or suspected.	Fit-tested N-95 respirator or powered air-purifying respirator (PAPR), and private room with negative pressure airflow (airborne infection isolation room)	Measles, chickenpox, pulmonary TB
<b>Combination: Contact + Droplet Precautions</b>	See above	Gloves, gown & mask	Adenovirus conjunctivitis, pharyngitis, bronchiolitis

HCW = Health care worker

TB = Tuberculosis

\*“Contact Plus” may have alternative names, including “Modified Contact” or “Enteric” Precautions

## Vertical vs. Horizontal Approaches to Infection Prevention

**Vertical Approach:** This approach is pathogen-specific; the goal is to reduce the prevalence of one pathogen, which may or may not impact broader transmission prevention efforts. Examples of vertical approach include **active surveillance** for an MDRO (e.g., screening every ICU admission for MDRO colonization), **contact precautions** for patients with identified MDRO colonization or infection, and **pathogen-specific decolonization** (e.g., nasal mupirocin to eradicate anterior nares colonization).

**Horizontal Approach:** A horizontal approach to decrease MDRO transmission widens the scope to reduce all infections and/or transmission. Examples of horizontal approaches include **standard precautions, chlorhexidine gluconate (CHG) skin bathing** to decrease the bioburden of MDRO skin colonization, environmental disinfection, and **prevention care bundles** (e.g., CLABSI prevention bundle).

Both types of approaches have merit – strengthening horizontal approaches to interrupting MDRO transmission is critical for all facilities and improves general infection prevention, while a vertical approach for targeted MRDOs layered on top of a solid horizontal infection prevention practice can bolster MDRO control via improved case finding, control, and eradication.

## Duration of Contact Precautions for MDROs

The absence of data and lack of national recommendations regarding the duration of contact precautions for MDROs has resulted in different policies among healthcare facilities.

In 2018, the Society for Healthcare Epidemiology of America (SHEA) highlighted this important gap for acute care facilities in a [SHEA expert guidance document](#). Coauthors note lacking the “quality of evidence” required for a formal guideline on duration of contact precautions for MDROs.<sup>(5)</sup> The review incorporated survey data of hospital epidemiologists, which highlighted the many different policies currently used. The paper also reviewed the literature on duration of MDRO carriage. Strikingly, the persistence of colonization for MRSA, VRE, and MDR-*Enterobacteriaceae* including CRE are similar across studies –roughly 50% at 6 months and ~10-30% at 12 months. Across studies, prolonged colonization is often associated with severe medical comorbidities, prolonged hospitalization, and presence of indwelling devices.

In attempt to create a statewide approach balancing need for simplicity to implement broadly without complex testing, risk factor assessment, and electronic reminders, we suggest a simplified 1-year duration on all MRSA, VRE, and Oregon XDR Gram-negative organisms with exception of carbapenemase-producing and other novel/pan-resistant organisms. See the recommendations by organism for details.

## Visitors to Healthcare Facilities

MDRO acquisition risk for visitors to healthcare settings is unknown. Similarly, the role of visitors in transmission of MDROs in healthcare facilities is also unclear. **In general, healthy visitors should be advised to follow Standard Precautions when visiting patients.** However, in some circumstances, visitors may need to follow additional transmission-based precautions. Visitors' use of additional precautions should be based on the risk of harm to the visitor, depending on the virulence and route of transmission of the pathogen in question, the vulnerability of the visitor to infection, and the possibility that the visitor could play a role in transmission of the pathogen to other patients (e.g., visiting multiple patients, using common areas). To assist with decision-making about infection control precautions for visitors, SHEA has published a [SHEA Expert Guidance Document](#).<sup>(6)</sup> We recommend adherence to the guidance provided in this document. Major points in this document include:

- “All visitors should perform hand hygiene prior to entering a patient room and immediately after leaving the room... Institutions should ensure that sinks and alcohol-based hand rub stations are easily accessible to visitors. Visitors should be educated on the importance of frequent hand hygiene in the hospital setting and on the available options and proper techniques for performing hand hygiene.”
- “For endemic situations with MRSA and VRE we recommend *not* using contact isolation precautions for visitors in routine circumstances. If visitors to patients with MRSA or VRE will be interacting with multiple patients, they may be at greater risk for transmitting pathogens between patients and should use isolation practices in a fashion similar to that of healthcare workers (HCWs).”
- “Utilization of contact precautions should be considered for visitors to patients either colonized or infected with extensively drug-resistant Gram-negative organisms (e.g., *Klebsiella pneumoniae* Carbapenemase).”
- “For visitors of patients infected with enteric pathogens (e.g., *C. difficile*, norovirus), we suggest the use of contact precautions.”
- “For parents/guardians/visitors with extended stay in a patient’s room, including overnight visitation, isolation precautions may not be practical. The risk of infection for parents/guardians/visitors is likely reduced if they practice good hand hygiene, and any additional benefit of wearing gowns and gloves in these scenarios of prolonged exposure is unclear.”

## Infection Prevention: Animals in Healthcare Facilities

Animals may be present in healthcare facilities for a variety of reasons, including working as a service animal, animal-assisted therapies, or research animals. In addition, questions frequently arise related to personal pet visitation. SHEA published a [SHEA Expert Guidance Document](#) about this topic.<sup>(7)</sup> We generally agree with and suggest adhering to the guidance provided in this document.

- “Animal-assisted activities animals are not service animals. An animal-assisted activities visit liaison should be designated to provide support and facilitate animal-assisted activities visits. Often these visits are managed by the facility’s Volunteer Office or Department. Only dogs should be used (i.e., exclude cats and other animals). Animals and handlers should be formally trained and evaluated. Facilities should consider use of certification by organizations that provide relevant formal training programs (e.g., Pet Partners, Therapy Dogs Incorporated, Therapy Dogs International). Alternatively, facilities should designate responsibility for the program elements to an internal department (e.g., volunteer department) to verify all elements.”
- “Pets should, in general, be prohibited from entering the healthcare facility, including pets of HCP, patients, and visitors. Exceptions can be considered when the healthcare team determines that visitation with a pet would be of benefit to the patient and can be performed with limited risk to the patient, other patients, and healthcare facility as a whole.”
- “Under the Federal Americans with Disabilities Act (ADA), “service animals” are defined as “dogs that are individually trained to do work or perform tasks for people with disabilities.”... Each healthcare facility should have a policy regarding the admittance of service animals into the facility. The policy allowing service animals into the facility should be compliant with the ADA, any other applicable state and local regulations.”

## Recommendations for Specific Pathogens

### Methicillin-resistant *Staphylococcus aureus* (MRSA)

#### 1. Background

*Staphylococcus aureus* is a Gram-positive bacterium and a common cause of healthcare-associated infections (HAI), including surgical site infections (SSI) and central line-associated bloodstream infections (CLABSI). Humans are natural reservoirs for *S. aureus*. Asymptomatic colonization is common, and anatomic sites are many: anterior nares, skin, axillae, groin, throat, rectum, and vagina.

#### 2. Laboratory information and definitions

**MRSA:** Methicillin resistance in *S. aureus* is defined as an oxacillin minimum inhibitory concentration (MIC) of  $\geq 4$  mcg/mL

**Vancomycin-intermediate and vancomycin-resistant *S. aureus*:** The Clinical and Laboratory Standards Institute (CLSI) and US Food and Drug Administration (FDA) have established the following vancomycin minimum inhibitory concentration (MIC) interpretive criteria for *S. aureus*. These definitions were modified in 2006 in response to increasing reports of vancomycin treatment failure in infections due to strains with elevated MICs (2 mcg/mL) and to identify isolates that are likely to be hetero-resistant.

	<b>CURRENT definition, based on MIC</b>
<b>Vancomycin susceptible</b>	$\leq 2$ mcg/mL
<b>Vancomycin intermediate (VISA or GISA)</b>	4 to 8 mcg/mL
<b>Vancomycin resistant (VRSA)</b>	$\geq 16$ mcg/mL

Vancomycin is an antibiotic in the glycopeptide class, hence originally VISA and glycopeptide-intermediate *S. aureus* (GISA) were synonymous. Several new glycopeptides are available such that VISA is a preferred term referring to vancomycin-intermediate susceptibility testing results.

#### 3. Strategies to Prevent MRSA Transmission

The first methicillin-resistant *S. aureus* (MRSA) strains were identified in the 1960's, and it has since become a common cause of HAIs. Many studies have been conducted over the past several decades to identify strategies to decrease MRSA transmission in the

healthcare setting. However, these studies also demonstrate the great challenges in defining a “one size fits all” strategy.

**Active Surveillance Testing:** AST, also often referred to as “active surveillance culturing” or “MRSA screening,” aims to identify asymptomatic patients who are colonized with MRSA by performing specimen collection and screening tests on anatomic areas often colonized with MRSA such as the nares (i.e. nostrils). Test methods include traditional culture or PCR. If asymptomatic carriers are identified, then interventions can be implemented to decrease transmission. Such interventions might include implementing contact precautions or decolonization with an intranasal antiseptic such as topical mupirocin or povidone iodine.

**Data regarding the benefit of AST for MRSA are mixed.**

Targeted MRSA screening and isolation: In 2007, the Veteran’s Health Administration (VHA) embarked on a national MRSA initiative implementation, which included AST, contact precautions for colonized patients, culture change conveying the idea that all HCWs are responsible for infection prevention, and funding for a new MRSA coordinator at each facility.(8) In 2011, VHA reported >50% sustained reductions in MRSA infections both in ICU and non-ICU units. On the other hand, the randomized multicenter Strategies to Reduce Transmission of Antimicrobial Resistant Bacteria in Intensive Care Units (STAR\*ICU) trial failed to demonstrate benefit of screening and isolation for MRSA (or VRE).(9)

Targeted MRSA screening and isolation coupled with decolonization: In ICUs, this approach was evaluated in the Randomized Evaluation of Decolonization versus Universal Clearance to Eliminate MRSA (REDUCE MRSA) trial, a cluster-randomized ICU trial showed a 25% reduction of MRSA clinical cultures when employing AST for MRSA coupled with contact precautions and MRSA decolonization (using intranasal mupirocin plus chlorhexidine) compared to MRSA screening and isolation without decolonization. However, a 3<sup>rd</sup> arm of this trial showed the largest reductions in MRSA-positive clinical cultures (37%) using a universal decolonization approach, where decolonization was administered to all ICU patients irrespective of MRSA colonization status.(10)

**Decolonization:** The role of decolonization as a method to decrease *S. aureus* transmission varies by strategy and setting. Decolonization has frequently been one strategy included in the context of large studies with multiple, simultaneously-bundled interventions, so it can be difficult to evaluate the effect of this particular intervention alone. While decolonization is very effective at reducing detection of *S. aureus* initially, re-colonization occurs over time. [CDC has provided updated recommendations regarding decolonization strategies](#) as of March 2019 for *S. aureus* prevention in acute-care facilities.(11)

**ICUs:** As mentioned above, the REDUCE MRSA trial demonstrated a 37% reduction in MRSA-positive clinical cultures when compared to targeted MRSA AST and contact

precautions in ICUs. Using these data, the authors reported that 181 and 99 patients would need to undergo decolonization to prevent one MRSA-positive clinical culture and one bloodstream infection from any pathogen, respectively. Concerns regarding resistance to primarily mupirocin but also chlorhexidine have been raised in the context of universal decolonization approaches.([12,13,14](#))

**Non-ICU acute care units:** In contrast, the Active Bathing to Eliminate Infection (ABATE Infection) trial was a cluster-randomized study in acute, non-ICU care units comparing the intervention of universal chlorhexidine and targeted nasal mupirocin for known MRSA-colonized patients to usual care, which at these hospitals consisted of MRSA AST in high-risk patients plus contact precautions for MRSA.([15](#)) The ABATE Infection trial found no significant benefit of this decolonization approach overall, but a post-hoc exploratory analysis demonstrated significant 37% reductions of MRSA and VRE clinical cultures in the 10% subset of patients with indwelling central lines, midline catheters, and lumbar drains.

**Dialysis:** One systematic review and meta-analysis in non-surgical settings noted that mupirocin decolonization reduced the risk for *S. aureus* infection in dialysis and non-dialysis settings by 59% and 40%, respectively.([16](#)) However, the meta-analysis found significant heterogeneity in study designs and populations. Also, after decolonization with mupirocin, re-colonization rates as soon as 4 months post-treatment is as high as 56% in hemodialysis patients.([17](#)) Similarly, *S. aureus* recolonization rates at one year after nasal decolonization were close to 50% for HCWs and 75% for peritoneal dialysis patients.([18](#))

**Pre-Surgical Setting:** Unlike MRSA decolonization for inpatients as described above, pre-surgical screening and decolonization for *S. aureus* (not just MRSA) has become common practice in cardiovascular and orthopedic procedures, and there is strong evidence to support this practice. Studies have shown that the genotypes of *S. aureus* colonization and infection isolations are identical in up to 85% of surgical patients.([19, 20](#)) A meta-analysis of 17 RCTs or quasi-experimental studies that included cardiac and orthopedic surgery patients evaluated the effectiveness of pre-operative decolonization and found significantly reduced *S. aureus* SSIs in the intervention groups.([21](#)) All but one of the studies included in the meta-analysis used mupirocin ointment for nasal decolonization, but one study used nasal CHG. Subsequently, a prospective multicenter implementation trial demonstrating reduced SSI using a bundled approach of intranasal mupirocin, chlorhexidine baths, and the addition of peri-operative vancomycin to prevent SSI in orthopedic and cardiac surgery.([22](#)) The SHEA compendium of strategies to prevent SSIs stated that screening for *S. aureus* and decolonization with agents such as mupirocin could be done as a special approach when basic approaches are not enough, especially among patients undergoing some orthopedic and cardiothoracic procedures.([16, 23](#)) In the 2019 CDC prevention recommendations, *S. aureus* decolonization is now recommended as a core pre-operative SSI prevention practice for all patients undergoing high-risk procedures.([11](#))



**Facilities therefore must review local epidemiology and weigh the benefit vs. costs in deciding if and how to employ AST and/or universal decolonization for MRSA in the inpatient setting. Groups that appear to show benefit from such strategies include ICU patients, hospitalized patients with an indwelling device or catheter, and patients receiving high-risk operative procedures.**

**Universal Gowns and Gloves:** The 2013 Benefits of Universal Glove and Gown (BUGG) Study was a cluster randomized control trial (20 ICUs) that studied universal gowning and gloves versus contact precautions for patients with known MRSA or VRE infection/colonization.[\(24\)](#) The study demonstrated a 40% relative reduction in MRSA acquisition in the universal gowning and gloving ICUs, compared with a 15% reduction in control ICUs. It could not be determined with certainty whether the gowns and gloves themselves were responsible for decreased MRSA transmission, or if other factors, such as decreased number of room entries, decreased patient contacts, and increased hand hygiene compliance at room exit were the operative factors. Whether or not universal gowning and gloving is a sustainable and cost-effective strategy is unclear. As of May 2019, there are no formal recommendations to implement this strategy by CDC, SHEA, APIC or other pertinent organizations.

**Contact Precautions:** Since 2006, CDC has recommended contact precautions for all patients known to be colonized or infected with epidemiologically-important MDROs, including MRSA.[\(25\)](#) In support of this ongoing recommendation, from 2005-2014, the incidence of invasive hospital-onset infection declined by 65%, and contact precautions were included in the multi-faceted bundles of MRSA control interventions.

Several factors have led to recent debate regarding the current benefit of contact precautions for MRSA, including: data demonstrating that patient-to-patient transmission rarely accounts for acquisition of *S. aureus* in the ICU setting ([26,27](#)); availability of many new treatment options for MRSA infection; a focus on improved adherence to Standard Precautions; increased implementation of bundled interventions such as CLABSI prevention bundles and universal decolonization; increased use of private rooms; and the high rates of MRSA-colonized individuals admitted to hospitals rendering contact precautions increasingly burdensome.

The debate regarding the utility of contact precautions for MRSA control is highlighted by two high-profile opinion pieces taking opposite positions on this issue.[\(28,29\)](#)

Though not currently the recommendation of this toolkit, some healthcare facilities throughout the US have chosen to de-implement contact precautions for MRSA. Decisions to do so should be informed by local context, patient characteristics, record of strong facility implementation of standard precautions, an assessment of the facility's risk of MRSA transmission, and methods in place to monitor for changes in MRSA rates.

For Oregon facilities electing to de-implement contact precautions for MRSA, we suggest each facility should maintain sound methods to monitor MRSA rates and rapidly identify MRSA outbreaks as well as demonstrate optimal “horizontal” facility-wide infection prevention practices by healthcare workers, including but not limited to:

- Knowledge of and demonstrated adherence to standard precautions including but not limited to hand hygiene compliance
- Knowledge of and adherence to any relevant prevention bundles
- Effective environmental cleaning and disinfection
- Adequate resources to ensure ongoing, reliable surveillance of above practices

Unfortunately, the definition of “optimal adherence to basic infection prevention practices” remains a matter of opinion and area for future research. Many facilities anecdotally target 80%–100%.

**Patient placement:** Hospitalized patients in ACH with MRSA colonization or infection should be placed in private rooms when available. Cohorting of patients with MRSA colonization (i.e., placing patients in the same room) is acceptable when no private rooms are available, as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

#### 4. Cleaning and disinfection information

Standard healthcare cleaning and disinfecting agents are active against all *S. aureus*, including VISA and VRSA. *S. aureus* is a common human colonizer. It can also remain on surfaces for hours, days, or even months depending on the bioburden, type of surface, and environmental factors such as temperature and humidity.

#### 5. Related regulations and requirements

**National:**

The Centers for Medicare & Medicaid Services (CMS) currently requires Hospitals to report MRSA bacteremia (via CDC’s National Healthcare Safety Network (NHSN) Lab ID Event) for all inpatients.

The CDC HICPAC 2006 MDRO guideline lists two sets of interventions, designated as “general” and “intensified, tier 2.” MRSA is considered an MDRO in this guideline. General guidance is to use Contact Precautions for inpatients colonized or infected with MDROs. Active surveillance testing and decolonization are listed as intensified, Tier 2 interventions (recommendation V.B.5.b).

**Oregon:**

Under [Oregon Administrative Rule \(OAR 333-019-0052\)](#), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with MRSA.(30)

Individual MRSA cases are not reportable in Oregon and active surveillance testing is not mandated.

VISA and VRSA cases should be reported immediately to the local health authority as an uncommon illness of public health significance ([OAR-333-018-0015](#)).(31)

Oregon's mandatory HAI reporting ([OAR 333-018-0110](#)) includes the requirement for facility-wide reporting of MRSA bacteremia (via NHSN Lab ID Event) for all hospital inpatients (including those hospitalized in acute care, long-term acute care, and critical access hospitals).(32)

**Other:**

***Joint Commission National Patient Safety Goal (NPSG): 2 relevant goals***

1. NPSG.07.03.01 EP 7: "Implement policies and practices aimed at reducing the risk of transmitting MDROs. These policies and practices meet regulatory requirements and are aligned with evidence-based standards..." Please refer to the CDC/HICPAC guideline entitled "[Management of Multidrug-Resistant Organisms In Healthcare Settings, 2006](#)".
2. EP 1 IC.01.05.01: "When developing infection prevention and control activities, the hospital uses evidence-based national guidelines or, in the absence of such guidelines, expert consensus."

**6. Summary: Infection prevention recommendations for MRSA**

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation	Other infection prevention strategies
ACH and LTACH	Standard + Contact Precautions for patients colonized or infected with MRSA.*	1 year after last positive MRSA test.  Optional: facility may also employ AST to assess ongoing carriage.**	AST optional**  Decolonization suggested in certain populations***
LTCF	Standard Precautions. Additionally, facilities should consider applying Enhanced Barrier Precautions for patients colonized or infected with MRSA.	1 year after last positive MRSA test.	AST optional**  Decolonization optional
Adult Foster Hospice Homecare Ambulatory Clinic	Standard Precautions	n/a	n/a

AST = Active surveillance testing to detect asymptomatic colonization.

\* If contact precautions are not used, the facility must demonstrate ongoing low infection risk and optimal adherence to Standard Precautions. The facility should have established methods for monitoring MRSA rates and for rapid identification of outbreaks.

\*\*Facilities with capacity and interest can consider performing AST for MRSA in previous carriers or other perceived high-risk individuals.

\*\*\*Decolonization using topical chlorhexidine +/- intranasal antibiotic/antiseptic is strongly suggested for ICU patients and should be considered for the subset of non-ICU acute care patients with indwelling central lines, midline catheters, or lumbar drains.

## **Vancomycin-resistant Enterococci (VRE)**

### **1. Background**

Enterococci are Gram-positive bacteria and normal commensal organisms of the human gastrointestinal tract, genitourinary system, and skin. Vancomycin-resistant enterococci (VRE) are prevalent in healthcare settings and primarily cause bloodstream infections (bacteremia), endocarditis, and urinary tract infections (UTIs). The most common enterococci species resulting in VRE infections are *Enterococcus faecalis* and *E. faecium*. *E. faecium* infections are more commonly associated with healthcare acquisition and commonly exhibit resistance to both ampicillin and vancomycin, while *E. faecalis*-related infections often come from the community and rarely are ampicillin- or vancomycin-resistant.

### **2. Laboratory information and definitions**

The laboratory definition of VRE has remained consistent since 2006. Vancomycin resistance among enterococci is defined as a vancomycin MIC of  $\geq 32$  mcg/mL. Vancomycin-intermediate enterococci have a vancomycin MIC of 8-16 mcg/mL.

### **3. Strategies to Prevent VRE Transmission**

VRE were first identified in Europe in 1986 and are now ubiquitous in healthcare settings worldwide. Infection prevention strategies for VRE are largely similar to those for MRSA and include standard precautions, particularly high compliance with hand hygiene, active surveillance to identify asymptomatically colonized patients, contact precautions, cohorting, and decolonization. In a sentinel infection prevention study, colonization pressure, i.e. the proportion of patients colonized or infected with VRE within a healthcare unit was identified as the most important risk factor for VRE acquisition. Based on that study, patient-to-patient transmission, rather than antibiotic selective pressure, was believed to be the primary driver of increasing prevalence of VRE.[\(33\)](#) However, molecular epidemiologic studies suggest that the patient-to-patient transmission may play a less significant role in VRE prevalence.[\(34\)](#)

**Active Surveillance Testing (AST):** AST for VRE is similar to that for MRSA and typically consists of screening cultures of the peri-rectal area or stool. VRE-colonized patients can then be targeted for subsequent infection prevention strategies such as contact precautions, cohorting, or decolonization. The utility of active surveillance is dependent on the effectiveness of these other strategies as well as the screening method (i.e. culture versus PCR), the underlying prevalence of colonization, and patient length of stay. Rapid diagnostic methods to screen for VRE are now available and have shorter turnaround times compared to traditional microbiologic methods. However, these methods have not been sufficiently studied and also have increased cost, which must be weighed against the potential benefits.

**Contact Precautions:** Similar to MRSA, CDC and SHEA recommend contact precautions for all patients colonized or infected with VRE. Earlier studies support this recommendation and suggest that use of gowns in addition to gloves are associated with significant decreased VRE transition in the ICU.(35,36) However, several more recent studies suggest a smaller benefit of contact precautions beyond standard precautions. This includes the BUGG Study described above, in which universal glove and gown use was not associated with a significant reduction in transmission of VRE compared to contact precautions used only for patients with known VRE colonization or infection.(24)

**Patient placement:** Similar to MRSA, in the absence of private rooms, cohorting of patients with VRE may be a useful strategy when not contraindicated by discordant MDRO colonization or infection. Cohorting patients with VRE has been individually evaluated and suggests reduced transmission and improved compliance with contact isolation requirements.(37) These results are intuitive; however, this study is more than 20 years old and more recent data are limited. Given the lack of private rooms in many healthcare settings, more research on the benefits and potential risks of cohorting is warranted.

**Decolonization:** The primary decolonization strategy for VRE is topical decolonization of the skin using CHG bathing; additionally, gastrointestinal decolonization has been attempted but durable success is not reliable. Similar to MRSA, decolonization strategies have been primarily included as part of a bundle of interventions often deployed in outbreak settings. As such the individual effect of decolonization on VRE transmission is also unclear.

#### 4. Cleaning and disinfection information

Enterococcal contamination of environmental surfaces is common and may be associated with increased risk of transmission and acquisition. Similar to MRSA, standard cleaning and disinfecting agents are active against enterococci including VRE.

#### 5. Related regulations and requirements

**National:**

VRE cases are not reportable by CMS via NHSN.

The CDC HICPAC 2006 MDRO guideline lists two sets of interventions, designated as "general" and "intensified, tier 2". VRE is considered an MDRO in this guideline.

General guidance is to use contact precautions for inpatients colonized or infected with MDROs. Active surveillance testing and decolonization are listed as intensified, Tier 2 interventions (recommendation V.B.5.b).

**Oregon:**

Under Oregon Administrative Rule ([OAR 333-019-0052](#)), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with VRE.<sup>(30)</sup>

VRE cases are not reportable in Oregon.

## 6. Summary: Infection prevention recommendations for VRE

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation	Other infection prevention strategies
ACH and LTACH	Standard + Contact Precautions for patients colonized or infected with VRE.*	1 year after last positive VRE test.  Optional: facility may also employ AST to assess ongoing carriage.**	AST optional**  Decolonization optional
LTCF	Standard Precautions. Additionally, facilities should consider applying Enhanced Barrier Precautions for patients colonized or infected with VRE.	1 year after last positive VRE test.	AST optional**  Decolonization optional
Adult Foster Hospice Home care Ambulatory Clinic	Standard Precautions	n/a	n/a

AST = Active surveillance testing to detect asymptomatic colonization.



\*In ACH/LTACH if contact precautions are not used, the facility must demonstrate ongoing low infection risk and optimal adherence to Standard Precautions. The facility should have established methods for monitoring MRSA rates and for rapid identification of outbreaks.

\*\*Facilities with capacity and interest can consider performing AST for VRE in previous carriers or other perceived high-risk individuals.

## **Drug-Resistant *Enterobacteriaceae***

### **1. Background**

Drug-resistant *Enterobacteriaceae* include Gram-negative enteric organisms such as *Escherichia coli*, *Klebsiella pneumoniae*, *Enterobacter spp.*, and *Salmonella spp.* that are resistant to a pre-specified number of antibiotics via a multitude of resistance mechanisms including both innate (chromosomal) and acquired (plasmid) drug resistance.

Examples of drug-resistant *Enterobacteriaceae* include CRE, ESBL-*E. coli*, ESBL-*Klebsiella spp.*, and AmpC-producing *Enterobacter spp.* amongst many others.

**Carbapenem-resistant *Enterobacteriaceae* (CRE):** CRE are defined as *Enterobacteriaceae* that are resistant to *any* carbapenem, including doripenem, ertapenem, imipenem, or meropenem. Carbapenemase-producing (CP)-CRE prevention and control continues to be a major focus of ongoing prevention efforts given the capacity of these organisms to spread in the healthcare setting. CRE are reportable in Oregon and have specific infection prevention guidelines addressed in detail in [Oregon's CRE Toolkit](#).(38) As such, CRE will not be the focus of this part of this toolkit. Instead, we will define and make recommendations for other, additional patterns of resistance among *Enterobacteriaceae*.

**Extended-spectrum beta-lactamases (ESBLs):** ESBLs are large heterogeneous group of enzymes first described in the late 1980's in the United States and Europe that can be acquired by Gram-negative organisms, primarily *Enterobacteriaceae*. Examples of classes of ESBL enzymes include CTX-M, TEM, and SHV.

### **2. Laboratory Information and Definitions**

**Oregon XDR-*Enterobacteriaceae* are organisms testing non-susceptible to  $\geq 1$  agent listed in at least 4 of the following 6 categories (i.e., organisms test susceptible to all listed agents in no more than 2 of the following 6 categories):**

1. Aminoglycosides (gentamicin, tobramycin, amikacin)
2. Anti-pseudomonal penicillins (piperacillin-tazobactam)
3. Carbapenems (ertapenem, imipenem, meropenem)\*\*
4. Extended-spectrum cephalosporins (ceftriaxone, cefotaxime, ceftazidime, cefepime\*)
5. Fluoroquinolones (ciprofloxacin, levofloxacin, moxifloxacin)
6. Folate-pathway inhibitors (trimethoprim-sulfamethoxazole)

\*"Susceptible dose-dependent" is considered susceptible for purposes of this definition

\*\*CRE are an independent category of drug-resistant *Enterobacteriaceae* that usually but not always meet the XDR-E definition— see the Oregon CRE Toolkit for detailed recommendations on reporting and managing carbapenemase-producing and non-carbapenemase-producing CRE.

Determining the amount of drug-resistance warranting contact precautions is complex given the heterogeneity of organisms, antibiotic susceptibilities, resistance mechanisms, and laboratory reporting practices.

Thus, the Oregon XDR-*Enterobacteriaceae* definition most closely mirrors the eCDC/CDC *possible* extensively drug-resistant bacterial definition ([1](#)) that can be practically adopted to Oregon clinical microbiology laboratories.

**A note on ESBLs:** The acquisition of an ESBL by an organism typically confers broad penicillin- and cephalosporin-class drug resistance including amoxicillin, amoxicillin-clavulanate, cephalexin, ceftriaxone, and ceftazidime; many test fluoroquinolone- and trimethoprim-sulfamethoxazole (TMP-SMX)-resistant; and some test piperacillin-tazobactam- and cefepime-resistant. ESBL detection in the clinical microbiology laboratory is neither straightforward nor required. Updated CLSI guidelines do not require ESBL detection and outline a reliance on improved clinical susceptibility breakpoints to detect ESBL-producing organisms.[\(39\)](#) **Thus, at this time, ESBL status is excluded from the Oregon XDR-*Enterobacteriaceae* definition as the definition is based on antimicrobial susceptibility alone**, noting that the definition will capture many of the ESBL-producing *Enterobacteriaceae*.

### 3. Strategies to Prevent Transmission

*Enterobacteriaceae* are responsible for a large number of heterogeneous human infections. A practical approach to infection prevention for extensively drug-resistant *Enterobacteriaceae*, in addition to Standard Precautions, is to employ Contact Precautions for patient care with a goal to prevent patient-to-patient transmission.

AST in non-outbreak scenarios is not commonly performed for extensively drug-resistant *Enterobacteriaceae* with the exception of CRE; also, decolonization as a strategy to limit transmission has not been established. Targeting patients with recent (within 6 months) travel history and in particular overnight healthcare outside the U.S., as is suggested for CRE, may improve the yield of AST for other Gram-negative organisms (e.g., carbapenemase-producing *Pseudomonas aeruginosa*) and ensure rapid implementation of prevention measures for colonized patients.

**Patient placement:** Hospitalized patients in acute care facilities with XDR-*Enterobacteriaceae* colonization or infection should be placed in private rooms when available. Cohorting of patients (i.e., placing patients in the same room) is acceptable when no private rooms are available, provided the organism involved is identical (same organism and resistance mechanism, if known) and as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

### 4. Cleaning and disinfection information

Standard cleaning and disinfecting agents are active against most (or all) of the *Enterobacteriaceae* that harbor ESBLs. Enterobacteria colonize primarily the human gut but many are very stable (days to weeks to months) in the environment.

### 5. Related regulations and requirements

**National:** No national reporting mandate as of January 2019.

However, CP-*Klebsiella*, CP-*E. coli*, and CP-*Enterobacter* are on the list of the Council of State and Territorial Epidemiologists (CSTE) notifiable conditions.

Extended-spectrum cephalosporin-resistant *Klebsiella* spp. and CRE are organisms included in the optional NHSN MDRO/CDI Module.

**Oregon:**

Under Oregon Administrative Rule ([OAR 333-019-0052](#)), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with highly resistant Gram-negative organisms.[\(30\)](#)

CRE are reportable within one working day to the local health authority.

All *Enterobacteriaceae* that are non-susceptible (intermediate or resistant using current CLSI breakpoints) to all antibiotics tested in the first panel should be reported immediately to the local health authority as an uncommon illness of public health significance ([OAR-333-018-0015](#)).[\(31\)](#)

**6. Summary: Infection prevention recommendations for XDR-E**

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
ACH and LTACH	<p><b>CP-CRE and pan-non-susceptible isolates*:</b> Standard + Contact Precautions. See Oregon CRE Toolkit for additional suggested measures</p> <p><b>Other Oregon XDR-E*:</b> Standard &amp; Contact Precautions.</p>	<p><b>CP-CRE and pan-non-susceptible isolates*:</b> Indefinite</p> <p><b>Other Oregon XDR-E:</b> ≥1 year after last positive Oregon XDR-E test**</p> <p>Optional for facilities to screen high-risk patients for colonization on admission***</p>
LTCF	<b>CP-CRE:</b> Standard + Contact Precautions	<b>CP-CRE:</b> Indefinite

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
	<p><b>Other Oregon XDR-E*:</b> Standard Precautions. Additionally, facilities should consider applying Enhanced Barrier Precautions for patients colonized or infected with Oregon XDR-E.</p>	<p><b>Other Oregon XDR-E:</b> Minimum 1 year after last positive Oregon XDR-E test**  Optional for facilities to screen high-risk patients for colonization on admission***</p>
<p>Adult Foster Home Hospice Home Care Ambulatory Clinic</p>	<p>All Oregon XDR-E including CRE: Standard Precautions</p>	<p>n/a</p>

ACH = Acute care hospital  
 CP= Carbapenemase-producing  
 LTACH = Long term acute care hospital  
 LTCF = Long term care facility  
 PA = *Pseudomonas aeruginosa*  
 XDR = Extensively drug-resistant

\*Pan-nonsusceptible isolates are defined as isolates testing intermediate or resistant to all antibiotics in first panel; consider employing isolation precautions & discontinuation parameters as for carbapenemase-producing organisms: consult with OHA HAI epidemiologist as needed on case-by-case basis.

\*\*Duration of recommended CP is minimum 1 year for XDR-E. Extending CP beyond 1 year is a clinical decision based on ongoing patient- and facility- factors.

\*\*\*Facilities with capacity and interest may or may not decide to screen for asymptomatic colonization of Oregon XDR-E organisms in previous carriers or other perceived high-risk individuals.

## **Drug-resistant *Pseudomonas aeruginosa* (PA)**

### **1. Background**

*Pseudomonas aeruginosa* (PA) is the most commonly encountered and frequently drug-resistant species in the genus *Pseudomonas*. This is an environmental organism often found in water including diverse sources such as contaminated fluids and hot tubs. It is a particular problem, causing infections in burn patients, cystic fibrosis patients, and ICUs. Drug-resistant PA has been endemic in many hospitals for decades.

The percent of PA that were reported as multidrug-resistant to CDC's NHSN in 2014 for central line-associated bloodstream infection (CLASBI), catheter-associated urinary tract infection (CAUTI), ventilator-associated pneumonia (VAP), and surgical-site infection (SSI) per the CDC's NHSN HAI criteria were 17.9, 17.7, 19.9, and 4.3, respectively.<sup>(40)</sup> Notably, unlike *Enterobacteriaceae*, carbapenem-resistant (CR)PA are relatively common (e.g., CRPA represented >25% of PA reported to NHSN of CLASBI, CAUTI, and VAP) and the resistance is primarily unrelated to carbapenemase acquisition (~2%); however, carbapenemase-producing (CP)-PA appear to be emerging; in Oregon, five cases have been reported as of October 2018.<sup>(41)</sup> Through the newly established Antibiotic Resistance Lab Network (ARLN), CDC has initiated broader CR-PA surveillance in an effort to better understand and determine resistance mechanisms.

### **2. Laboratory Information and Definitions**

**“Oregon XDR-*Pseudomonas aeruginosa*” are organisms testing non-susceptible to ≥1 listed agent in at least 3 of the following 5 categories (i.e., organisms test susceptible to all listed agents in no more than 2 of the following 5 categories):**

1. Aminoglycosides (gentamicin, tobramycin, amikacin)
2. Anti-pseudomonal penicillins (piperacillin-tazobactam)
3. Anti-pseudomonal carbapenems (imipenem, meropenem)
4. Anti-Pseudomonal cephalosporins (ceftazidime, cefepime)
5. Anti-pseudomonal fluoroquinolones (ciprofloxacin, levofloxacin)

The Oregon XDR-PA definition most closely mirrors the eCDC/CDC *possible* extensively drug-resistant bacterial definition <sup>(1)</sup> adopted to Oregon clinical microbiology laboratories.

### **3. Prevention Strategies**

Standard plus contact precautions are commonly employed for drug-resistant strains. As with other drug-resistant Gram-negative organisms, a universal definition to set a threshold for *when* to implement contact precautions has previously not been established.

In both endemic and epidemic scenarios, water sources should be considered as a primary environmental reservoir including contaminated solutions, respiratory therapy equipment, sinks, and showers. Supply carts and equipment should not be stored near sinks or bathrooms.

Asymptomatic screening and/or decolonization are not commonly encountered nor recommended as additional strategies.

**Patient placement:** Hospitalized patients in acute care facilities with XDR-PA colonization or infection should be placed in private rooms when available. Cohorting of patients (i.e., placing patients in the same room) is acceptable when no private rooms are available, provided the organism involved is identical (susceptibility pattern and resistance mechanism, if known) and as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

#### 4. Cleaning and disinfection information

Standard cleaning and disinfecting agents are active against PA. Frequent disinfection of water supply and sink areas is recommended and may warrant collaboration with facility engineers to ensure appropriate cleaning and maintenance. Respiratory therapy in particular, should be cognizant of hand hygiene & cleaning with ventilator and tracheostomy cares.

#### 5. Related regulations, rules, and requirements

**National:** No national reporting mandates as of January 2019.

**Oregon:**

Under Oregon Administrative Rule ([OAR 333-019-0052](#)), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with XDR-*Pseudomonas spp.*([30](#))

*Pseudomonas sp.* that are non-susceptible (intermediate or resistant using current CLSI breakpoints) to all antibiotics tested in the first panel should be

reported immediately to the local health authority as an uncommon illness of public health significance ([OAR-333-018-0015](#)).(31)

In 2017, the newly established regional ARLN launched CR-PA surveillance in sentinel laboratories across the nation. In Oregon, selected sentinel laboratories outside the Portland Tri-County area started reporting CR-PA in 2018.

**6. Summary: Infection prevention recommendations for XDR-PA**

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
ACH and LTACH	<p><b>CP-PA and pan-non-susceptible isolates*:</b> Standard + Contact Precautions. Consult with OHA for additional suggested measures</p> <p><b>Other XDR-PA*:</b> Standard + Contact Precautions</p>	<p><b>CP-PA and pan-non-susceptible isolates*:</b> Standard + Contact Precautions.: Indefinite</p> <p><b>Other XDR-PA: minimum 1</b> year after last positive Oregon XDR-PA test.</p> <p>Optional for facilities to screen high-risk patients for colonization on admission***</p>
LTCF	<p><b>CP-PA and pan-non-susceptible isolates*:</b> Standard &amp; Contact Precautions</p> <p><b>Other XDR-PA*:</b> Standard Precautions. Additionally, facilities should consider applying Enhanced Barrier Precautions for patients</p>	<p><b>CP-PA and pan-non-susceptible isolates*:</b> Indefinite</p> <p><b>Other XDR-PA: Minimum 1</b> year after last positive Oregon XDR-PA test.**</p>



Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
	colonized or infected with Oregon XDR-E.	
Adult Foster Home Hospice Home Care Ambulatory Clinic	Standard Precautions	n/a

ACH = Acute care hospital  
 CP= Carbapenemase-producing  
 LTACH = Long term acute care hospital  
 LTCF = Long term care facility  
 PA = *Pseudomonas aeruginosa*  
 XDR = Extensively drug-resistant

\*Pan-nonsusceptible isolates are defined as isolates testing intermediate or resistant to all antibiotics in first panel; consider employing isolation precautions & discontinuation parameters as for carbapenemase-producing organisms: consult with OHA HAI epidemiologist as needed on case-by-case basis.

\*\*Duration of recommended CP is minimum 1 year for XDR-PA. Extending CP beyond 1 year is a clinical decision based on ongoing patient- and facility- factors.

\*\*\*Facilities with capacity and interest may or may not decide to screen for asymptomatic colonization of Oregon XDR-PA organisms in previous carriers or other perceived high-risk individuals.

## **Drug-resistant *Acinetobacter baumannii* (AB)**

### **1. Background**

*Acinetobacter* species are aerobic, Gram-negative bacteria ubiquitous in nature (soil, water, animals, humans) that colonize the skin, throat, and rectum of humans, and the respiratory tract in ventilated patients. Clinical infection with *Acinetobacter* in healthcare settings often relates to invasive procedures and underlying or debilitating conditions (e.g., alcoholism, diabetes, cancer, chronic wounds, and immunocompromised states).

*Acinetobacter baumannii* (AB) is a significant health-care associated, opportunistic, multidrug-resistant organism (MDRO) causing ~80% of *Acinetobacter* species infections, commonly in patients via central lines, mechanical ventilation, and chronic wounds.

Carbapenem resistance (CRAB) is found and is due to multiple drug-resistance mechanisms including chromosomal and plasmid-mediated **carbapenemases; the degree to which acquired (e.g., plasmid-mediated) carbapenem resistance contributes to CRAB is another matter under active investigation by CDC.** Oregon experienced a multi-facility extensively drug-resistant CRAB outbreak from 2012-2014. ([42](#), [43](#))

### **2. Laboratory Identification and Definitions**

**“Oregon XDR-*Acinetobacter baumannii*” are organisms testing non-susceptible to  $\geq 1$  listed agent in at least 5 of the following 7 categories (i.e., organisms test susceptible to all listed agents in no more than 2 of the following 7 categories):**

1. Aminoglycosides (gentamicin, tobramycin, amikacin)
2. Anti-pseudomonal penicillins (piperacillin-tazobactam)
3. Anti-pseudomonal carbapenems (imipenem, meropenem)\*
4. Extended-spectrum cephalosporins (ceftriaxone, cefotaxime, ceftazidime, cefepime)
5. Antipseudomonal fluoroquinolones (ciprofloxacin, levofloxacin)
6. Folate-pathway inhibitors (trimethoprim-sulfamethoxazole)
7.  $\beta$ -lactam/ $\beta$ -lactamase inhibitor (ampicillin/sulbactam)

**\*While most Carbapenem-resistant *Acinetobacter baumannii* (CRAB) meet The Oregon XDR-AB definition, all CRAB, regardless of the remainder of susceptibility patterns also warrant Contact Precautions.**

The Oregon XDR-AB definition most closely mirrors the eCDC/CDC possible extensively drug-resistant bacterial definition (1) adopted to Oregon clinical microbiology laboratories. Also, CRAB is included in the Oregon XDR-AB because these organisms already contain clinically and epidemiologically important drug-resistance.

### 3. Prevention Strategies

Standard plus contact precautions are commonly employed for drug-resistant strains. As with other drug-resistant Gram-negative organisms, a universal threshold for when to implement contact precautions has previously not been established.

**Environmental Contamination:** The ability of *Acinetobacter* to participate in biofilm formation promotes durability in and on surfaces and may contribute to continuation of environmental sources during outbreaks. Because *Acinetobacter* is capable of surviving for extended periods of time on inanimate surfaces, elimination of an identified source may require multiple or novel interventions. Contamination in healthcare environments has been identified on many surfaces and equipment, including suctioning equipment, ultrasound equipment, washbasins, bedrails, bedside tables, ventilators, sinks, pillows, mattresses, hydroscopic bandages, resuscitation equipment and trolleys. The hands of healthcare workers frequently touch these objects in patient environments.

Outside of the outbreak setting, asymptomatic screening and/or decolonization are not commonly encountered nor recommended additional strategies. During an outbreak, environmental cultures can be utilized to assess degree of environmental contamination and to guide enhanced disinfection efforts.

**Patient placement:** Hospitalized patients in acute care facilities with XDR-AB colonization or infection should be placed in private rooms when available. Cohorting of patients (i.e., placing patients in the same room) is acceptable when no private rooms are available, provided the organism involved is identical (susceptibility pattern and resistance mechanism, if known), and as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

### 4. Cleaning and disinfection information

Standard healthcare cleaning and disinfecting agents are active against AB.

However, AB has unique outbreak response issues regarding enhanced environmental disinfection due to the ability of the organism to form biofilms and persist in the environment on fomites.

**5. Related regulations and requirements**

**National:** No national reporting mandate as of January 2019.

Extended-spectrum cephalosporin-resistant *Klebsiella* spp. and CRE are organisms included in the optional NHSN MDRO/CDI Module.

**Oregon:**

Under [Oregon Administrative Rule \(OAR\) 333-019-0052](#), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with highly resistant *Acinetobacter* sp.([30](#))

*Acinetobacter* sp. that are non-susceptible (intermediate or resistant using current CLSI breakpoints) to all antibiotics tested in the first panel should be reported immediately to the local health authority as an uncommon illness of public health significance ([OAR-333-018-0015](#)).([31](#))

**6. Summary: Infection prevention recommendations for Oregon XDR-AB**

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
ACH and LTACH	<p><b>CP (acquired)-CRAB and pan-non-susceptible isolates*:</b> Standard &amp; Contact Precautions. Consult with OHA for additional suggested measures</p> <p><b>Other XDR-AB*:</b> Standard + Contact Precautions</p>	<p><b>CP (acquired)-CRAB and pan-non-susceptible isolates*:</b> Indefinite</p> <p><b>Other XDR-AB:</b> Minimum 1 year after last positive Oregon XDR-AB test.</p>

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
		Optional for facilities to screen high-risk patients for colonization on admission**
LTCF	<b>CP (acquired)-CRAB and pan-non-susceptible isolates*:</b> Standard + Contact Precautions	<b>CP (acquired)-CRAB and pan-non-susceptible isolates*:</b> Indefinite
	<b>Other XDR-AB*:</b> Standard Precautions. Standard Precautions. Additionally, facilities should consider applying Enhanced Barrier Precautions for patients colonized or infected with Oregon XDR-AB.	<b>Other XDR-AB:</b> 1 year after last positive Oregon XDR-AB test.***
Adult Foster Home Hospice Home Care Ambulatory Clinic	Standard Precautions	n/a

ACH = Acute care hospital

LTACH = Long term acute care hospital

LTCF = Long term care facility

CRAB = Carbapenem-resistant *Acinetobacter baumannii*

CP (acquired)= Carbapenemase-producing organisms by acquired and not innate carbapenemase gene

AB = *Acinetobacter baumannii*

XDR = Extensively drug-resistant

\*Pan-nonsusceptible isolates are defined as isolates testing intermediate or resistant to all antibiotics in first panel; consider employing isolation precautions & discontinuation parameters as for carbapenemase-producing organisms: consult with OHA HAI epidemiologist as needed on case-by-case basis.

\*\*In absence of carbapenemase-producing (acquired) CRAB or pan-resistant AB, duration of recommended CP is minimum 1 year for XDR-AB. Extending CP beyond 1 year is a clinical decision based on ongoing patient- and facility- factors. Consult with OHA HAI epidemiologist as needed on case-by-case basis.

\*\*\*Facilities with capacity and interest may or may not decide to screen for asymptomatic colonization of Oregon XDR-AB organisms in previous carriers or other perceived high-risk individuals.

## **Drug-resistant *Stenotrophomonas maltophilia* (SM)**

### **1. Background and Epidemiology**

*Stenotrophomonas maltophilia* (SM) is an uncommonly encountered Gram-negative organism that possesses several unique intrinsic resistance mechanisms including a chromosomal metallo-beta-lactamase carbapenemase rendering it intrinsically resistant to carbapenems. Thus, when the organism acquires resistance to only a handful of commonly used agents such as TMP-SMX, levofloxacin and ceftazidime, it becomes quite difficult to treat. It is most commonly encountered in antibiotic-experienced patients as a pathogen in hospital- or ventilator-associated pneumonia.

### **2. Laboratory Information & Definitions**

**Oregon XDR-SM are organisms testing non-susceptible to  $\geq 3$  of the following 4 listed agents (i.e., organisms test susceptible to no more than 2 of the following 4 listed agents):**

- 1. ceftazidime**
- 2. levofloxacin**
- 3. trimethoprim-sulfamethoxazole**
- 4. minocycline**

The Oregon XDR-SM definition most closely mirrors the eCDC/CDC *possible* extensively drug-resistant bacterial definition ([1](#)) adopted to Oregon clinical microbiology laboratories.

CLSI-approved antibiotic susceptibility testing for SM is limited to the above FDA-approved, currently available antibiotics.

### **3. Strategies to Prevent SM Transmission**

Standard plus contact precautions are commonly employed for drug-resistant strains. As with other drug-resistant Gram-negative organisms, a universal definition to set a threshold for when to implement contact precautions has previously not been established.

*Stenotrophomonas* is an opportunistic pathogen found in water, soil in the environment and has been identified in contaminated fluids and on invasive devices. Because it is most commonly identified as a pneumonia, during an outbreak an initial focus of investigation should be turned to contaminated solutions and/or respiratory therapy and ventilator care infection prevention.

Asymptomatic screening and/or decolonization are not commonly encountered nor recommended additional strategies.

**Patient placement:** Hospitalized patients in acute care facilities with XDR-SM colonization or infection should be placed in private rooms when available. Cohorting of patients (i.e., placing patients in the same room) is acceptable when no private rooms are available, provided the organism involved is identical (susceptibility pattern and resistance mechanism, if known) and as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

#### 4. **Cleaning and disinfection information**

Standard cleaning and disinfecting agents are active against SM. Respiratory therapy, in particular, should be cognizant of hand hygiene & cleaning with ventilator and tracheostomy cares.

#### 5. **Related regulations, rules, and requirements**

**National:** No national reporting mandates as of January 2019.

**Oregon:**

Under Oregon Administrative Rule ([OAR 333-019-0052](#)), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be colonized or infected with XDR-SM. ([30](#))

*Stenotrophomonas* strains. that are non-susceptible (intermediate or resistant using current CLSI breakpoints) to all antibiotics tested in the first panel should be reported immediately to the local health authority as an uncommon illness of public health significance ([OAR-333-018-0015](#)). ([31](#))

## 6. Summary: Infection prevention recommendations for Oregon XDR-AB

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
ACH and LTACH	<b>XDR-SM:</b> Standard + Contact Precautions.	<b>XDR-SM:</b> 1 year after last positive Oregon XDR-SM test.  Optional for facilities to screen high-risk patients for colonization on admission.**
LTCF	<b>XDR-SM:</b> Standard Precautions. Additionally, consider the individual patient's clinical situation (e.g. potential for spread based on site of colonization or infection) and facility resources in deciding whether to implement Contact Precautions.	<b>XDR-SM:</b> minimum 1 year after last positive Oregon XDR-SM test.*
Adult Foster Home Hospice Home Care Ambulatory Clinic	Standard Precautions	n/a

ACH = Acute care hospital

LTACH = Long term acute care hospital

LTCF = Long term care facility

XDR = Extensively drug-resistant

SM = *Stenotrophomonas maltophilia*

\*Duration of recommended CP is minimum 1 year for XDR-SM. Extending CP beyond 1 year is a clinical decision based on ongoing patient- and facility- factors.



\*\*Facilities with capacity and interest may or may not decide to screen for asymptomatic colonization of “Oregon XDR-SM” organisms in previous carriers or other perceived high-risk individuals.

## ***Clostridioides difficile* (*C. difficile*)**

### **1. Background and Epidemiology**

*Clostridioides difficile* (formerly *Clostridium difficile*, *C. difficile*) is a Gram-positive, spore-forming, anaerobic bacillus that is widely distributed in the environment, and colonizes 5-15% of healthy adults and up to 84.4% of newborns and healthy infants.<sup>(44)</sup> Some strains produce two toxins (toxin A and toxin B) that cause disease, ranging from mild diarrhea to pseudomembranous colitis and toxic megacolon.

*C. difficile* infection (CDI) is a leading cause of healthcare-associated diarrhea, with reported rates ranging from 1-10 cases per 1,000 discharges and 17-60 cases per 100,000 bed-days.<sup>(45)</sup> Rates of CDI has continued to rise since 2000 with the emergence of a new toxigenic, fluoroquinolone-resistant strain, especially in the recently hospitalized elderly and those residing in LTCFs.

The major CDI risk factors are exposure to antibiotics and exposure to the organism. Other risk factors include comorbid conditions, gastrointestinal surgery, and medications that reduce gastric acid, including proton-pump inhibitors (PPIs).

Transmission in health-care facilities primarily results from environmental surface contamination such as toilets, but it can occur via contaminated reusable medical equipment and hand carriage by HCW. However, recent data analyzing regional *C. difficile* strain relatedness indicate that intra-facility transmission may play less of an important role than initially thought.<sup>(46)</sup> The role of the gut microbiome and other introduction sources (i.e. community-based introductions) require further study.

### **2. Laboratory Information & Definitions**

Because *C. difficile* can be a gut colonizer or cause infection and because no clinical test has demonstrated clear superiority in distinguishing the two, laboratory testing algorithms for diagnosis of CDI should incorporate the following recommendations.

- Only loose, unformed stools from patients *with diarrhea* should be tested for *C. difficile*.
- **Multiple tests are available to diagnose CDI, and each has pros and cons. Two commonly employed testing strategies are outlined below:**

Algorithm 1 -- Nucleic acid amplification test (NAAT) alone: The use of a NAAT such as PCR for *C. difficile* toxin genes (A and/or B) is highly sensitive to detect toxigenic *C. difficile* but may over-diagnose colonization because hospitalized patients may be colonized with *C. difficile* and have diarrhea for many reasons other than *C. difficile*. This may be a preferred approach if sample quality is controlled & the pre-test probability of *C. difficile* in submitted samples is high.

Algorithm 1b: Because NAAT alone may be *too sensitive and not sufficiently specific* (depending on the pre-test probability of disease), labs performing NAAT may add toxin A and B enzyme immunoassay (EIA) testing for positive NAAT tests to confirm infection. In cases with NAAT+/Toxin EIA- results, laboratories may provide a comment indicating that these results likely represent asymptomatic colonization, however diagnosis and treatment decisions should be also based on the clinical evaluation.

Algorithm 2 – Multistep algorithm that includes 2 EIA tests often performed simultaneously on the same testing card: a glutamate dehydrogenase (GDH) EIA detects protein on all *C. difficile* strains while a Toxin A/B EIA detects the actual toxin itself. If the tests are discrepant (i.e. GDH+/toxin-), often a NAAT is used as a “tie-breaker” to determine the final test result. This approach may miss cases, specifically it may be *too specific and not sufficiently sensitive*, when compared to algorithm 1 using NAAT. This may be preferred approach if sample quality is not well controlled & the pre-test probability of *C. difficile* in submitted samples is relatively low.

Given that neither algorithm is clearly optimal, new rapid, accurate diagnostic tests are being developed. When selecting the best test for your facility, turnaround times must be weighed with the type of testing desired. Recent IDSA *C. difficile* guidelines provide further detail on these diagnostic options.[\(47\)](#)

- Repeat testing after negative CDI test results on the same patient/resident within 1 week without worsening symptoms should be discouraged.
- Repeat testing following CDI treatment (i.e., test for cure) in absence of recurrent diarrhea is not recommended as the stool may still test positive for weeks.

### 3. Strategies to Prevent *C. difficile* Transmission

Sustained control of CDI may be achieved by a) eliminating unnecessary antibiotic exposures that promote colonization transitioning to infection; and b) infection control measures directed at interrupting the horizontal spread of *C. difficile*.

**Antibiotic stewardship:** while antibiotic stewardship is important for prevention of all MDROs, the direct impact of minimizing antibiotic use on *C. difficile* risk is very clear, as the overwhelming majority of patients with *C. difficile* infection have been exposed to

antibiotics. Avoidance of unnecessary and unnecessarily prolonged antibiotic administration is a win-win for patients, providers, and healthcare facilities.

**Transmission Prevention:** Important to the cornerstone of horizontal transmission prevention are the use of:

- a system for identification and prompt isolation of suspected or known CDI cases
- access to appropriate and timely laboratory testing
- barrier precautions for the care of a patient with CDI
- appropriate environmental services policies and procedures for CDI cases, including the use of sporicidal agents for cleaning and disinfection of reusable medical equipment and the environment and a system for disposal of fecal material that prevents environmental contamination

**Hand Hygiene:** The optimal method of hand hygiene is controversial. *C. difficile* spores are not killed by alcohol-based hand rub and not easily removed by soap and water. Because alcohol-based hand rub is generally favored in healthcare facilities and in the absence of clear evidence for superiority of soap and water for infection prevention, for **endemic (not epidemic)** disease, either hand hygiene method is considered acceptable. Soap and water are preferred in outbreak situations.[\(47, 48\)](#)

**Patient placement:** Hospitalized patients in acute care facilities with *C. difficile* infection should be placed in private rooms when available.

A single room with dedicated toileting facilities (i.e., private bathroom or individual commode chair) is strongly recommended. If single rooms are limited, prioritize patients with fecal incontinence.

Cohorting of patients (i.e., placing patients in the same room) is acceptable when no private rooms are available, as long as patients do not have other discordant MDROs or conditions requiring different types of isolation precautions.

#### 4. Cleaning and Disinfection Information

**Specialized cleaning and disinfection practices are required for *C. difficile*.** While the bacterium in the vegetative form is readily killed with hospital-grade disinfectants, the spores are not and can persist in the environment for months.

Thus, environmental disinfection is recommended by using an Environmental Protection Agency (EPA)-registered product with a *C. difficile*-sporicidal label claim or using a 5000 ppm chlorine-containing cleaning agent.<sup>(49)</sup> Note, for EPA-registered disinfectants, the solution should have a contact time that meets the manufacturers' recommendations for killing *C. difficile* spores. For chlorine-containing cleaning agents with a minimum of 5000 ppm of available chlorine, evidence supports a contact time of at least 10 minutes.<sup>(50)</sup>

No touch disinfection devices, also known as automated decontamination devices, have become more widely available and implemented as part of hospital cleaning programs. Examples include ultraviolet (UV) systems, hydrogen peroxide systems, and others. These devices can be rolled or carried into hospital rooms (without patients) to disinfect surfaces, including those contaminated by *C. difficile* spores, after manual cleaning. Currently the clinical utility and cost-effectiveness of these devices is uncertain.

## 5. Related Regulations and Requirements

**National:** The Centers for Medicare & Medicaid Services (CMS) currently requires Hospitals and Long-Term Acute Care Hospitals to report CDI LabID events (via the National Healthcare Safety Network ID Event).

### State:

Under Oregon Administrative Rule ([OAR 333-019-0052](#)), a transferring facility is required to provide written notification to a receiving facility if a patient is known to be infected with *C. difficile*.<sup>(30)</sup>

As part of the *C. difficile* infection population-based surveillance conducted through CDC's Emerging Infections Program (EIP) Healthcare-Associated Infections Community Interface (HAIC) activity, laboratories within a select catchment area report all *C. difficile* cases to the state health department.

Oregon's mandatory HAI reporting ([OAR 333-018-0110](#)) includes the requirement for facility-wide reporting of CDI (via NHSN Lab ID Event) for all hospital inpatients.<sup>(32)</sup>

## 6. Infection Prevention Recommendations

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
ACH and LTACH	Contact-Plus* for CDI	Minimum 48 hours after cessation of diarrhea

Healthcare Setting	Suggested isolation precautions	When to discontinue isolation
	<i>C. difficile</i> <u>colonization</u> : unresolved issue regarding best approach to isolation precautions - not currently recommended.	Many facilities opt to continue precautions for duration of hospitalization.
LTCF	Contact-Plus* for CDI  <i>C. difficile</i> <u>colonization</u> : unresolved issue regarding best approach to isolation precautions - not currently recommended.	Minimum 48 hours after cessation of diarrhea  Many facilities opt to continue precautions for duration of the initial 10- to 14-day antibiotic treatment.
Adult Foster  Hospice  Homecare  Ambulatory Clinic	Standard Precautions	n/a

ACH = Acute care hospital

LTACH = Long term acute care hospital

LTCF = Long term care facility

CDI = Clostridioides *difficile* infection

\*Contact plus –labelled alternatively as “modified-contact” or “enteric” precautions

## Glossary of Abbreviated Terms

**AB** - *Acinetobacter baumannii*

**ABHR** - Alcohol-based hand rub

**ACH** - Acute care hospital

**APIC** - The Association for Professionals in Infection Control and Epidemiology

**AST** - Active surveillance testing

***C. difficile*** - *Clostridioides difficile*

**CDC** - Centers for Disease Control and Prevention

**CDI** - *C. difficile* infection

**CHG** - Chlorhexidine gluconate

**CLABSI** - Central line-associated bloodstream infections

**CLSI** - The Clinical and Laboratory Standards Institute

**CMS** - The Centers for Medicare & Medicaid Services

**CP-CRE** - Carbapenemase-producing carbapenem-resistant *Enterobacteriaceae*

**CRAB** - Carbapenem-resistant *Acinetobacter baumannii*

**CRE** - Carbapenem resistant *Enterobacteriaceae*

**DROP-CRE** - The Oregon Drug-Resistant Organism and Coordinated Regional Epidemiology

**eCDC**: European Centre for Disease Prevention and Control

**EBP** - Enhanced barrier precautions

**EIA** - Enzyme immunoassay

**EIP** - Emerging infections program

**EPA** - Environmental Protection agency

**ESBL** - Extended-spectrum beta-lactamases

**FDA** - US Food and Drug Administration

**GDH** - Glutamate dehydrogenase

**GISA** - Glycopeptide-intermediate *S. aureus*

**HAI** - Healthcare-associated infections

**HAIAC** - OHA Healthcare Acquired Infection Advisory Committee

**HAIC** - Healthcare-associated infections community interface

**HCW** - Healthcare workers

**ICU** - Intensive care unit

**IDSA** - Infectious Diseases Society of America

**LTACH** – Long term acute care hospital

**LTCF** - Long term care facility

**MDRO** - Multidrug-resistant organisms

**MIC** - Minimum inhibitory concentration

**MRSA** - Methicillin-resistant *S. aureus*

**NAAT** - Nucleic acid amplification test

**NHSN** - National Healthcare Safety Network

**OAR** - Oregon Administrative Rule

**OHA** - Oregon Health Authority

**OSWAPIC** - Oregon-Southwest Washington Association for Professionals in Infection Control and Epidemiology

**PA** - *Pseudomonas aeruginosa*

**PCR** - Polymerase chain reaction

**PICC** - Peripherally-inserted central catheters

**PPE** - Personal protective equipment

**PPI** - Proton-pump inhibitors

**PPM** - Parts per million

**SHEA** - Society for Healthcare Epidemiology of America

**SM** - *Stenotrophomonas maltophilia*

**SSI** - Surgical site infections

**TB** - Tuberculosis

**VHA** - Veteran's Health Administration

**VISA** - Vancomycin-intermediate *S. aureus*

**VRE** - Vancomycin-resistant Enterococci

**XDR** - Extensively drug-resistant

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