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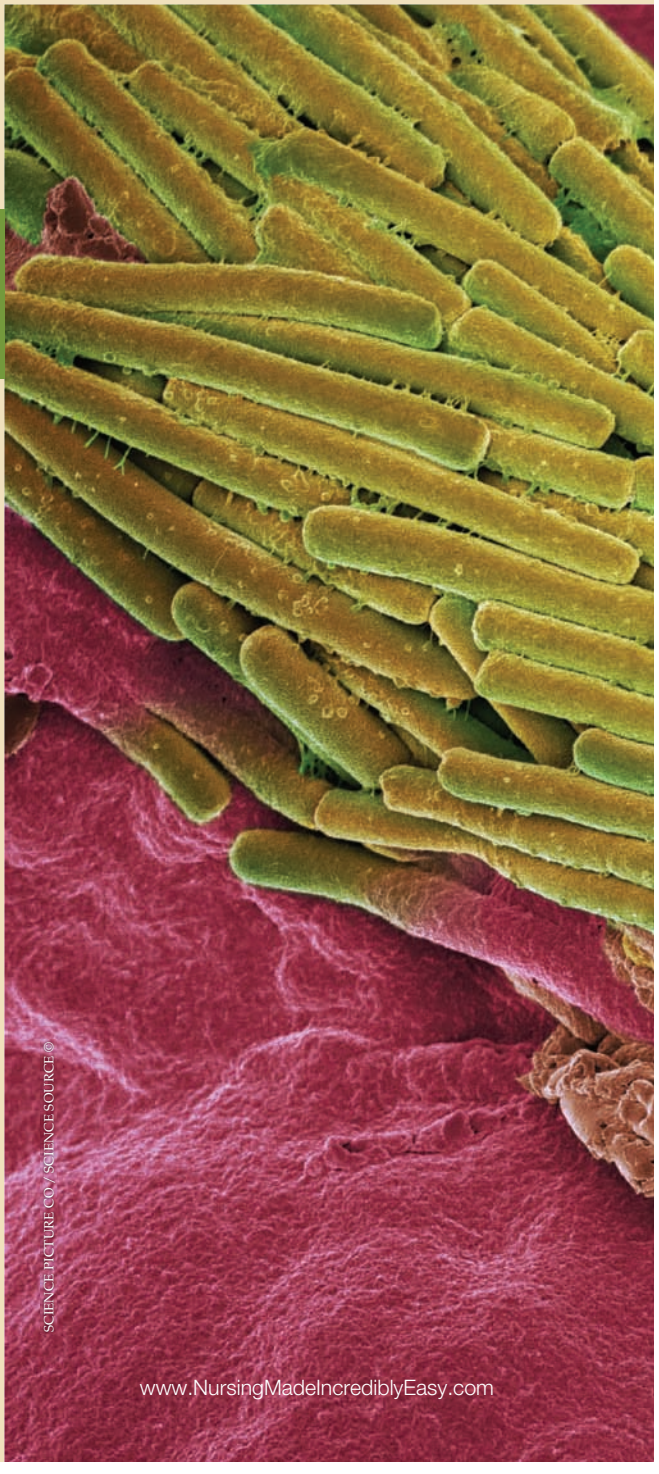
Managing the mayhem of

CDI is a major healthcare-associated infection. Learn how to recognize it early and prevent its spread.

By Charlotte Davis, BSN, RN, CCRN; Brenda Thompson, MSN, RN; Andrea Stone, BSN, RN; and Rita Jordan, MSN, RN



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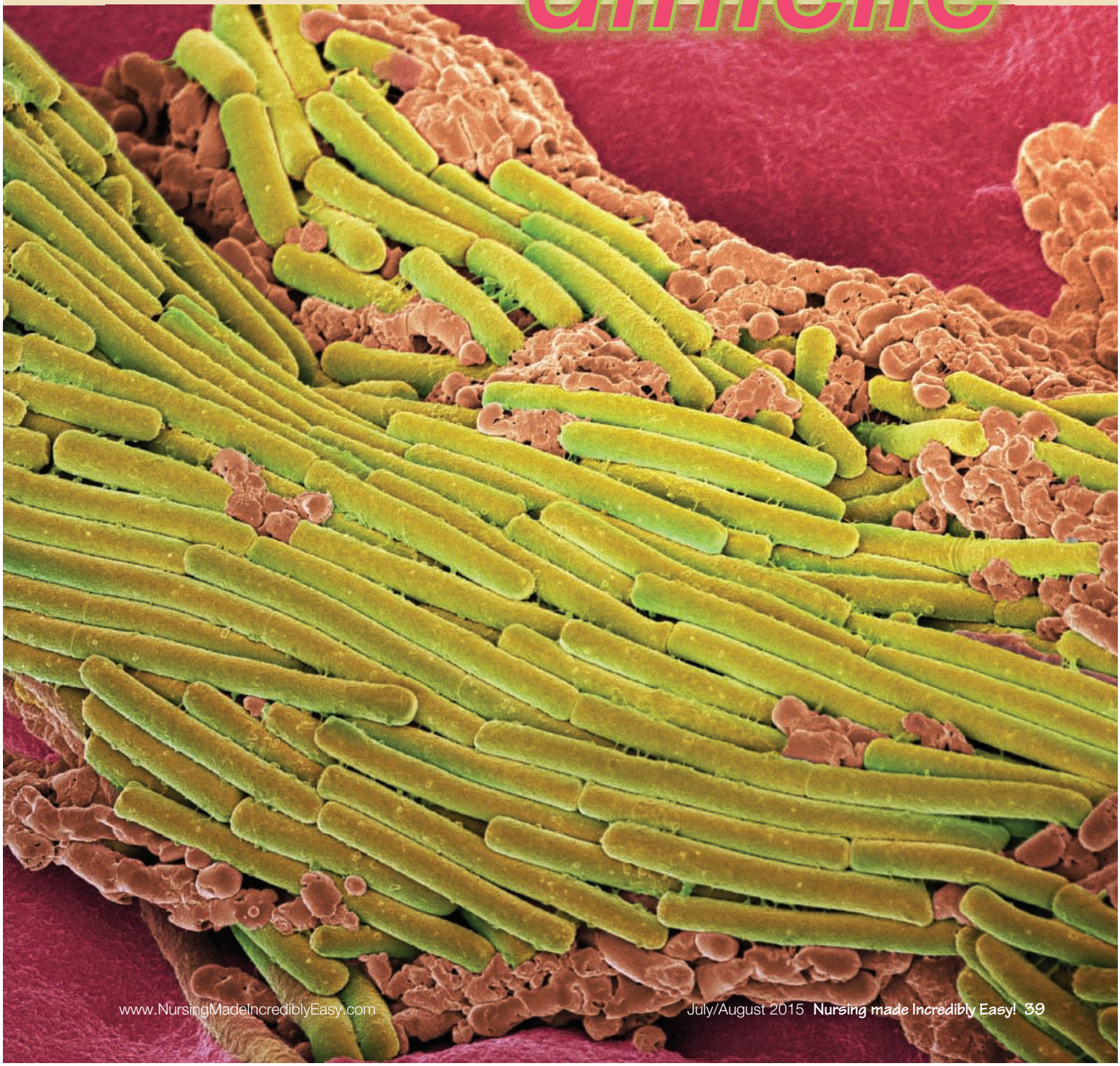
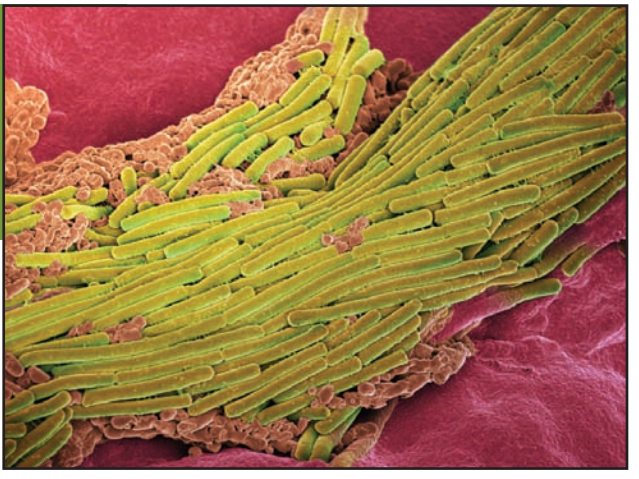
Clostridium difficile are Gram-positive, spore-forming bacteria. According to the CDC, *C. difficile* caused almost half a million infections in the United States in 2011 and 29,000 patients died within 30 days of the initial diagnosis; of those, approximately 15,000 deaths were estimated as being directly attributed to *C. difficile* infection (CDI). The CDC estimates that at least 80% of all CDI cases are the direct result of healthcare-associated interventions or healthcare environmental exposure. *C. difficile* bacteria are typically associated with acute care hospitals and long-term-care facilities. If strict adherence to infection control measures isn't maintained, CDI can quickly spread to patients and healthcare personnel.

In this article, we discuss the signs and symptoms, diagnosis, and treatment of CDI, as well as the isolation precautions needed to manage patients with CDI and minimize the risk of transmission to others.

Clostridium difficile



When antimicrobial medications are administered to treat infection, they can disrupt the normal balance of GI flora, which can cause *C. difficile* spores to grow out of control.



Who's at risk?

Although CDI can affect all age-groups, individuals most at risk are older adults; infants; and those with impaired immune systems, such as people with HIV, infants who don't have a fully developed immune system response, or those who are on immunosuppressive therapy. The risk of CDI increases by 2% for each additional year of age after age 18.

Patients who are receiving antibiotics are at increased risk for developing CDI. Some antibiotics are more commonly associated with an increased risk of CDI because they can extensively alter the normal flora of the intestines. These include clindamycin, penicillins, cephalosporins, and fluoroquinolones. Proton pump inhibitors (PPIs) are also linked to CDI (see *At risk for colonization*).

The good, the bad

The normal flora of the gastrointestinal (GI) tract contains millions of "good" bacteria; many of these bacteria help with autoregulation and protect the body from infection. When antimicrobial medications are administered to treat infection, they can disrupt the normal balance of flora within the patient's intestinal mucosa. This imbalance can cause *C. difficile* spores to grow out of control.

According to the Association for Professionals in Infection Control and Epidemiology (APIC), *C. difficile* spores are ingesting from the environment, healthcare personnel, or other patients. The spores are resistant to the acidity of the GI tract and flourish as they imbed in the warm, moist, and highly vascular intestinal wall. After they're imbedded, the spores release toxins that are damaging to the fragile intestinal mucosal tissue. These toxins cause inflammatory cell patches, cellular destruction, and debris, which lead to the hallmark sign of frequent, watery diarrhea.

The two most common types of toxins produced by *C. difficile* are enterotoxin (often called toxin A) and cytotoxin (often called toxin B). Both toxins can induce profound intestinal epithelial cell damage and increase intestinal mucosal permeability.

Patients with severe CDI can experience extensive edema and erosion that evolves to the point where the intestinal wall becomes increasingly fragile and breaks, resulting in bowel perforation. An intestinal perforation is a medical emergency requiring immediate medical or surgical intervention.

What to look for

The patient's clinical presentation usually causes the healthcare team to suspect CDI. Common signs and symptoms include:

- frequent foul-smelling, loose, watery stools
- abdominal cramping
- abdominal tenderness

- nausea
- vomiting
- fever
- early tachycardia
- late bradycardia (indicative of severe sepsis or shock)
- shock
- loss of appetite.

Diagnostic details

Before any diagnostic procedures are performed, ask about the patient's medication regimen (including over-the-counter medications) to ensure that the patient hasn't taken laxatives in the last 48 hours, which might explain diarrheal symptoms. Patients experiencing three or more loose stools per day should be tested for CDI. Stool sample testing for CDI should be performed only on a loose stool unless an ileus is suspected (see *Performing a stool culture*).

These four tests can be performed to diagnose CDI.

- ***Enzyme immunoassay (EIA)*** is used most frequently to differentiate between toxin A and toxin B. This test can typically provide results within 1 hour, but it's slightly less sensitive than some of the older testing methods. Several stool samples may be required for an accurate result. Although there are numerous strains of CDI, a basic EIA stool culture can't be used to determine which strain is present.
- ***Polymerase chain reaction*** is considered a highly accurate test that's sensitive enough to rapidly detect toxin B in the stool. This DNA amplification test for *C. difficile* bacteria has a reported sensitivity of greater than 95%.
- ***Tissue culture cytotoxicity assay*** tests human cells in a culture and the effects of the toxins on them. Although sensitive, it takes 24 to 48 hours to get results—longer than other tests—and it's less widely available. This test is often used in conjunction with the EIA to achieve accurate results.
- ***Two-step method*** uses EIA detection of glutamate dehydrogenase (GDH) as initial screening and then uses the tissue culture cytotoxicity assay or toxigenic culture as the confirmatory test for GDH-positive stool specimens only. According to the Infectious Diseases Society of America (IDSA), toxin testing is an important diagnostic test but the results are often complicated by its lack of sensitivity. The IDSA recommends the two-step method to determine accurate toxin identification.

Other beneficial diagnostic procedures include abdominal X-ray or abdominal computed tomography studies. These can identify potential complications, such as thickening of the colon wall, bowel wall perforation, peritonitis, or intestinal dilation that may be indicative of toxic megacolon. In more severe cases, a colonoscopy exam may be ordered to view the colon. A colonoscopy or flexible sigmoidoscopy can be beneficial in identifying the presence of CDI or toxic megacolon and determining the severity of the overall inflammatory process within the intestinal tract.

Obtaining a serum procalcitonin level, complete blood cell (CBC) count, and complete metabolic panel (CMP) is advised.

At risk for colonization

According to the CDC, *C. difficile* colonization is more common than CDI and occurs when the patient has no clinical symptoms but tests positive for *C. difficile* or its toxins. With CDI, the patient tests positive and exhibits clinical symptoms.

Colonization of *C. difficile* is more prevalent if the patient:

- has been hospitalized within the past 2 months
- is receiving chemotherapy
- is receiving PPI therapy
- is using H2 blockers
- has antibodies specifically against *C. difficile* toxin B.

A serum procalcitonin and CBC count can provide valuable information needed to guide the treatment plan. For instance, an elevated white blood cell (WBC) count or rising procalcitonin level may indicate sepsis. A CMP can allow the team to identify elevated sodium levels indicative of dehydration, electrolyte imbalances, and renal dysfunction.

According to the 2013 IDSA guidelines, a serum lactate level and the peripheral blood WBC count may be helpful in prompting a decision to operate because a serum lactate level rising to 5 mmol/L and a WBC count rising to 50,000 cells/mL have been associated with greatly increased perioperative mortality. If surgical management is needed, the surgical team often performs a partial colectomy with preservation of the rectum.

Treatment options

The usual treatment for CDI includes stopping the causative antibiotic, if possible. Treatment plans must encompass strategies to manage the patient's physical signs and symptoms, and maintain a strict cleaning regimen of the patient's environment to minimize pathogen exposure. Common treatment options for CDI include medications and surgery or other procedures if needed.

According to the American College of Gastroenterology's 2013 recommendations for patients older than age 65, the medication treatment regimen depends on disease severity. For example, for an adult with mild-to-moderate CDI, the treatment of choice is typically oral metronidazole. If the patient doesn't respond to the metronidazole, oral vancomycin is typically added. According to the IDSA, vancomycin can be administered orally or as a retention enema if an ileus is suspected. Vancomycin is commonly administered with I.V. metronidazole for the treatment of severe, complicated CDI. Reoccurrence occurs in as many as 30% of all CDI patients treated with antibiotics.

If the patient doesn't respond to vancomycin and metronidazole, or his or her condition worsens, he or she will be started on I.V. fluids with electrolyte replacements as needed to correct fluid volume losses and prevent hypovolemic shock. Antiemetic medications, such as ondansetron and promethazine, are commonly added to the medication regimen to treat nausea and vomiting. If the patient experiences a decline in status, such as low BP (systolic BP less than 90 mm Hg) with changes in level of consciousness that don't respond to I.V. fluid replacement, vasopressive medications such as

Performing a stool culture

1. Instruct the patient to obtain a loose stool sample in a sterile specimen container. Formed stools are typically unacceptable samples because they aren't indicative of CDI.
2. After the specimen is obtained, firmly seal the lid and immediately apply a patient identification label to the specimen cup to reduce the risk of contamination of the specimen and also reduce the risk of *C. difficile* spores being transferred onto surfaces within the patient's or healthcare team's environment.
3. After the specimen container is labeled with the patient information per your healthcare facility's policy, it should be transported immediately to the lab.
4. After the lab personnel receive the specimen, they'll use a sterile applicator to apply a sample to an agar plate for culture.
5. Agar medium is then incubated anaerobically for 48 to 72 hours at a temperature of 95° F (35° C) to promote optimal specimen culture growth.

norepinephrine are commonly administered to correct hypotension.

In severe cases, if toxic megacolon or bowel perforation is present, a partial or complete colectomy (removal of a portion of the intestine) may be necessary. In rare situations, peritoneal dialysis is used to lavage the toxic waste from the peritoneal cavity if the bowel is perforated.

A fecal microbiota transplant (FMT) is a new treatment option that has been 90% effective in resolving CDI. An FMT is the transplantation of a medically processed, dried fecal donor specimen from a family member. The FMT sample can be instilled by inserting it into a multilayered oral capsule that melts when inside the intestinal tract or by directly inserting the FMT sample into the intestinal tissue via a rectal or duodenal tube or during a colonoscopy. The colonoscopy is often favored due to the fact that the extent of the infection can be viewed and the entire colon recolonized.

Avoiding complications

Many complications can arise from CDI because of the large volume losses, erosive manifestation of the toxins, and risk of bacteremia or septicemia. Dehydration is always a concern when dealing with a patient who has severe diarrhea caused by CDI. Severe diarrhea can lead to not only large volume losses, but also the loss of electrolytes, which can cause the BP to drop to life-threatening levels. Dehydration may occur so rapidly that it can cause acute kidney injury or acute kidney failure.

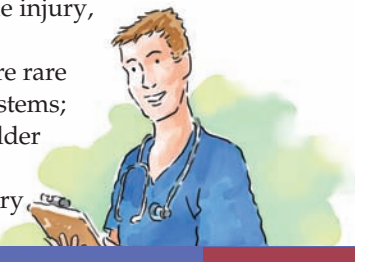
Toxic megacolon is an acute form of toxic colitis that causes extensive and rapid dilatation of the colon. This complication, if untreated, can cause the intestinal wall to rupture or perforate, releasing bacteria into the abdominal cavity, which may require surgery and can be fatal. In severe cases, a partial or total colectomy may be required.

As the intestinal wall rapidly becomes edematous in CDI, it becomes fragile and can tear once stretched beyond its limits, causing a bowel perforation. The toxic bacteria spill out into the abdominal cavity and peritonitis can develop, increasing the patient's risk of morbidity and mortality even further. Peritonitis can rapidly occur when toxic bacteria contaminate the peritoneal cavity as the bowel perforates or becomes ischemic.

Pseudomembranous colitis is also a common occurrence in severe cases of CDI. This extensive inflammation and edema of the large intestines is characterized by diarrhea mixed with blood and pus.

Shock can arise from dehydration, large-volume losses, electrolyte depletion, and sepsis. Patients suffering from CDI-induced shock should be emergently moved to an ICU for close monitoring because their status can quickly decline. Sepsis can occur as the bacteria invade the circulatory system and then quickly attack multiple organs. Death can occur due to volume losses, overwhelming tissue injury, and septicemia.

Severe complications from CDI are rare in patients with healthy immune systems; complications most often occur in older adults and patients with ulcerative colitis; chronic obstructive pulmonary



Infection prevention

cheat sheet

- Wash your hands frequently and in between patients.
- Place the patient in a single room.
- Place the patient on contact precautions.
- Wear a gown, gloves, and mask when entering the patient's room.
- Remind all healthcare team members, family, and patient visitors to remove their gown and gloves, and also wash their hands thoroughly with soap and water, before leaving the patient's room.
- Ensure that your environmental service team members aren't using the same cleaning implements to disinfect the patient's room that they're using in other rooms to minimize the incidence of cross-contamination.
- Be an antimicrobial steward; consider judicious usage of antibiotics.
- Monitor new prevention recommendations from the CDC.

disease; or weakened immune systems, such as those with HIV or cancer.

Dangerous trends

Over the last decade, CDI has become more virulent. This increased virulence is linked to changes in infection control practices and the overuse of antimicrobial therapy, which has increased both the occurrence rate and severity of CDI. These cumulative effects have caused the *C. difficile* bacteria to evolve into a new epidemic strain—North American pulsed-field gel electrophoresis type 1 (NAP1)—linked to excessive secretion of toxins A and B from the intestinal wall. Patients with symptomatic healthcare-associated CDI are more likely to be infected with the NAP1 strain, which is often referred to as hypervirulent.

When *C. difficile* bacteria excrete toxins A and B, it's notably more resistant to the antibiotic group known as fluoroquinolones. These broad-spectrum antibiotics are commonly used to treat both Gram-negative and Gram-positive bacteria.

According to the APIC, in 2013 over 1,087 healthcare professionals were surveyed and asked if the CDI incidence rate was decreasing within their healthcare organizations. Despite aggressive prevention strategies being implemented, 70% of the respondents noted that the CDI occurrence rate wasn't decreasing.

Stopping the spread

C. difficile is spread via the fecal-oral route. All *C. difficile* infected fecal material is highly contagious because it contains microscopic spores. Patients can become infected with *C. difficile* if they come in contact with a contaminated surface and then touch their mouth, introducing the spore into their body where it can proliferate.

C. difficile bacteria can live on environmental items for weeks, causing difficulties for the healthcare team and environmental management staff. All surfaces must be cleaned aggressively to minimize the risk of cross-contamination.

Follow your facility's policy to perform a thorough cleaning of the patient's room or primary living areas. The decontamination process is often called a *terminal clean*. All surfaces, beds, tables, and drapes must be cleaned with special chlorine-containing agents or other facility-approved sporicidal cleaners that will destroy the *C. difficile* spores.

Ensure that your patient is placed on empiric contact precautions and all visitors are educated about protective gear, such as gowns and gloves, which are applied before entering the patient's room. All visitors should adhere to the healthcare facility's isolation policy to minimize the risk of transmitting *C. difficile* to other areas of the healthcare facility. Patients suspected of having CDI should be placed in a private room unless they can share a room with another patient with CDI.

consider this

You're working in the ED and have just received report on your new patient, Mr. J. He's 68 years old and was seen in his primary care physician's office 5 days ago with an upper respiratory infection and complaints of nausea and other mild GI symptoms. His physician placed him on a PPI and an antibiotic for his upper respiratory infection.

He presents to your ED with complaints of loose watery stools that are occurring 10 to 15 times a day for the last 48 hours. His other complaints include abdominal tenderness and loss of appetite. His vital signs are: temperature, 101.2° F; respiratory rate, 20; heart rate, 102; and BP, 98/46. His labs reveal a serum sodium level of 151. You suspect your patient has CDI. What should you do?

Answer: Consult with your healthcare team about starting I.V. fluids to combat Mr. J's dehydration, low BP, and slightly elevated heart rate. Recommend obtaining a stool specimen to verify CDI and stopping the antibiotic and PPI if not contraindicated. As you continue your assessment, your healthcare team will identify the safest unit for Mr. J so he can receive the appropriate level of care. He's at increased risk for mortality because of his age, current physiologic state, and continued loose stool. You should discuss the need for a private room while awaiting confirmation of the CDI diagnosis to minimize the likelihood of cross-contamination to other patients.

Using alcohol-based hand rubs doesn't kill the *C. difficile* bacteria. Instead, the most effective way to prevent the spread of *C. difficile* is for all visitors and healthcare team members to thoroughly wash their hands with soap and water. All reusable oral or rectal thermometers should be replaced with disposable ones. If possible, BP cuffs should be disposable or single-patient-use only. If a reusable BP cuff must be employed, make sure it has been sanitized between patients with a solution approved by your healthcare facility.

After CDI is suspected, consult with your facility's dietary team to request patient meals be served on disposable trays with disposable utensils. This will minimize the risk of transmitting the bacteria to other areas of the healthcare facility.

Patients with CDI may need to be transferred to other areas of the healthcare facility as their clinical condition changes or when additional testing or medical procedures are required. With planning and clear communication between the healthcare team sending and receiving the patient, we can alleviate the risk of intraunit contamination in areas such as patient rooms, ORs, and radiology procedure units. All areas of the healthcare facility to which the patient is transported must be thoroughly cleaned after the patient departs and before receiving another patient in that area to minimize the risk of cross-contamination.

Buck the bug

CDI can be devastating for patients and their caregivers. With careful observation and adherence to evidence-based practice, we can identify patients with CDI early and ensure positive outcomes. ■

on the web

- **Agency for Healthcare Research and Quality:** http://www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/cdifftoolkit/
- **American College of Gastroenterology:** http://www.patients.gi.org/topics/c-difficile-infection/
- **Association for Professionals in Infection Control and Epidemiology:** http://apic.org/Professional-Practice/CDIresources
- **CDC:** http://www.cdc.gov/HAI/organisms/cdiff/Cdiff_infect.html
- **Infectious Diseases Society of America:** http://www.idsociety.org/Guidelines/Patient_Care/IDSA_Practice_Guidelines/Infections_by_Organism/Bacteria/Clostridium_difficile
- **Mayo Clinic:** http://www.mayoclinic.org/diseases-conditions/c-difficile/basics/definition/con-20029664
- **MedlinePlus:** http://www.nlm.nih.gov/medlineplus/clostridiumdifficileinfections.html

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