1. ANTIBIOTIC RESISTANT ORGANISMS

1.1 Extended Spectrum Beta Lactamase Resistant Organisms (ESBLs)

Cause/Epidemiology

ESBLs are enzymes that confer resistance to most beta-lactam antibiotics, including penicillins, cephalosporins (e.g., cefotaxime), and aztreonam.

To date, ESBLs are found exclusively in Gram-negative organisms, primarily in the Enterobacteriaceae family (e.g., Klebsiella pneumoniae, Klebsiella oxytoca, Escherichia coli, Salmonella spp., Proteus spp., Enterobacter spp., Citrobacter spp., Serratia spp., and Pseudomonas spp.).

ESBLs are generally found post treatment with broad-spectrum cephalosporins or through acquisition of a resistant strain via contact transmission. Medical use of antibiotics can considerably accelerate the diversification and dissemination of ESBLs. Selective antibiotic pressure leads to colonization of a patient’s bowel and skin with increased risk of subsequent infection.

ESBL-producing Enterobacteriaceae have been reported worldwide, most often in the hospital setting (acute care), but also in nursing homes and long-term care settings, as well as community-acquired cases.

Clinical Presentation

Most individuals with ESBLs are colonized, and are asymptomatic; some may develop infection. Both colonized and infected individuals may be a source of transmission to others.

ESBL producing strains have been isolated from various sites including abscesses, blood, lungs, catheter tips, peritoneal fluid, throat, sputum, and urine. ESBL producing organisms are responsible for a variety of infections like urinary tract infections, septicemia, hospital-acquired pneumonia, intra-abdominal abscess, brain abscess, and device related infections (e.g., catheters).

Infections with organisms producing ESBLs present in the same manner as infections caused by non-ESBL-producing organisms. ESBL infections can be serious and have been associated with poor patient outcomes. Therefore, knowing a person has an infection caused by an ESBL producing organism is important to ensure the most appropriate treatments are prescribed.
Risk Factors

Known risk factors for colonization and/or infection with ESBL-producing organisms include:

- Admission to a high risk unit (e.g., ICU, Hemodialysis Unit)
- Prior administration of antibiotics
- Recent surgery
- Indwelling medical devices (IV and urinary catheters, gastrostomy or jejunostomy tube)
- Prolonged hospitalization
- Emergency abdominal surgery
- Gut colonization
- Low birth weight
- Residence in a long-term care facility
- Severity of illness
- Ventilator assistance

Incubation

The lower digestive tract of colonized patients is the main reservoir of these organisms. Gastrointestinal carriage can persist for months.

Transmission

Direct and Indirect Contact

Transmission is by direct contact via the hands of healthcare workers who become colonized while performing care, when removing gloves, or when touching contaminated surfaces.

Transmission is also by indirect contact via contaminated equipment or surfaces.
1.2 Methicillin Resistant *Staphylococcus aureus* (MRSA)

**Cause/Epidemiology**

*Staphylococcus aureus* is a facultative anaerobic coagulase-positive organism. It appears as gram-positive cocci in clusters on gram stain. *S. aureus* colonizes the skin of humans, which leads to localized, superficial, self-limiting abscesses when the skin is disrupted.

When *Staphylococcus aureus* develops resistance to methicillin, an antibiotic commonly used to treat infections caused by this organism, it is known as Methicillin-Resistant *Staphylococcus aureus* (MRSA). These highly resistant organisms deserve special attention in healthcare facilities. Treatment choices for MRSA infections are limited.

Prevalence of MRSA varies temporally, geographically, and by healthcare setting. The type and level of care also influence the prevalence of MRSA. ICUs, especially those at tertiary care facilities, may have a higher prevalence than do non-ICU settings. Antimicrobial resistance rates are also strongly correlated with hospital size, tertiary-level care, and facility type [e.g., Long Term Care Facilities (LTCF)]. The frequency of clinical infection caused by these pathogens is low in LTCFs; however MRSA infections in LTCFs can increase patient morbidity and mortality. Colonized or infected LTCF residents may serve as reservoirs and introduce MRSA into acute care facilities.

MRSA may also be acquired in the community. Community acquired MRSA (CA-MRSA) is being identified with increased frequency around the world. CA-MRSA may be resistant to different antibiotics than hospital associated MRSA. CA-MRSA is most frequently identified in patients who present with skin abscesses (boils) but has been isolated in young people who have died of necrotizing MRSA pneumonia following respiratory viral infections. CA-MRSA has been associated with outbreaks of skin and invasive infections.

Preventing infections and further antimicrobial resistance depends on incorporating appropriate clinical practices into all routine patient care activities. Measures include optimal management of vascular and urinary catheters, prevention of lower respiratory tract infection in intubated patients, accurate diagnosis of infectious etiologies, and judicious antimicrobial selection and utilization.

The use of Routine Practices by all healthcare workers is essential to reduce the transmission and subsequent colonization or infection from MRSA and other potential pathogens.
Clinical Presentation

MRSA most frequently colonizes the nares and wounds; it also colonizes the throat, skin, and rectum.

In most instances, MRSA infections have clinical manifestations similar to infections caused by methicillin-sensitive Staphylococcus aureus (MSSA). Common bacterial infections include impetigo, folliculitis, furuncles, carbuncles, abscesses and infected wounds. MRSA may invade the blood and cause potentially serious complications such as bacteremia, septic shock, and serious invasive infections (endocarditis, pneumonia, osteomyelitis, and arthritis).

When patients with MRSA have been compared to patients with MSSA, MRSA colonized patients more frequently develop symptomatic infections. Higher case fatality rates have been observed for certain MRSA infections, including bacteremia, post sternotomy mediastinitis, and surgical site infections. These outcomes may be a result of delays in the administration of appropriate antibiotics, the relative decrease in the bactericidal activity of those antibiotics, or persistent bacteremia associated with intrinsic characteristics of certain MRSA strains.

Staphylococci conjunctivitis may occur in newborns or the elderly. Staphylococcal endocarditis and other complications of staphylococcal bacteremia may result from parental use of illicit drugs or be hospital associated through the use of intravascular catheters and other devices.

Embolic skin lesions are frequent complications of endocarditis and/or bacteremia.

Options for treating patients with MRSA are often extremely limited. For example, until recently, only vancomycin provided effective therapy for potentially life-threatening MRSA infections. Although antimicrobials are now available for treatment of these infections, resistance to each new agent has already emerged in clinical isolates. These limitations may influence antibiotic usage patterns in ways that suppress normal flora and create a favorable environment for development of colonization when exposed to potential multi-drug resistant pathogens (i.e., selective advantage).

Incubation

The incubation period is variable. It occurs commonly around 4–10 days.
Transmission
Direct and Indirect Contact

Healthcare workers hands can pick up MRSA from patients, whose MRSA status is often not known. Healthcare workers hands can also pick up MRSA from patient equipment that has not been cleaned after use. MRSA can then be spread to patients by healthcare workers hands if they do not perform hand hygiene appropriately.

Droplet

Staphylococcal pneumonia is spread via droplet transmission whether methicillin resistant or sensitive.

Although transmission of MRSA is most frequently documented in acute care facilities, all healthcare settings are affected by its emergence and transmission.

Risk Factors

Known risk factors for colonization and/or infection with MRSA include

- Admission to a high risk unit (e.g., ICU, burn unit, hemodialysis unit)
- Use of broad spectrum antibiotic (e.g., levofloxacin, aminoglycosides, second and third generation cephalosporins, quinolones and some synthetic penicillins)
- Greater number and longer duration of antibiotic use
- Surgical wounds
- Decubitus ulcers
- Poor functional status
- Prolonged hospitalization
- Proximity to another patient with MRSA

Screening of Staff for MRSA

Screening staff for MRSA is not routinely done but may be considered by IP & C when an outbreak of the same strain of MRSA continues despite adherence to control measures or when an individual is epidemiologically linked to new acquisitions of MRSA. Staff who are concerned about exposure to, or may be colonized with, MRSA should receive assessment and counseling from Occupational Health and Safety. In the event of an MRSA outbreak, heightened surveillance for skin and soft tissue infections in staff is warranted (e.g., folliculitis, paronychia). See Occupational Health and Safety in this section).
1.3 Vancomycin Resistant Enterococci (VRE)

Cause/Epidemiology

Enterococci are facultative anaerobic gram- positive cocci that inhabit the gastrointestinal tract of human hosts. They are extremely hardy, and have the ability to survive in a multitude of growth conditions. *Enterococcus faecalis* and *Enterococcus faecium* are the most clinically relevant and prevalent enterococcal isolates.

These highly resistant organisms deserve special attention in healthcare facilities. Although the name describes resistance to only one agent (i.e., vancomycin), these pathogens are frequently resistant to most available antimicrobial agents.

Prevalence of VRE varies temporally, geographically, and by healthcare setting. The type and level of care also influence the prevalence of VRE. ICUs, especially those at tertiary care facilities, may have a higher prevalence of VRE infections than do non-ICU settings. Antimicrobial resistance rates are also strongly correlated with hospital size, tertiary-level care, and facility type.

Most individuals with VRE are colonized. The frequency of clinical infection caused by these pathogens is low; however VRE infections can cause significant morbidity and mortality. Colonized or infected individuals may be a source of transmission to others.

Increased lengths of stay, costs, and mortality have been associated with VRE. According to CNISP, the incidence of VRE increased in Canadian hospitals between 1999 and 2006. Preventing infections and subsequent antimicrobial resistance depends on the use of appropriate clinical practices that should be incorporated into all routine patient care activities. Measures include optimal management of vascular and urinary catheters, prevention of lower respiratory tract infection in intubated patients, accurate diagnosis of infectious etiologies, and judicious antimicrobial selection and utilization.

The use of Routine Practices by all healthcare workers is essential to reduce the transmission and subsequent colonization or infection from VRE and other potential pathogens.
Clinical Presentation

In most instances, VRE infections have clinical manifestations similar to infections caused by vancomycin susceptible enterococci.

The lower intestinal tract is the most frequently colonized site and enterococci are a common cause of urinary tract infections. Enterococcal bacteremia has become more common in recent years. Enterococcal endocarditis is a common cause of bacteremia, accounting for up to 20% of valve infections. Enterococci cause intra-abdominal and pelvic abscesses. Intra-abdominal abscesses in liver transplant patients have become quite problematic. Surgical site infections are a source of secondary enterococcal bacteremias.

Although antimicrobials are now available for treatment of VRE infections, resistance to each new agent has already emerged in clinical isolates. These limitations may influence antibiotic usage patterns in ways that suppress normal flora and create a favorable environment for development of colonization when exposed to potential multi-drug resistant pathogens (i.e., selective advantage).

Vancomycin resistance has been reported to be an independent predictor of death from enterococcal bacteremia. Furthermore, VRE has been associated with increased mortality, length of hospital stay, admission to the ICU, surgical procedures, and costs when VRE patients were compared with a matched hospital population.

Colonization

Colonization of the bowel can occur within 48 hours after ingestion. Variation in bowel motility may affect the time to colonization.

Transmission

Direct and Indirect Contact

VRE is most commonly spread via colonized hands of healthcare workers who acquire it from contact with colonized or infected clients/patients/residents, or after handling contaminated material or equipment. VRE transmission via environmental sources is well recognized and includes most items in the health care environment such as; blood pressure cuffs, electronic thermometers, monitoring devices, stethoscopes, call bells and bed rails. Contamination of the environment with VRE is more likely when a client/patient/resident has diarrhea.

Although transmission of VRE is most frequently documented in acute care facilities, all healthcare settings are affected by its emergence and transmission.
Risk Factors

The risk factors in acquiring VRE are:
- Immunocompromised host
- Transplant recipient
- Severity of underlying illness
- Renal insufficiency
- Enteral feedings
- *Clostridium difficile* diarrhea
- Major burns
- Hemodialysis unit
- Intensive care unit admission
- Multiple unit stays
- Proximity to a patient with VRE
- Number, type, and duration of antibiotic therapy
- Prior antimicrobial use (e.g., vancomycin, third generation cephalosporins, anti-anaerobic antibiotics-clindamycin, fluoroquinolones-ciprofloxacin)
- Preoperative bowel preparations
- Invasive procedures
- Prolonged hospitalization

Colonization can occur as a result of the conditions present above. VRE may inhabit a host and cause no discernible problems. The gastrointestinal tract is the most common site of colonization.

VRE infection can occur throughout the body with the most common body sites being the urinary tract, surgical wounds, and/or bloodstream.

1.4 Vancomycin-Intermediate Staphylococcus Aureus (VISA)

Cause/Epidemiology

*Staphylococcus aureus* is a facultative anaerobic coagulase-positive organism. It appears as gram-positive cocci in clusters on gram stain. *S. aureus* colonizes the skin of humans, which leads to localized, superficial, self-limiting abscesses when the skin is disrupted.

The usual treatment for *S. aureus* infections is a group of antibiotics related to penicillin called methicillin. Included in this group are oxacillin and cloxacillin. In the 1980’s, methicillin-resistant *S. aureus* (MRSA) emerged and has become endemic in many hospitals. This led to increased use of vancomycin. While most *S. aureus* strains are susceptible to vancomycin, a few have developed resistance and cannot be successfully treated with vancomycin. These antimicrobial resistant *S. aureus* are classified as either vancomycin intermediate *Staphylococcus aureus* (VISA), or...
vancomycin resistant *Staphylococcus aureus* (VRSA) based on laboratory tests that determine the degree of resistance.

For vancomycin and other antimicrobial agents, laboratories determine the minimum concentration of the agent that is required to inhibit the growth of the organism. The result of the test is expressed as a minimum inhibitory concentration (MIC) in μg/mL. Therefore, *Staphylococcus aureus* bacteria are classified as VISA if the MIC for vancomycin is 4-8μg/ml, and classified as VRSA if the vancomycin MIC is >16μg/ml. VISA cannot be successfully treated with vancomycin because the organism is no longer susceptible to vancomycin. VISA cause similar infections to sensitive *S. aureus* strains but infections may be more difficult to treat because of limited effective antibiotics.

Reports in the 1990s suggested the susceptibility of *S. aureus* was changing. In May 1996, the first documented infection with VISA was reported in a patient in Japan. Subsequently, infections with VISA strains have been reported in patients from the United States, Europe, and Asia. Although healthcare associated spread of VISA strains has not been observed in U.S. hospitals, reports from France and Denmark suggest transmission has occurred in a hospital and transmission of hetero-resistant *S. aureus* strains (i.e. vancomycin susceptible strains that contain vancomycin non-susceptible subpopulations) has occurred in Japan, Hong Kong, and elsewhere.

To date, VISA strains are characterized by a resistance mechanism that is not transferable to susceptible strains, and is usually associated with vancomycin exposure. Therefore, the likelihood of transmission to contacts and the maintenance of the VISA phenotype in the absence of vancomycin pressure is presumed to be low. Colonization of healthcare workers or family members associated with the case patients has not been reported.

**Clinical Presentation**

Risk factors are not well described, except all cases have received long courses of vancomycin or other glycopeptide antibiotics.

Persons that developed VISA infections had several underlying health conditions (such as diabetes and kidney disease), previous infections with methicillin-resistant *Staphylococcus aureus*, invasive catheters (e.g., intravenous catheters), recent hospitalizations, and recent exposure to vancomycin and other antimicrobial agents.

**Incubation**

The incubation period is variable and indefinite.
Transmission
Direct and Indirect Contact

Within institutions, healthcare workers' hands and the environment are the most common means of spreading VISA. VISA infections occur in the same manner as vancomycin sensitive *Staphylococcus aureus* (VSSA) infections. Common bacterial infections include impetigo, folliculitis, furuncles, carbuncles, abscesses and infected wounds.

Droplet

Vancomycin resistant and vancomycin sensitive Staphylococcal pneumonia are both spread via droplet transmission.

Contact investigation for VISA cases is not routinely recommended unless there is suspicion transmission has occurred.

1.5 Vancomycin-Resistant Staphylococcus aureus (VRSA)

Cause/Epidemiology

*Staphylococcus aureus* is a facultative anaerobic coagulase- positive organism. It appears as gram-positive cocci in clusters on gram stain. *S. aureus* colonizes the skin of humans, which leads to localized, superficial, self-limiting abscesses when the skin is disrupted.

The usual treatment for *S. aureus* infections is a group of antibiotics related to penicillin called methicillin. Included in this group are oxacillin and cloxacillin. In the 1980’s, methicillin-resistant *S. aureus* (MRSA) emerged and has become endemic in many hospitals. This led to increased use of vancomycin. While most *S. aureus* strains are susceptible to vancomycin, a few have developed resistance and cannot be successfully treated with vancomycin. These antimicrobial resistant *S. aureus* are classified as either vancomycin intermediate *Staphylococcus aureus* (VISA), or vancomycin resistant *Staphylococcus aureus* (VRSA) based on laboratory tests that determine the degree of resistance.

*Staphylococcus aureus* bacteria are classified as VRSA based on laboratory tests. For vancomycin and other antimicrobial agents, laboratories determine the minimum concentration of the agent that is required to inhibit the growth of the organism. The result of the test is expressed as a minimum inhibitory concentration (MIC) in μg/ml. Therefore, *Staphylococcus aureus* bacteria are classified as VISA if the MIC for vancomycin is 4-8μg/ml, and classified as VRSA if the vancomycin MIC is ≥16μg/ml.

VRSA strains are characterized by expression of vanA, which was acquired from a vancomycin-resistant *Enterococcus* spp. Therefore, this resistance is potentially...
transferable to susceptible strains or other organisms. Contact investigations and follow-up for VRSA cases are recommended.

VRSA cannot be successfully treated with vancomycin because the organism is no longer susceptible to vancomycin. VRSA cause similar infections to sensitive *S. aureus* strains but infections may be more difficult to treat because of limited effective antibiotics.

Vancomycin is ineffective for treatment of VRSA infections. Published data indicate infections due to *S. aureus* strains for which the vancomycin MICs are ≥4 µg/ml are refractory to vancomycin therapy. Patients infected with these strains may fail to improve clinically on vancomycin therapy, particularly when the patient has indwelling catheters or an unrecognized focus of infection.

Vancomycin-Resistant *Staphylococcus aureus* has the potential to become a prevalent, virulent and transmissible bacterium for which limited therapy would be available. The threat of the growth of VRSA is considered a public health catastrophe because patients with *S. aureus* infections are likely to have poor outcome.

**Clinical Presentation**

VRSA infections present in the same fashion as vancomycin sensitive *Staphylococcus aureus* (VSSA) infections. Common bacterial infections include impetigo, folliculitis, furuncles, carbuncles, abscesses and infected wounds. VRSA may invade the blood and cause potentially serious complications such as bacteremia, septic shock, and serious metastatic infections (endocarditis, pneumonia, osteomyelitis, and arthritis).

Risk factors are not well described except that all cases have received long courses of vancomycin or other glycopeptide antibiotic.

Persons that developed VRSA infections had several underlying health conditions (such as diabetes and kidney disease), previous infections with methicillin-resistant *Staphylococcus aureus*, invasive catheters (such as intravenous catheters), recent hospitalizations, and recent exposure to vancomycin and other antimicrobial agents. Most patients were found to be colonized with both MRSA and VRE prior to the development of VRSA.

In some cases, antecedent MRSA infection (peritoneal, bloodstream, and/or device-related) was treated repeatedly and for long time periods with a glycopeptide. Over time, isolates developed reduced susceptibility to vancomycin.

**Incubation**

The incubation period is variable and indefinite.
Transmission
Direct and Indirect Contact

Within institutions, healthcare workers’ hands and the environment are the most common means of spreading VRSA.

Droplet

Vancomycin resistant and vancomycin sensitive Staphylococcal pneumonia are both spread via droplet transmission.

1.6 Multi Drug Resistant Gram Negative Bacteria

Cause/Epidemiology

Resistance with gram-negative pathogens continue to be a concern due to increased morbidity and mortality, longer hospital stays, and higher hospital costs when compared with infections associated with susceptible strains.

Examples of gram negative bacteria that may become multi-drug resistant include *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Klebsiella pneumoniae*, *Escherichia coli*, *Enterobacter spp.*, *Enterobacter cloacae*, *Serratia marcescens*, *Stenotrophomonas maltophilia* and *Neisseria gonorrhoeae*.

A) *Pseudomonas aeruginosa*

Clinical Presentation

Multidrug-resistant *Pseudomonas aeruginosa* (MDRPA) is defined as isolates resistant to at least three antimicrobial classes e.g., B-lactams, Beta-lactamase inhibitor combinations, cephalosporins, carbapenems, aminoglycosides or fluoroquinolones.

*P. aeruginosa* is a highly virulent pathogen and the source of multiple types of infections, including pneumonia, urinary tract infection, bacteremia, and wound infection. *Pseudomonas* attacks patients with weakened defenses from illness or treatment and those with invasive devices. In most cases, infections due to *P. aeruginosa* occur in a nosocomial setting with comorbid illness and compromise from catheters, tubes, and surgery. In general, *P. aeruginosa* has a strong tendency to become a multidrug-resistant pathogen. Usually this process occurs as a result of both intrinsic resistance mechanisms of the organism and acquisition of drug resistance during treatment. Several studies have found that multidrug-resistant strains of *P. aeruginosa* typically occur after prolonged exposure to antipseudomonal treatments or after empirical therapy.

Transmission
P. aeruginosa (both MDRPA and PA) can be spread by contact with contaminated surfaces, or exposure in the environment. Sinks, mops, disinfectant solutions, respiratory equipment and other moist environments can serve as reservoirs of P. aeruginosa in the hospital setting. Transmission has been linked to negligent hygiene issues and contaminated tap water or equipment.

**B) Acinetobacter baumannii**

**Clinical Presentation**

Multidrug-resistant *Acinetobacter baumannii* is defined as isolates resistant to at least three antimicrobial classes e.g., B-lactams, Beta-lactamase inhibitor combinations, cephalosporins, carbapenems, aminoglycosides, fluoroquinolones or folate-pathway inhibitors.

*A. baumannii* is an opportunistic Gram-negative pathogen that is difficult to treat, increasingly common in the ICU, and associated with nosocomial outbreaks. *A. baumannii* frequently colonizes the ICU and can survive on wet or dry surfaces for prolonged periods. Similar to *Pseudomonas* spp., *A. baumannii* attacks patients with weakened defenses from illness or treatment and those with invasive devices. *A. baumannii* has been implicated in ventilator associated pneumonia (VAP), soft tissue infections, urinary tract infections, catheter-associated infections, meningitis and bacteremia. Unlike *P. aeruginosa*, which is intrinsically resistant to many antibiotics, *Acinetobacter* spp. can be either very susceptible or highly resistant to antibiotics.

*Acinetobacter* strains that are resistant to all aminoglycosides, cephalosporins, B-lactams, and fluoroquinolones are increasing in prevalence. *A. baumannii* also forms biofilms on endotracheal tubes and other invasive devices. *Acinetobacter* spp. outbreaks have been traced to common-source contamination, particularly contaminated respiratory therapy and ventilator equipment, to cross-infection by the hands of healthcare workers who have cared for colonized or infected patients or touched contaminated fomites. *Acinetobacter* infections rarely occur outside of healthcare settings.

**Transmission**

**Direct and Indirect**

*Acinetobacter baumannii* and Multidrug-resistant *Acinetobacter baumannii* can be spread to susceptible persons by direct person-to-person contact or indirect contact with contaminated surfaces/equipment. Both can live on the skin and may survive in the environment for several days. Both are able to grow at various temperatures and pH conditions and are capable of persisting in either moist or dry conditions in the hospital environment.
C) Carbapenem-resistant Gram-negative bacilli

Clinical Presentation

Carbapenem-resistance involves resistance to carbapenem antimicrobials (e.g., imipenem, meropenem), which may be mediated by the production of a carbapenemase. Carbapenemases are a class of enzymes that inactivate carbapenem, cephalosporin and penicillin antibiotics.

There are several different classes of carbapenemases, each having a three-letter acronym. These enzymes evolve rarely, but bacteria carrying them spread easily. Particular classes of carbapenemases are most common in the geographic area where they evolved, but spread around the world, usually when patients have received health care in another country.

Klebsiella pneumoniae (KPC)

A carbapenemase that has recently spread in the world and causes a number of nosocomial outbreaks was first identified in Klebsiella pneumoniae and is referred to as Klebsiella pneumoniae carbapenemase (KPC). This is of concern as carbapenem antibiotics are often the last line of defense against gram-negative infections that are resistant to other antibiotics.

Klebsiella pneumoniae is a type of gram-negative bacteria that can cause infections in healthcare settings, including pneumonia, bloodstream infections, wound or surgical site infections.

New Delhi metallo beta-lactamase (NDM-1 enzyme).

This enzyme is found mostly in Escherichia coli and K. pneumoniae and also in other Enterobacteriaceae. It is an enzyme produced that renders all current beta lactam drugs used in clinical practice inactive. Organisms with the enzyme are frequently multidrug resistant. The enzyme is encoded by a gene carried on a plasmid, and thus can spread from one organism to another. This is the first time a metallo-beta-lactamase, the most potent of drug resistant enzymes in its class, has been found on a plasmid in clinically relevant cases. Most commonly, it is E. coli and K. pneumoniae (often ventilator associated), bacteremias and urinary tract infections. NDM-1 enzyme has been identified in people who returned to United Kingdom, USA, Australia and the Netherlands after receiving health care in India and Pakistan.

Transmission
Direct and Indirect

New Delhi metallo beta-lactamase (NDM-1 enzyme) and KPC’s can be spread to susceptible persons by direct person-to-person contact or indirect contact with contaminated surfaces/equipment/healthcare environment.
Implement **Contact Precautions** in addition to **Routine Practices**. Place Contact Precautions sign in visible location.

IP & C practices for all AROs are the same **except** for where specifically identified as different:

### 2.1 Accommodation/Placement of Patient

- Cohort patients with the same AROs in consultation with Infection Prevention & Control.
- Patients restricted to room except for necessary tests and treatments.

**NOTE:** Patients with **CMRSA6 OR CMRSA3/6** are not to be cohorted, unless with other **CMRSA6 OR CMRSA 3/6**

### 2.2 Admission Screening

- **ESBL:** Not required
- **MRSA:** Refer to WRHA IP & C Operational Directive “Admission Screening of Patients for MRSA and VRE”
- **VRE:** Refer to WRHA IP & C Operational Directive “Admission Screening of Patients for MRSA and VRE”
- **VISA/VRSA:** As directed by IP & C
- **MDR-GNB:** As directed by IP & C

### 2.3 Ambulatory Care

- Referral source must notify Ambulatory Care in advance of the required Contact Precautions.
- Cover or remove supplies/equipment not required for the visit
- Patient performs hand hygiene on arrival.
- Place patient directly in examination room. If this is not possible, maintain a spatial separation from other individuals in the waiting room.
- Open wounds to be covered.
- Procedures can be performed with 2 staff members—one designated clean and one designated dirty.
- One staff member must not touch:
  - The patient.
  - Any equipment or surfaces that the patient or staff have contaminated by touching.
- The second staff member:
  - Only touches the patient, equipment or environmental surfaces the patient would have come in contact with.
- If only one healthcare worker is available, everything touched by the patient and staff must be cleaned/disinfected by area staff.
• All staff must wear gown and gloves. Good hand hygiene between patients and tasks is essential.
• Ensure privacy curtains changed between patients if visibly soiled.
• Disinfect all reusable equipment and surfaces touched by patient and/or healthcare worker with facility-approved disinfectant after patient leaves or before use on another patient.
• Cleaning and disinfection of floors after patient leaves is only necessary when visibly soiled.
• If patient requires laboratory or diagnostic services refer to specific sections entitled Laboratory or Diagnostic Imaging.

2.4 Code Blue

• Unit staff member should inform Code Blue team of patients ARO status and required Contact Precautions.
• Code Blue cart with medications should stay outside the room. If in multi-bed room the cart should stay outside the bed space curtain.
• Clean HCW will provide needed items to staff in room.
• Obtain all necessary supplies prior to entering room or bed space.
• Defibrillator is removed from the cart and taken into the room.
• The intubation basket may be taken into the room.
• When the resuscitation is completed, all reusable equipment that entered the room must be sent to MDR for reprocessing or cleaned and disinfected. Single use items are discarded. All disposable used or unused supplies shall be discarded.
• If Code Blue medications are brought into the room, follow the Code Blue Team Resuscitation in Acute Care Policy # 110.050.010, available at http://home.wrha.mb.ca/corp/policy/files/110.050.010.pdf
• If the Code Blue cart is taken into the room, clean and disinfect the cart, inside and out, with facility approved disinfectant.

2.5 Diagnostic Imaging

• Referral source must notify department in advance of the required Contact Precautions.
• Cover or remove supplies/equipment not required for the visit
• Patient performs hand hygiene on arrival.
• Place patient directly in examination room. If this is not possible, maintain a spatial separation from other individuals in the waiting room.
• Open wounds to be covered.
• Procedures can be performed with 2 staff members
• One staff member must not touch:
  o The patient.
7.1.

- Any equipment or surfaces that the patient or staff have contaminated by touching.
- The second staff member:
  - Only touches the patient, equipment or environmental surfaces the patient would have come in contact with.
- If only one healthcare worker is available, everything touched by the patient and staff must be cleaned/disinfected by area staff.
- All staff must wear gown and gloves. Good hand hygiene between patients and tasks is essential.
- Ensure privacy curtains changed between patients if visibly soiled.
- Disinfect all reusable equipment and surfaces touched by patient and/or healthcare worker with facility-approved disinfectant after patient leaves or before use on another patient.
- Cleaning and disinfection of floors after patient leaves is only necessary when visibly soiled.

2.6 Discharge/Transfer between Facilities

Prior to discharge/transfer, the sending unit staff:
- Informs receiving facility of patient’s ARO status.
- Notifies Transport Service of required Contact Precautions.
- Documents on Transfer/Referral form.
- Patients known positive for ESBL and VRE DO NOT REQUIRE re-screening.

Preparation of patient for discharge/transfer:
- Cover stretcher or wheelchair with a clean sheet.
- Ensure patient performs hand hygiene on leaving room.
- Ensure patient wears clean clothes, housecoat and has wounds covered.
- Patient does not wear gloves or isolation gown.

Upon arrival of patient to receiving facility
- Collect surveillance cultures as required.(Refer to WRHA IP & C Admission Screening for MRSA and VRE Operational Directives Add hyperlink)

2.7 Dishes/Meal Trays

- Routine Practices.
- Disposable dishes are not required.
- Place the soiled meal tray directly onto designated soiled dietary cart.
- Perform hand hygiene after handling soiled dishes/meal tray.
2.8 Duration of Precautions

- **MRSA:** Directed by Infection Prevention & Control- three sets of weekly negative cultures while off effective antibiotics is required to discontinue precautions.

- **ESBL and VRE:** Patients are considered permanently colonized. Contact Precautions are not discontinued based on negative surveillance cultures. Contact Precautions may be modified upon direction from Infection Prevention & Control.

- **VISA/VRSA or VISA SUS/VRSA SUS:** Directed by Infection Prevention & Control.

- **MDR-GNB:** Directed by Infection Prevention & Control.

2.9 Emergency/Resuscitation Room

- Remove all unnecessary supplies from the room.
- Ensure items remaining on top of carts are kept in an enclosed bin or placed in a drawer.
- Relocate chart from racks to outside of room.
- Disinfect outside surfaces of all carts in surrounding bed space upon patient discharge.
- Change curtain upon patient discharge.

**Note:** Changing of curtains is recommended for all patients cared for in the resuscitation room due to the higher risk of body fluid sprays and splashes.

2.10 Environment/Housekeeping/Isolation Room Cleaning

- Follow Regional/Facility Standard Operating Procedure “Cleaning of Isolation Discharge Client Room/Cleaning of Occupied Client Isolation Room”, special attention to frequently touched surfaces, e.g., bed rails, nurse call system.

2.11 Family/Visitor

- Perform hand hygiene when entering and leaving patient room.
- Family/visitors not required to wear PPE when visiting unless providing direct care i.e., bathing, suctioning, turning patient, wound care/dressing changes, incontinence care, or toileting. Feeding a patient or pushing a wheelchair are not classified as direct care.
Families and visitors may be required to wear PPE in specific circumstances and as directed by IP&C.

2.12 Health Record/Health Record Documents, Other Papers

e.g., vital sign sheets, Medication Records/Personal documents, voting Health Record: The Health care record/MAR should not be taken into the isolation room.

- Sites may consider using PYXIS slips to do bedside checks.
- If the MAR has been in the isolation room: wipe the pen and the external surface of the MAR with facility approved disinfectant upon leaving.

Other papers that must be brought into the patient room

- Patient performs hand hygiene.
- Wipe the surface/table that the document is to be placed on with facility – approved disinfectant.
- Wipe the pen with facility approved disinfectant.
- Site may consider using disposable folders or wipeable clipboards for holding paper documents. If these items are used wipe down or discard prior to leaving the room.

2.13 Home Visits/LOA with Hospital Healthcare Workers

- The patient should wear clean clothes and wounds should be covered.
- Hand hygiene is performed by the patient, staff and family before leaving the room.
- A separate staff member should transport the patient in a wheelchair and return the wheelchair to the unit. Following transport the wheelchair is cleaned with disinfectant.
- Routine Practices should be followed and alcohol based hand rub should be available for use during the home visit.
- Equipment taken on the visit should be bagged for return and then cleaned according to facility policy before used in the care of another patient.

2.14 Laboratory - Out Patient

- Avoid cross contamination between patients and supplies.
- Follow Routine Practices and Contact Precautions unless otherwise directed by Infection Prevention & Control.
- Modification of Contact Precautions: When practices to avoid cross contamination between patient and supplies are in place at all times, Routine Practices may be sufficient when providing services to patients with an ARO in this setting. The Routine Practices procedures must first be reviewed by the Infection Control Professional and include hand hygiene, proper removal/replacement of gloves after handling the requisition/computer registration, before gathering clean supplies and before/after drawing blood from the patient. In addition, the
registration keyboard, and patient chair and armrest must be wiped between all patients with facility-approved disinfectant

- Ensure that all patient care equipment is cleaned/disinfected with hospital approved disinfectant; i.e., keyboard, patient chair and armrest.  

2.15 Linen

- Place all re-usable/soiled linen in the laundry hamper in the patient’s room.
- Wear clean gloves to remove laundry bag from room.
- Remove gloves and perform hand hygiene after handling linen.

2.16 Mental Health Patients

- Follow Routine Practices unless otherwise directed by Infection Prevention & Control.
- If transferred off Mental Health unit/ward to general ward/unit, Contact Precautions for AROs must be followed.

2.17 Notification and Initiation of Contact Precautions

- Place patient in private room with dedicated bathroom facilities.
- Place Contact Precautions sign in visible location.
- Set up isolation cart/supplies outside of patient room.
- Place laundry hamper and garbage receptacle in patient’s room.
- Notify Infection Prevention & Control.
- Discuss Contact Precautions with patient and family and provide educational material included in the Appendix of this manual. Document in the IPN.
- Inform patient’s physician. 

2.18 Operating Room

Pre-Op

- Prior to procedure, notify Patient Transport Services, (is there a more common name?) receiving area, and recovery area as appropriate, regarding need for Contact Precautions
- Schedule patient to facilitate OR cleaning.
- Equipment that cannot be removed from the immediate area of the surgery should be covered with a clean cover.
- Transporting the patient to the OR:
  - A minimum of two individuals should be available to transport
  - Transport patient to and from the OR on own bed when possible
  - Patient performs hand hygiene when leaving the room and wears clean clothes
Cover patient’s open wounds.
Cover bed with a clean sheet.
Transport personnel shall perform hand hygiene and apply clean PPE upon leaving the patient room/bed space.
Transport in an empty elevator is preferred.
Transport directly to OR theatre.
On route to OR, the clean person (no patient contact) shall open doors and push elevator buttons.
Chart shall be carried by the “clean” transport person or placed in a plastic bag or clean pillow case and transported on the bed. *Note – Outside of the bag/pillow case is contaminated.

Intra-Op

- Place Contact Precautions sign on all theater doors.
- Appropriate PPE shall be available immediately outside of the OR theatre.
- All staff (within one meter of the patient or contaminated equipment) entering the OR theatre shall wear PPE including gown and gloves.
- Personnel assigned to the OR theatre shall include:
  - One designated ‘clean’ circulating nurse who has no contact with patient or patient supplies/equipment
  - One designated ‘dirty’ circulating nurse who has contact with patient or used patient supplies/equipment
  - One scrub nurse (if applicable)
- The ‘clean’ circulating nurse shall obtain/open supplies for the team, while maintaining their “clean” status
- Staff in direct or indirect contact with the patient shall not touch clean surfaces with contaminated gloves
- The ‘dirty’ circulating nurse (direct/indirect patient contact) may become ‘clean’ by removing PPE, performing hand hygiene and re-applying clean PPE
- Documentation shall be placed in a designated “clean area” and be handled/completed by a designated ‘clean’ person
- If patient will be transported to the post-op destination on the same bed/stretcher:
  - Whenever possible, transport bed/stretcher should remain in the OR theatre
  - If the bed/stretcher cannot remain in the OR theatre
- Clean and disinfect the transport bed/stretcher with facility approved disinfectant immediately upon removal from OR theatre, or if not possible, then
- Cover the transport bed/stretcher with a clean sheet and place a Contact Precautions sign on it immediately upon removal from OR theatre. The sheet should only be removed after the transport bed/stretcher is in the OR theatre.

Post-Op

- Notify the recovery area (e.g., PACU, ICU) that the patient will require Contact Precautions.
- Follow guidelines for Transporting the patient to the OR when transporting patient to the post-op area
• Cleaning
  Cleaning staff shall wear PPE including gown and gloves.
• Facility approved products shall be used for cleaning and disinfection.
• Terminal Cleaning shall be performed as per facility Housekeeping Standard Operating Procedure.
• Reusable equipment is to be cleaned and reprocessed prior to use on another patient.
• Electronic equipment should not be covered with plastic or other material that traps heat.

2.19 Physical Rehabilitation

• Referral source must notify Physical Rehabilitation in advance of the required Additional Precautions.
• Dedicated equipment recommended. If shared equipment is used, disinfect with facility-approved disinfectant before use on another patient.
• Schedule therapy during time of minimal activity.
• Designate therapy to one area of department.
• Transport patient according to “Transport within Facility” section.

2.20 Post Mortem/Autopsy

Post Mortem

• Place clean sheet on transfer stretcher prior to entering deceased patient’s room.
• Healthcare workers wear gown and gloves while attending the body.
• Wrap the body in a shroud and transfer to stretcher.
• Healthcare workers remove gloves and gowns and perform hand hygiene upon leaving the room.
• Transport body to the morgue.
• Healthcare worker performs hand hygiene upon leaving the morgue.
• Clean stretcher with facility approved disinfectant before use on another patient.

Autopsy
• No additional measures required.

2.21 Specimens

• Use dedicated/disposable lab equipment.
• When tourniquets are used, they must be single use or left at the patient’s bedside and used for duration of their hospital stay. Discard if visibly soiled.
• Take only supplies needed into the patient room prior to procedure.
• Deposit specimen into impervious sealable bag and ensure that outside of bag does not become contaminated.
• Remove gloves and perform hand hygiene after collecting and handling specimens.

2.22 Supplies/Equipment

• Dedicated equipment preferred.
• If reusable equipment must be used, clean/disinfect with facility-approved disinfectant prior to removal from room.
• Keep minimal supplies in patient room. Do not overstock.
• Use dedicated personal supplies, e.g., combs, razors, lotions, creams, and soaps.
• Discard supplies that cannot be appropriately disinfected or sterilized when patient is discharged or deceased or Contact Precautions discontinued.
• Upon discharge, personal articles that cannot be disinfected, e.g., books, magazines, toys playing cards should be bagged and given to the patient or discarded.

2.23 Surveillance Cultures/Contact Management

ESBL

• Surveillance cultures not routinely required, unless specifically requested by Infection Prevention & Control.

MRSA

• Surveillance cultures of nares and all open wounds should be sent on any patient with newly identified clinical specimen positive for MRSA, on re-admission of previously positive case and when they meet the criteria outlined in the WRHA admission screening Operational Directive.
• Send culture for MRSA
  o Indicate on the requisition if the patient is on antibiotics.
  o If aware, indicate on requisition if patient is previously known MRSA positive.
• When required, Infection Prevention & Control will identify contacts and order appropriate surveillance cultures.
• Contacts that have been discharged prior to submission of cultures will be flagged as MRSA SUS in the relevant facility system.

VRE

• Surveillance cultures (rectal or ostomy) should be sent on patients found to have a clinical specimen positive for VRE.
• Admission cultures are not required on previous VRE positive patients.
• Indication of antibiotic use on requisition is not required.
• Infection Prevention & Control will identify close contacts and order appropriate surveillance cultures.
• Contacts that have been discharged prior to submission of cultures will be flagged as VRE SUS in the relevant facility system.

2.24 Transport within Facility

• Patient restricted to room except for medically essential tests and treatments.
• Contact Precautions required for transport.
• Cover wheelchair/stretcher with clean sheet.

Healthcare worker(s):
• Perform hand hygiene on leaving patient room.
• Put on clean gloves and gown outside room.

Patient:
• Performs hand hygiene on leaving the room.
• Wears clean clothes and has all wounds covered.
• Does not wear gloves or isolation gown.

2.25 Treatment and Eradication

ESBL
• No treatment or eradication therapy currently available.

MRSA
• Treatment of infection is determined by attending physician, and if requested in consultation with an Infectious Disease Consultant.
• Routine decolonization is discouraged.

VRE
• Treatment of infection is determined by attending physician and if requested, in consultation with an Infectious Disease Consultant.
• There is no recognized effective decolonization therapy for VRE carriage.

2.26 Waste

• Routine Practices, no special precautions required. Double bagging of waste not required.
• Wear clean gloves to remove waste from room.
• Remove gloves and perform hand hygiene after handling waste.

3. OCCUPATIONAL AND ENVIRONMENTAL SAFETY AND HEALTH (OESH)

Please refer to the WRHA OESH document Antibiotic Resistant Organisms (ARO) – Management Protocol for Healthcare Workers which can be found at www.wrha.mb.ca/professionals/safety

ESBL

Definition of Occupational Exposure:

A healthcare worker (HCW) who has had direct or indirect contact of body secretions/excretions (wound drainage, urine, feces of a patient who is positive for an ESBL colonization/infection.

Management:

• HCWs exposed to or infected with an ESBL shall be managed on a case by case basis by OESH in consultation with Infection Prevention & Control.

MRSA

Definition of Occupational Exposure:

A HCW who has had direct or indirect contact of non-intact skin or mucous membranes with MRSA colonized/infected body sites or wound drainage of an MRSA positive patient.

Management:

A HCW exposed to MRSA
• No modifications to work practices or work restrictions required.
• Consult with OESH.

A HCW symptomatic/infected with MRSA
• Personal physician confirmed diagnosis
• Contact OESH
• OESH will inform Infection Prevention & Control immediately if suspected or confirmed case of MRSA
• In consultation between OESH, Manager, and Infection Prevention and Control, work restrictions and reassignments may be considered until appropriate decolonization therapy is completed as prescribed by physician, if required.
VRE

Definition of Occupational Exposure:

A HCW who has had direct or indirect contact with feces, urine, wound drainage, or areas of colonized skin of an infected or colonized patient.

Management:

A HCW exposed to VRE
- No modifications to work practices or work restrictions required.
- Consult with OESH.

A HCW who is symptomatic/infected with VRE
- Personal physician confirmed diagnosis
- Contact OESH
- OESH will inform Infection Prevention & Control immediately if suspected or confirmed case of VRE
- HCW colonized with VRE has no work modifications or restrictions
- HCW colonized with VRE and has diarrhea, shall be excluded from work until diarrhea has resolved or 24 hours symptom free.

VISA/VRSA

Management:

HCWs exposed to or infected with VISA/VRSA shall be dealt with on a case by case basis by OESH in consultation with Infection Prevention & Control.

PREGNANT HEALTHCARE WORKERS:

- Pregnant HCWs can care for patients with Antibiotic Resistant Organisms (ARO's) provided they adhere to Routine Practices and Additional Precautions for the specific situation.
- Pregnant HCWs who have concerns regarding caring for ARO infected/colonized patients should be referred to OESH for further management.
### Appendix A. Antibiotic Resistant Organism Electronic Patient Record Codes and Required Actions

Infection Control health issue codes are used in the Electronic Patient Record (EPR) to indicate the Antibiotic Resistant Organism status of a patient.

The following may appear as a single code or in a combination of abbreviated codes in the EPR.

<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation of Code</th>
<th>Required Actions</th>
</tr>
</thead>
</table>
| ESBL    | ESBL Positive: Extended Spectrum Beta Lactamase (ESBL) positive                     | • Implement Contact Precautions  
• Collect surveillance specimens as directed by Infection Prevention and Control |
| POS     | ESBL Previous: Previous Extended Spectrum Beta Lactamase (ESBL) positive patient who was treated and eradicated or self-eradicated | • Follow Routine Practices  
• Contact Precautions are NOT required |
| ESBL    | ESBL Suspect: Exposed to Extended Spectrum Beta Lactamase (ESBL); requires cultures to determine status | • Follow Routine Practices  
• Contact Precautions are NOT required |
| SUS     | ESBL Modified Precautions: Extended Spectrum Beta Lactamase (ESBL) case with modified isolation precautions | • Follow Routine Practices  
• Discontinue ESBL Modified Precautions, implement Contact Precautions & notify Infection Prevention and Control if patient:
  o has contained or uncontained bowel or bladder incontinence; is not able to practice appropriate hand hygiene; does not have good personal hygiene practices; OR is not cognitively able to follow directions |
| MDR     | MDR GNB Positive: Multi-Drug Resistant Gram Negative Bacteria positive               | • Implement Contact Precautions  
• Notify Infection Prevention and Control  
• Collect surveillance specimens as directed by Infection Prevention and Control |
| GNB P   |                                                                                     |                                                                                  |
| MRSA    | MRSA Positive: Methicillin Resistant *Staphylococcus aureus* (MRSA) positive       | • Implement Contact Precautions  
• Collect MRSA surveillance cultures from nares and open wounds |
| POS     |                                                                                     |                                                                                  |
| MRSA    | MRSA Suspect: Exposed to Methicillin Resistant *Staphylococcus aureus* (MRSA); requires cultures to determine status | • Follow Routine Practices, unless otherwise directed by Infection Prevention and Control  
• Collect MRSA surveillance specimens from nares and wounds |
| SUS     |                                                                                     |                                                                                  |
| MRSA    | MRSA Previous: Previous Methicillin Resistant *Staphylococcus aureus* (MRSA) positive patient who was treated and eradicated or self-eradicated | • Follow Routine Practices  
• Contact Precautions are NOT required  
• Collect MRSA surveillance specimens from nares and wounds |
<p>| PREV    |                                                                                     |                                                                                  |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Explanation of Code</th>
<th>Required Actions</th>
</tr>
</thead>
</table>
| VRE POS | **VRE Positive:** Vancomycin Resistant Enterococcus (VRE) positive                  | • Implement Contact Precautions  
• No surveillance specimen required                                                    |
| VRE SUS | **VRE Suspect:** Exposed to Vancomycin Resistant Enterococcus (VRE); requires cultures to determine status | • Follow Routine Practices, unless otherwise directed by Infection Prevention and Control  
• Collect VRE surveillance specimens from rectum/ostomy unless otherwise directed by Infection Prevention and Control |
| VRE MODIFY | **VRE Modified Precautions:** Vancomycin-Resistant Enterococcus (VRE) case with modified isolation precautions | • Follow Routine Practices.  
• Discontinue VRE Modified Precautions, Implement Contact Precautions & notify Infection Prevention and Control if patient:  
  o has contained or uncontained bowel or bladder incontinence; is not able to practice appropriate hand hygiene; does not have good personal hygiene practices; OR is not cognitively able to follow directions |
| VISA POS | **VISA Positive:** Vancomycin Intermediate *Staphylococcus aureus* (VISA) positive | • Implement Contact Precautions  
• Notify Infection Prevention and Control  
• Collect surveillance specimens as directed by Infection Prevention and Control |
| VISA SUS | **VISA Suspect:** Exposed to Vancomycin Intermediate *Staphylococcus aureus* (VISA); requires cultures to determine status | • Implement Contact Precautions  
• Notify Infection Prevention and Control  
• Collect surveillance specimens as directed by Infection Prevention and Control |
| VRSA POS | **VRSA Positive:** Vancomycin Resistant *Staphylococcus aureus* (VRSA) positive      | • Implement Contact Precautions  
• Notify Infection Prevention and Control  
• Collect surveillance specimens as directed by Infection Prevention and Control |
| VRSA SUS | **VRSA Suspect:** Exposed to Vancomycin Resistant *Staphylococcus aureus* (VRSA); requires cultures to determine status | • Implement Contact Precautions  
• Notify Infection Prevention and Control  
• Collect surveillance specimens as directed by Infection Prevention and Control |
References:


Back to the top