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## **C.DIFF: AN EVER INCREASING PROBLEM FOR A HEALTHCARE FACILITY**

By: Dr. Helene Paxton, MS, MT(ASCP), PhD, CIC, Infection Preventionist, Bio Guidance, LLC.

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*C. difficile* is a spore-forming, Gram-positive anaerobic bacillus that can lead to antibiotic-associated diarrhea and sepsis. <sup>1</sup>

*C. diff* is shed in feces, so any surface, device or material that becomes contaminated with feces can serve as a reservoir for *C. diff* spores, which can be transferred to patients mainly via the hands of healthcare personnel who have touched a contaminated surface or item. <sup>2</sup>

Additionally, *C. diff* spores may remain in the environment for as long as 5 months or more and be passed to the next individual occupying the hospital or nursing home room. Proper environmental cleaning is essential to prevent the infection of the next room resident. *C. diff* is also carried by animals, including cows, horses, and pigs; increased by the use of certain antibiotics such as fluoroquinolones, use of Proton Pump Inhibitors (PPI), and use of alcohol hand rubs by healthcare workers. <sup>3,4</sup>

Some interesting facts:

- According to a recent CDC report, *C. diff* caused nearly half a million infections in U.S. hospitalized patients in 2011. That year, about 29,000 patients died within 30 days of the *C. diff* diagnosis, with 15,000 of those deaths directly attributable to the infection.
- *C. diff* infections, or CDIs, account for 10 percent of all HAIs in hospitalized patients. The excess cost of a CDI per patient is estimated at around \$11,000. <sup>3</sup> Part of that excess cost comes from the increased length of stay for a patient with a CDI. When a CDI occurs, it adds roughly 3.3 days onto the average length of stay for a patient. <sup>3</sup>
- CDIs make up 5 percent of the excess costs in U.S. hospitals associated with all HAIs (whereas central line-associated bloodstream infections represent 36 percent of excess costs in U.S. hospitals and catheter-associated urinary tract infections represent 2 percent). <sup>3</sup>
- Over the last 10 years, the rate of CDIs were highest in the following regions: Northeast (eight CDI discharges per 1,000 total discharges), Midwest (6.4/1,000), South (5/1,000) and West (4.8/1,000). Between 2001 and 2010, *C. diff* mortality was highest in the Midwest (7.3 percent). This is also accentuated by circulating toxigenic strains leading to greater severity of CDI. <sup>4</sup>
- CDI pressure on hospitals and hospital admissions is further aggravated due to community onset as noted above by external factors. Hospital may be experiencing a 5-10 fold increase in community prevalence rates. (NHSN PC)
- Recent data from CDC suggest that there are 4 factors predicting HO CDI rates (hospital acquired): 1. Test being used; 2. medical school affiliation; 3. facility bed size; 4. and CO-CDI prevalence rate. <sup>6</sup>

As discussed above, *Clostridium difficile* infections (CDI) in the hospital and healthcare environment are difficult to control in spite of expanded vigilance and attempts to prevent transmission. Increased sensitivity in testing has contributed to higher detection rates due to higher sensitivity of the assays. A 300 bed inner city hospital was able to bring their infection rates and SIRS (Standard Infection Ratios) under control by adjusting their isolation and cleaning protocols. In late 2013, this facility changed the algorithm for CDI testing which includes testing by ELISA (EIA) for CD Antigen and CD Toxins A and B, followed by PCR for Toxin B if EIA was negative for Toxin with a positive Antigen test. This more sensitive approach has increased the detection rate, and therefore the facility's Hospital Acquired Infection (HAI) rates as well as the SIR for CDI. Using the EIA for Toxin alone, the sensitivity for detection was in the 60-65% range. With PCR, sensitivity and specificity approaches 100%. The number of patients being admitted from outside facilities with CDI has also increased. These are determined to be community onset (CO-HCFA) unless recently discharged from another healthcare institution ( $\leq 4$  weeks earlier). The National Health and Safety Network (NHSN) have increased the surveillance for these occurrences by collecting FAC-Wide-In data as a Lab ID data from hospitals. The clinical definition remains a laboratory determined parameter and does not recognize pre-existing conditions. If a patient is admitted to the hospital after a recent occurrence of CDI, redevelops diarrhea, and is retested greater than three days' post admission, this is charged as a HAI to the hospital regardless of where the infection may have originated. This lab based reporting without context makes it even more difficult for a hospital to reduce their HAI Rates or SIRs (known as HO Hospital onset vs CO Community onset) for CDI. The epidemiology of CDI as described in a paper by Freeman et. al (2010)<sup>3</sup> indicates that both the geographic distribution and strain differences affects the respective rates reported as noted above.

In 2012-13, the hospital's rate for HAI CDI was an average of 6-7/10,000 patient days. This rate exceeded targets set by the hospitals governing bodies as well as insurance carriers and other regulators. Expected acceptable targets vary and are being continuously reevaluated by regulatory agencies. Protocols for terminal cleaning of the *C. diff* rooms at that time utilized bleach wipes and a phenolic product with a micro-fiber rag. In searching for interventions and in consultation with infectious disease physicians, the facility initiated a nurse driven protocol that allowed for immediate placement of patients admitted or developing diarrhea in enteric contact (enhanced contact) precautions with four or more Bristol stools, category 5-7<sup>5</sup> in a 12-hour period. With isolation, the protocol allowed the ordering of CDI testing by methods described earlier. The Environmental Service staff with direction from Infection Prevention Committee then integrated a new final step to the terminal cleaning protocol. This new technology known as SteraMist™ Binary Ionization Technology® (BIT™), (TOMI, Beverly Hills, CA), converts a 7.8% hydrogen peroxide solution into a Hydroxyl Radical mist. This EPA registered solution is passed thru an atmospheric cold plasma arc where activation occurs. Activation creates a mist/fog containing a high concentration of Reactive Oxygen Species, mainly the Hydroxyl Radical. The mist/fog referred to as Activated Ionized Hydrogen Peroxide (AIHP) is delivered via a handheld application system to the terminal cleaning of CDI rooms after the base cleaning with bleach wipes and a general all-purpose cleaner. The phenolic disinfectant use was completely removed from the facility. The ionized properties of the mist/fog allow for uniform distribution and address hard to reach areas commonly missed in manual cleaning. Use of Bleach wipes will be discontinued with approval of the AIHP by EPA for *C. diff* spores. The advantage of the technology is ease of use and rapid mobile application to target affected areas and rooms. Room turnover is less than 25 minutes with no residual odor or annoying surface film.

The Hospitals results with the new isolation/testing order set and use of the AIHP technology, infection rates dropped to 3.1/10,000 for calendar 2014. Rates fell further to 1.6/10,000 days between August 2014 and March 2015. Since March 2015, the facility has maintained CDI rates in the 2.1-3.0/10,000 range with a SIR of 0.41-0.9. With the SIR being less than 1, the facility shows improvement, but is finding it difficult to control small outbreaks. Their institutional target is a SIR of 0.41 which is very aggressive. The facility found the occurrence of CDI is not service location dependent, and small clusters have occurred in the Med-Surgical units, the Medical ICU, and the General Step down units. The units get 3 or 4 positive patients in a 3-5 day period, then nothing. The in-coming Community Acquired Infections range from 3-7 per month. Actual NHSN data for the hospital population suggests that the prevalence rate for incoming patients has risen ten-fold since 2013 adding to the *C. diff* pressure. In each incoming case, the staff is reminded to wash their hands with soap and water, wear gowns, and isolate the patient immediately upon the finding of diarrhea. Visitors are asked to wear gowns and gloves as well. The IP, Pharmacy staff, and attending actively monitor antibiotic regimens during daily clinical rounds to shorten antibiotic therapy and substitute antibiotics to replace high incidence CDI associated antibiotics when clinically possible.

The AIHP technology added as a final step in the terminal clean protocol is EPA registered for use as a Hospital/Healthcare disinfectant and is now cleared by EPA for a 6-log *C. diff* spores kill. The hospital will further streamline the cleaning protocol by discontinuation of bleach wipes as noted above. The use of AIHP in combination with the active isolation and antibiotic interventions has greatly reduced the hospital's *C. diff* burden. By moving to stricter isolation protocols and incorporating AHIP technology into EVS cleaning protocols, this hospital has been able to stabilize their CDI rates even with the use of increasingly sensitive *C. diff* detection methods and increased community prevalence rates.

The AHIP BIT technology now EPA cleared for *C. diff* spores is an indispensable part of the arsenal to control CDI in both in-patient and out-patient facilities. Continued antibiotic stewardship vigilance as well as proper PPE utilization in active cases will help further reduce the burden of CDI for patients.

1. Centers for Disease Control and Prevention. February 25, 2015. Healthcare-associated Infections (HAIs). *Clostridium difficile* Infection. [http://www.cdc.gov/HAI/organisms/cdiff/Cdiff\\_infect.html](http://www.cdc.gov/HAI/organisms/cdiff/Cdiff_infect.html)
2. Centers for Disease Control and Prevention. March 6, 2012. Healthcare-associated Infections (HAIs).
3. Frequently Asked Questions about *Clostridium difficile* for Healthcare Providers. [http://www.cdc.gov/HAI/organisms/cdiff/Cdiff\\_faqs\\_HCP.html](http://www.cdc.gov/HAI/organisms/cdiff/Cdiff_faqs_HCP.html)
4. J Freeman et al. Clin Microbiol Rev. 2010; Vol23 (3);529-549
5. [www.bowelcontrol.nih.gov/bristol.aspx](http://www.bowelcontrol.nih.gov/bristol.aspx)
6. Dudeck, MA et al. :<http://www.cdc.gov/nhsn/pdfs/mrsa-cdi/RiskAdjustment-MRSA-CDI.pdf> 2013
7. NHSN personal communication 2015

**C.DIFF Rates/SIR in an Inner City Acute Care Hospital Markedly Decrease After Adjusting Isolation and Cleaning Protocols**

*Background*

*C. diff* is a spore-forming, Gram-positive anaerobic bacillus that can lead to antibiotic-associated diarrhea and sepsis, <sup>1</sup>*C. diff* is shed in feces, so any surface, device or material that becomes contaminated with feces can serve as a reservoir for *C. diff* spores.

*Clostridium difficile* infections (CDI) in the hospital and healthcare environments remain difficult to control in spite of expanded vigilance and antibiotic interventions. Increased sensitivity in testing contributes to higher detection rates. In late 2013, this facility changed the algorithm for CDI testing: ELISA (EIA) for antigen and Toxins A and B, followed by PCR for Toxin B if EIA is negative for Toxin.

*Methods:*

In 2012-13, the hospital’s rate for HAI CDI was 6.439/10,000 patient days. Protocols for terminal cleaning of the *C. diff* rooms at that time utilized bleach wipes and a phenolic product with a micro-fiber rag. The facility initiated a nurse driven protocol that allowed for immediate placement of patients admitted or developing > 4 diarrhea stools (Bristol 5-7) in enteric contact precautions, and ordered CDI testing. A new technology which converts a 7.8% hydrogen peroxide solution into a Hydroxyl Radical mist was added. The mist/fog referred to as Activated Ionized Hydrogen Peroxide (AIHP) was applied via a handheld system after terminal cleaning of CDI rooms with bleach wipes and an all-purpose cleaner. Potentially hard to reach areas were reached with this approach.

*Results:*

With the new isolation/testing order set and use of the AIHP technology, infection rates/SIR was:

	Pre-intervention rate	Post intervention HAI rate	SIR*	CDI In Patient Admission CO Prev. Rate	Testing
2012-13 FACWIDEIN	6.439/10,000		1.158	0.162	Used EIA 1 <sup>st</sup> 10 mos; new testing initiated 11/1/13
2014 FACWIDEIN		3.176/10,000	0.408	0.512	New Testing algorithm
8/2014-3/2015 FACWIDEIN		3.3/10,000	0.391	0.775	New Testing algorithm
1/2015-12/2015 FACWIDEIN		8.3/10,000	0.909	1.436	New Testing algorithm

*Conclusion:*

The use of AIHP in combination with the active isolation and antibiotic interventions has greatly reduced the hospital’s *C. diff* burden. By moving to stricter isolation protocols and incorporating AIHP into cleaning protocols, this hospital has been able to stabilize their CDI events even with using increasingly sensitive detection methods and 10 fold increase in CDI CO-prevalence.

1 Centers for Disease Control and Prevention. February 25, 2015. Healthcare-associated Infections (HAIs). *Clostridium difficile* Infection. [http://www.cdc.gov/HAI/organisms/cdiff/Cdiff\\_infect.html](http://www.cdc.gov/HAI/organisms/cdiff/Cdiff_infect.html)

\*2010-11 CDC Aggregate data