Data Collection and Analysis of a Surveillance and Epidemiologic Investigation

Anna Roe

American Sentinel University
Data Collection and Analysis of a Surveillance and Epidemiologic Investigation

The infection preventionist (IP) at a 75 bed, acute care, rural hospital, The Saint Joseph Care Hospital (SJCH) understood the reasons for implementing a well-designed infection control program. Included each year in the program, based on the previous years outcomes and the current new regulatory requirements, was a new infection control surveillance plan. In the plan the IP included the demographics of SJCH describing it as a 75 bed acute care facility in a rural community that had an approximate population of 14,000. The medical/surgical unit had 50 beds and was located on the first floor; all the rooms were private. The floor was staffed by registered nurses and patient care providers. The average length of stay was 3.3 days. The critical care unit had a total of 15 beds also located on the first floor and was staffed by registered nurses. The average length of stay in the critical care unit was 4.2 days. SJCH was equipped with a modern laboratory and radiology department. Administration required that the yearly infection control surveillance plan be completed and presented to the Infection Prevention Committee by the beginning of December every year, so that the new plan could take effect January first.

In an article in the America Journal of Infection Control Lee, Montgomery, Marx, Olmstead, & Scheckler (2007) discussed the creation of an infection control surveillance plan and pointed out, so that that resources were not wasted, the plan should have clear goals and objectives that clearly define how to meet those goals. One important part of plan development according to Arias (2010, p. 40) is that “those responsible for designing a surveillance program in a hospital should target their surveillance to defined populations…so that the number of patients in the population can be identified” as well as identifying the risk associated with not only hospitalization, but also use of medical devices and even medications that may be used in their care.
In describing the demographics of Marshall County it was noted from the United States Census Bureau that citizens over age 65 accounted for 13.2% of the county population (United State Census Bureau, 2011, People Quick Facts Sec 1). Marshall County also has five long term care facilities from which patients were received into SJCH for treatment. One of the basic components of a healthcare surveillance system is to identify and monitor which patients may be at risk for infection; because of the aging population in the county it would be prudent to look at diseases and conditions that might target this population.

The Association for Infection Control Practitioners and Epidemiology (APIC) stated *Clostridium difficile* (*C. difficile*) has had a significant impact on healthcare and is now, “recognized as a pathogen capable of causing human suffering to a degree matching that of Methicillin-resistant Staphylococcus aureus” (APIC, 2008, p. 5). The *Clostridium difficile* Elimination guide further stated that *Clostridium Difficile* Infection (CDI) is becoming more severe and affecting children, adults and the elderly (2008, p. 5). In addition to the elderly since CDI also affects other patient populations, including children, it would definitely be prudent to include it in the Infection Prevention Surveillance plan related to the fact that Saint Joseph Physician Network (SJPN) included three pediatricians. According to APIC (2008), CDI “is associated with an increased length of stay in healthcare facilities by 2.6 to 4.5 days and costs for in-patient care have been estimated to be $2,500 to $3,500 per episode, excluding costs associated with surgical interventions” (p.5). Further information from the guide quoted a mortality rate of 6.9% at 30 days and 16.7% at one year are associated with a CDI (2008, p.5). From these CDI statistics it was clear that prevention of health care associated CDI would be an important component of the infection prevention plan. In addition to all of the evidence relating how destructive this organism and subsequent disease can be the IP also became aware that CDI
was slated to be included in the Centers for Medicare and Medicaid services (CMS) mandatory reporting beginning January of 2013.

The next step in the process of developing an infection surveillance plan is the development of surveillance definitions. As outlined by Lee et al. (2007, p. 430) “In any surveillance system, all data elements should be clearly defined.” Definitions should also include the risk factors of the population at risk for development of an HAI (2007, p. 430). One reason for uniform infection definitions is so that the information can be used to compare units or facilities, as well as checking the progress of interventions that have been made to curtail HAI development.

Because of mandatory reporting of infections through the National Healthcare Safety Network (NHSN) and for the purpose of consistent reporting the IP will follow the definitions outlined in the NHSN modules. The Center for Disease Control and Prevention (CDC) Multidrug-Resistant Organism & Clostridium difficile Infection (MDRO/CDI) Module has two options for reporting CDIs. IPs can either choose Laboratory-Identified (LabID) Event Reporting or C. difficile Infection Surveillance Reporting (2013, p.12-4). The IP at SJCH decided that more information could be gained from entering data into the C. difficile Infection Surveillance Reporting.

The CDC module introduction states (2013), “The Infection Surveillance reporting option for MDRO and C. difficile infections enables users to utilize the CDC/NHSN healthcare-associated infections definitions for identifying and reporting infections associated with MDROs and/or C. difficile” (p. 12-20). The information further outline that surveillance should occur from at least one patient care area and that a trained IP “seeks to confirm and classify infections” (p.20) during a patient stay, in the period of surveillance.
The Module defines the setting for which *C. difficile* infection surveillance must occur as an “inpatient location where denominator data can be collected (CDC, 2013, p. 20)” including intensive care units, wards, step down units, specialty care areas and chronic care units. In the case of SJCH, two wards would be monitored; those being the 15 bed critical care unit, and the 50 bed medical surgical unit.

The definition section (CDC, 2013, p. 12-21) instructs that the IP should “Report all healthcare-associated infections where *C. difficile*, identified by a positive toxin result, including toxin producing gene (PCR) is the associated pathogen.” The numerator data is outlined as the number of HAI with the organism *C. difficile* (CDC, 2013, p. 12-22). The denominator is defined as the number of patient days and admissions during the surveillance month for the defined location (CDC, 2013, p. 12-22).

For reporting purposes into NHSN (Centers for Disease Control and Prevention [CDC], 2013, p. 12-23) as outlined in the MDRO and CDI module a HAI CDI should be reported into NHSN as a GI-GE or a GI-GIT. Gastrointestinal System Infection (GI): Gastroenteritis (GE) has to meet one of these criteria:

1. Patient has an acute onset of diarrhea (liquid stool for more than 12 hours) with or without vomiting or fever (>38 C) and no noninfectious cause (e.g., diagnostic tests, therapeutic regimen other than antimicrobial agents, acute exacerbation of a chronic condition, or psychologic stress.)

2. Patient has at least 2 of the following signs or symptoms: nausea, vomiting, abdominal pain, fever (>38 C), or headache and at least one of the following:
   a. An enteric pathogen is cultured from stool or rectal swab
   b. An enteric pathogen is detected by routine or electron microscopy
c. An enteric pathogen is detected by antigen or assay on blood or feces

d. Evidence of an enteric pathogen is detected by cytopathic changes in tissue culture (toxin assay)

e. Diagnostic single antibody titer (IgM) or 4-fold increase in paired sera (IgG) for the pathogen

Gastrointestinal System Infection (GI): Gastrointestinal tract infection (GIT) …must meet at least one of these criteria:

a. Patient has an abscess or other evidence of infection seen during an invasive procedure or histopathologic examination

b. Patient has at least 2 of the following signs or symptoms compatible with infection of the organ or tissue involved without any other recognizable cause:
fever (>&38 C), nausea, vomiting, abdominal pain, or tenderness and at least one of the following:

1. Organisms cultured from drainage or tissue obtained during an invasive procedure or endoscopy or aseptically-placed drain.

2. Organisms seen on Gram’s or KOH stain or multinucleated giant cells seen on microscopic examination of drainage or tissue obtained during an invasive procedure or endoscopy or from an aseptically-placed drain.

3. Organisms cultured from blood

4. Evidence of pathologic findings on imaging test

5. Evidence of pathologic findings on endoscopic examination (e.g., Candida esophagitis or proctitis)
According to the module, data analysis is accomplished by data being “stratified by time (e.g., month, quarter, etc.) and by patient care location. The formula is “C. difficile Infection Incidence Rate = Number of HAI CDI cases/Number of patient days x 10,000” (CDC, 2013, p. 12-22). Because SJCH was a 75 bed acute care hospital and only 65 beds would be monitored for CDI the rate will be figured and reported every quarter. Because SJCH did not have an electronic monitoring system the sources of data for the IP would be laboratory based monitoring for C. difficile positive toxins, as well as active monitoring every Monday, Wednesday and Friday for patients with diarrhea who may potentially have had CDI.

The Infection Control Plan for 2013 including the surveillance elements for C. difficile was accepted, as presented, by the Infection Control Committee of SJCH and surveillance for HAI with C. difficile began January 1, 2013. Data was entered into NHSN as instructed each month. According to Arias (2010), “Surveillance data should be collected on an ongoing basis in order to identify trends, detect organisms of epidemiologic importance, and recognize clusters and outbreaks.” (p.44) She further points out that “there is no defined time period…” but adds that there will be difficulty interpreting rates for events that do not occur often; most IPs will do surveillance on the indicators for a period of time such as each month or quarter to determine if problems are identified. The IP decided that for internal monitoring and rate comparison of floors the CDI health-care acquired infections will be reported to the Infection Prevention Committee quarterly as: Incidence Rate = Number of HAI CDI cases/Number of patient days x 1000 patient days.

The first quarter, January 1, 2013 through March 31, 2013 was uneventful with no CDI found on the medical/surgical floor, while critical care reported One HAI C. difficile infection/629 patient days x 1000 = 1.6 infections per 1000 patient days. The second quarter found no
CDI on either floor. The third quarter surveillance found one HAI CDI on the medical surgical floor for a rate of 0.45 per 1000 patient days, and no patients in the critical care unit. The fourth quarter of 2013 the IP reported a rate of two CDI HAIs /2242 patient days x 1000 = 0.9 infections per 1000 patient days on the medical/surgical unit and 1 case on the critical care unit for a rate of 0.9 per 1000 patient days. Because it was fall and winter the hospital was very busy with additional respiratory illness patients being admitted. The IP thought that with staff being so busy perhaps hand hygiene rates or even isolation practice might have fallen, however when the surveillance information on those practices were compiled the rates on both were consistently 90% or greater. The first quarter of 2014 the critical care unit had no CDIs while the medical /surgical unit reported a rate of 1.44 per 1000 patient days.

According to Arias (2010, p. 281) “an outbreak is defined as the occurrence of more cases of disease or event than expected during a specified period of time in a given area or among a specific group of people.” Because of the increase in the incidence of C. difficile above the initial incidence of 0.22 infections per 1000 patient days, the IP recognized that an outbreak of C. difficile at SJCH might be possible.

Since the IP suspected an outbreak in March of 2014 she verified the diagnosis of all the HAI CDI cases beginning with the initial case in February of 2013. Following the steps in an outbreak investigation as outlined by Arias (2010) she developed a line listing of all of the cases, entering the data into a retrievable database file (See Appendix for the line listing). The following was included in the line listing: patient identifier, date of birth, date of admission, patient location including unit and room number at the time of stool collection, CDI symptom onset date, stool collection date, the type of laboratory testing that was done, discharge date and disposition of each patient (Association of Professionals in Infection Control [APIC], 2008, p.
20). She asked the medical record department to query for additional patients who might have had CDI but had been missed being identified in the surveillance. Three additional cases were found after the query increasing the rate on the medical/surgical floor to 2.88 cases per 1000 patient days in the first quarter of 2014.

At this point she notified the appropriate hospital leadership so that a team could be assembled to assist with the investigation. A literature search was conducted to determine what other institutions had identified as “risk factors, sources, reservoirs, modes of transmission, and effective control measures” (Arias, 2010, p. 289). The APIC Clostridium difficile Elimination Guide (Association of Professionals in Infection Control [APIC], 2008, p. 13) indicates that important concepts regarding C. difficile would be:

- Survival of the spore in the hospital environment
- Transmission or acquisition by patients or healthcare workers of C. difficile from contaminated surfaces
- Transmission by the fecal oral route so any activity resulting in movement of the organism into the mouth must be addressed as part of prevention activities

Based on these recommendations the IP again increased monitoring regarding hand hygiene and contact isolation precautions. The elimination guide does advise private patient rooms if possible; this is not an issue at SJCH as all the rooms are private. The guide also states regarding patient care equipment, (2008, p. 25) “C. difficile contaminates patient care equipment and devices through fecal shedding”, therefore it was decided that all equipment entering into a room where the patient had C. diff should remain in the room until discharge.

The elimination guide (APIC, 2008, p. 21) suggested expressing CDI rates as feedback to staff to facilitate awareness of the rise in CDI infections.
The Elimination guide in discussing the environment states, (APIC, 2008, p. 32) “The environment must be recognized as a critical source of contamination, and it plays a significant role in supporting the spread of infection.” The guide states that spores can exist for months on hard surfaces with the heaviest contamination on floor and in bathrooms (APIC, 2008, p. 32).

A meeting was held with the manager of the Environmental Services Department (EVS) to discuss daily and terminal environment cleaning in *C. difficile* rooms. The disinfectant that is used at SJCH is a quaternary ammonium that does not have a sporicidal claim on the label. According to Cohen et al. (2010, p. 443) “current evidence supports the use of chlorine-containing cleaning agents (with at least 1,000 ppm available chlorine) particularly to address environmental contamination in areas associated with endemic or epidemic CDI.” The EVS manager and the IP developed an intervention that included adding cleaning of high-touch areas using sodium hypochlorite wipes for daily cleaning. For terminal room cleaning the room would be totally cleaned with the hospital environment disinfectant and then sodium hypochlorite wipes would be used on the high-touch areas: walls would be cleaned and curtains removed for cleaning.

With all of the additional interventions, the surveillance for the second quarter of 2014 found no HAI CDI in the critical care unit. However, on the medical surgical unit the incidence rate continued to be above the baseline incidence of 0.22 infections per 1000 patient days, it was 1.1 per 1000 patient days. While the IP was adding information to the line listing she noticed that several of the patients who developed CDI during their hospital stay were being admitted or transferred into room 229 on the medical/surgical unit. Room number 229 was not used as often as other rooms because it was the farthest room from the nurses’ station however during time of increased census it had to be used more often. Curious, the IP made a visit to room 229 and
noticed in the bathroom that the wall behind the toilet was darker and seemed wet. The maintenance department was contacted and it was discovered that the toilet was leaking. Apparently, the EVS department thought that nursing staff was reporting the leak and the nursing staff thought that the EVS staff was making the report.

According to (VanEnk, 2012, slide 11) since the organism is “found in the stool of the sick patient with diarrhea, the organism soon spreads to all areas and items of the room that are touched.” Of course in this case the source of the continual environmental contamination was the leaking toilet and wet wall which provided a continual environmental source of contamination. The IP closed the room for repairs and a thorough cleaning. The source of the outbreak was apparently the leaking toilet as surveillance for CDI in the third quarter of 2014 found no cases of HAI CDI in the critical care unit or on the medical surgical unit.
References


<table>
<thead>
<tr>
<th>Admission date</th>
<th>Hospital number</th>
<th>DOB</th>
<th>Unit</th>
<th>Room # at the time of stool collection</th>
<th>CDI Symptom onset date</th>
<th>Stool collection onset date</th>
<th>Type of lab test and results</th>
<th>Discharge date</th>
<th>Pt. Disposition at discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/09/2013 Quarter one of 2013</td>
<td>065821</td>
<td>12/01/1935</td>
<td>Critical Care Unit</td>
<td>203</td>
<td>02/14/2013</td>
<td>02/15/2013</td>
<td>Positive for Clostridium Difficile (C. diff) Toxin B Gene by PCR (polymerase chain reaction)</td>
<td>2/22/2013</td>
<td>Return to home</td>
</tr>
<tr>
<td>08/10/2013 Quarter three of 2013</td>
<td>45909</td>
<td>03/04/1940</td>
<td>Medical/Surgical (M/S)</td>
<td>223</td>
<td>08/14/2013</td>
<td>08/14/2013</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>08/24/2013</td>
<td>Return to home</td>
</tr>
<tr>
<td>11/05/2013 Quarter four of 2013</td>
<td>760337</td>
<td>05/23/1930</td>
<td>Began in CCU in room 201 and transferred to room 229 on M/S</td>
<td>229</td>
<td>11/07/2013</td>
<td>11/08/2013</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>11/18/2013</td>
<td>Return to Long Term Care</td>
</tr>
<tr>
<td>12/20/2013</td>
<td>444579</td>
<td>04/10/1946</td>
<td>M/S</td>
<td>229</td>
<td>12/22/2013</td>
<td>12/22/2013</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>01/01/2014</td>
<td>Return to home</td>
</tr>
<tr>
<td>Admission date</td>
<td>Hospital number</td>
<td>DOB</td>
<td>Unit</td>
<td>Room # at the time of stool</td>
<td>CDI Symptom onset date</td>
<td>Stool collection onset date</td>
<td>Type of lab test and results</td>
<td>Discharge date</td>
<td>Pt. Disposition at discharge</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------</td>
<td>----------</td>
<td>------</td>
<td>-----------------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>----------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>01/03/2014 Quarter one of 2014</td>
<td>226908</td>
<td>03/12/1960</td>
<td>M/S</td>
<td>229</td>
<td>01/05/2014</td>
<td>01/05/2014</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>01/15/2014</td>
<td>Return to home</td>
</tr>
<tr>
<td>01/06/2014</td>
<td>338500</td>
<td>01/20/1949</td>
<td>M/S</td>
<td>257</td>
<td>01/09/2013</td>
<td>01/10/2014</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>01/22/2014</td>
<td>Return to home</td>
</tr>
<tr>
<td>02/05/2014</td>
<td>3338501</td>
<td>07/24/1933</td>
<td>Began on M/S transferred to CCU after total colectomy 02/20</td>
<td>229</td>
<td>02/09/2014</td>
<td>02/10/2014</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>02/27/2014</td>
<td>Transfer to LTC for recovery</td>
</tr>
<tr>
<td>02/22/2014</td>
<td>778340</td>
<td>12/03/1919</td>
<td>M/S</td>
<td>229</td>
<td>02/26/2014</td>
<td>02/26/2014</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>02/25/2014</td>
<td>Return to LTC where she developed CDI</td>
</tr>
<tr>
<td>03/02/2014</td>
<td>227709</td>
<td>05/30/1939</td>
<td>Started on M/S and transferred to different hosp.</td>
<td>229</td>
<td>03/04/2014</td>
<td>03/05/2013</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>03/04/2013</td>
<td>Transfer on 03/04/2014</td>
</tr>
<tr>
<td>03/04/2014</td>
<td>888901</td>
<td>06/28/1950</td>
<td>M/S</td>
<td>229</td>
<td>03/06/2014</td>
<td>03/06/2014</td>
<td>Positive for C.diff. Toxin B Gene by PCR</td>
<td>03/06/2014</td>
<td>Transfer to LTC</td>
</tr>
</tbody>
</table>