

Telemedicine-Cloud: Clostridium Difficile Infection Control in Hospitals

Overview

Clostridium difficile (CD) is a gram-negative, spore forming, obligate anaerobic bacillus. A recent study indicated¹ > 600,000 /year reports of Clostridium difficile infection (CDI) in America, > 15,000 deaths/year primarily due to the recurrence (25-45%) of CDI and the economic cost to the hospitals was > \$4.5 billion/year. Magill et al, recommended prevention strategies against CDI in hospitals.² Diagnosis of CDI is also difficult. Audrey Schuetz summarized various testing methodologies for CDI and provided an algorithm for its diagnosis.³ The clinical practice guidelines and treatment modalities of CDI have been recently reviewed.^{4,5,6} Mermel et al, proposed a CDI control plan⁷ for the hospitals but it was labor intensive to execute thus financially not feasible in most of the hospitals (Appendix I). We have achieved a computerized standard operating procedure for the CDI control in hospitals. Our procedure is not labor intensive, therefore economically feasible in all hospitals.

1. Desai k, et al. Epidemiological and economic burden of Clostridium difficile in the United States: estimates from a modeling approach. BMC Infectious Diseases 2016; 16(303); 1- 10.
2. Magill et al. Changes in Prevalence of Health Care-Associated Infections in U.S. Hospitals. N Engl J Med 2018; 379(18): 1732
3. Schuerz AN. Diagnosis of C. Difficile-Why so Difficult. CLN November 2018, 13.
4. Hopkins RY, Wilson RB. Treatment of recurrent Clostridium difficile colitis: a narrative review. Gastroenterol Rep. (Oxf) 2018; 6(1): 21-29
5. McDonald LC et al. Clinical Practice Guidelines for Clostridium Difficile Infections in Adults and Children: 2017 Update by the Infectious Diseases Society of America (IDSA) and Society for Healthcare Epidemiology of America (SHEA). Clin Infect Disease 2018. Available from: http://www.idsociety.org/Guidelines/Patient_Care/IDSA_Practice_Guidelines/Infections_By_Organ_System-81567/Gastrointestinal/Clostridium_difficile/

6. Wilcox MH et al. Bezlotoxumab for Prevention of Recurrent Clostridium difficile Infection. N Engl J Med 2017; 376: 305-317.
7. Mermel LA et al. Reducing Clostridium difficile Incidence, Colectomies and Mortality in the Hospital Setting: A successful Multidisciplinary Approach. The Joint Commission Journal on Quality and Patient Safety 2013; 39(7): 208-305 (AP1-AP4)

Solution:

This program has been designed to track the steps that are part Clostridium Difficile Infection Control Plan. Each step is marked with a date and timestamp when the caregiver performs the task and mark it as complete. The historical information is saved in the database for future references in the form of reports. The solution works independent of or in conjunction with the EMR and can also push the data back to patient record in the form of HL7 message. The caregiver can put special notes to Lab, Radiology, etc., which can be viewed in the respective department user's login. The tracker is configurable with task scheduling, alerts/notifications in case of a missed schedule. It also has capability built in to report any information needed by Admin, Management for view, email and print.

Technology:

This is a web-based solution developed using Microsoft technologies like .NET, SQL Server and is designed to be hosted on Cloud platform or local environment. Cloud version is very handy in case the HealthCare system prefers to run this with minimal hardware. The functionality doesn't differ with method of access of this solution.

Appendix 1

Clostridium Difficile Infection Control in Hospital

1001	Find Patient	Patient Orders		
MRN: 1001	Patient Name: Praveen	DOB: 7/19/1979	Sex: M	Address: 837 Grovecrest, Rochester Hills, MI, 48307
Phone1: 3134211527	Phone2:	Email: guv.praveen@gmail.com	Insurance ID: 10992832	Login Date/Time: 9/15/2018
Hospital #: 258981	Room #: 302	Admitting Physician: Dr. Zia	Ordering Physician: Dr. Chawla	Authorized Person: Dr. Zia

Legend: *CSD: Central Services Department, *EVS: Environmental Services, *EKG: Electro Cardiogram, *CL: Clinical Laboratory, *HP: Hospital Pharmacy, *PT: Physical Therapy, *CD: Cardiology Department, *RD: Radiology Department, *RT: Respiratory Therapy

Staff Members		About CDI								
Description	Location	Frequency	Responsibility	Daily Room Cleaning Product	Daily Isolation Room Cleaning Product	Discharge Room Cleaning Product	Monitoring	Completed Date/Time		
Automated external defibrillator (after use)	Units and hospitalwide	As needed	CSD	Disinfectant wipes	N/A	N/A	CSD		Mark Complete	Reset
Bathroom	Patient room	Daily and Discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Bed/chair alarm	Patient room	Daily and Discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	Nursing		Mark Complete	Reset
Beds (remains in room)	Patient room	Daily and Discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Bedside and overbed table	Patient room	Daily and Discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Blood pressure cuffs in room	Patient room	Daily and Discharge	Nursing	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	Nursing		Mark Complete	Reset
Call bell/control	Patient room	Daily and Discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	Nursing		Mark Complete	Reset
Cardiac monitors telemetry and lead wire	Patient room	Daily and Discharge	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Chair scale	Patient room	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Commode	Patient room	After use and between patients	Nursing	Disinfectant wipes	Dispatch disinfectant	Dispatch disinfectant	Nursing		Mark Complete	Reset
Computer	Patient room	Daily and as needed	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	EVS		Mark Complete	Reset
Computer in nurses' station	Nursing Station	Daily and as needed	Unit secretary	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Computer on wheels	Unit	Daily and as needed	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Cooling blanket	Patient Room	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Continuous passive motion machine for knee	Patient Room	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Crash cart	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Continuous veno-venous hemodialysis machine	Patient room	After use and between patients	Dialysis	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Defibrillator	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Dialysis machine	Patient room	After use and between patients	Dialysis	Clorox Disinfectant	Clorox Disinfectant	Clorox Disinfectant	Nursing		Mark Complete	Reset
Doorknob	Patient room	Daily and discharge	EVS	Dimension 11	Dispatch Disinfectant	Dispatch Disinfectant	EVS		Mark Complete	Reset
Doppler	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Dinamap	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
EKG machine	Hospitalwide	After use and between patients	EKG technician	Disinfectant wipes	Disinfectant wipes	Per department policy	Nursing		Mark Complete	Reset
Epidural pump	Unit	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset

External pacemaker	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Extracorporeal membrane oxygenation machine	Patient room	Daily and discharge	Respiratory care	Disinfectant wipes without alcohol	Disinfectant wipes	Per department policy	Nursing		Mark Complete	Reset
Feeding pump	Patient room	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Floor	Patient room	Daily and discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Glucometer	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Gomco suction container	Unit	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Hallway computer	Unit	Daily and discharge	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Hallway handrails	Unit	Daily	EVS	Dimension 11	Dispatch disinfectant	N/A	EVS		Mark Complete	Reset
Heating blanket machine	Patient room	After use and between patients or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Hover jack unit	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Hover mat	Unit	After use and between patients unless disposable	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Hoyer pad	Unit	After use and between patients unless disposable	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Intermittent sequential compression device	Patient room	Daily and discharge	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Isolation cart	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
IV poles w/ or w/o pump	Patient room	Daily and discharge or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Kitchen	Unit	Daily	Nursing or EVS	Disinfectant wipes	Disinfectant wipes	N/A	Nursing or EVS		Mark Complete	Reset
Linen hamper in hallway	Unit	Daily	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Medication administration check (MAK) machine	Unit	Daily	Nursing or EVS	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Medication pumps with pole	Patient room	Daily and discharge or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Dispatch disinfectant	Nursing		Mark Complete	Reset
Medication refrigerator	Unit	Weekly	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Medication room	Unit	Daily	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Medication storage and dispensing machine (external)	Unit	Daily	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Medication storage and dispensing machine (internal)	Unit	Quarterly	Pharmacy	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Monitoring cables and wire	Patient room	Daily and discharge	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Nurses' station	Unit	Daily	EVS	Dimension 11	N/A	N/A	EVS		Mark Complete	Reset
Nursing station computer	Unit	Daily	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Oxygen flowmeter	Patient room	Daily and discharge	Respiratory care	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Oxygen sensor	Unit	After use and between patients unless disposable	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Pacemaker cable	Patient room	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Patient-controlled analgesia pump	Patient room	Daily and discharge or send to CSD	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Patient lift	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset

Patient thermometer	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Portable BiPAP machine	Patient room	After use and between patients	Respiratory care	Disinfectant wipes	Disinfectant wipes	Per department policy	Nursing		Mark Complete	Reset
Portable pulse-oximeter	Patient room	After use and between patients unless disposable	Nursing	Disinfectant wipes	Disinfectant wipes	Return to CSD	Nursing		Mark Complete	Reset
Portable X-ray machine	Hospitalwide	After use and between patients	Radiology technician	Disinfectant wipes	Disinfectant wipes	Per department policy	Radiology		Mark Complete	Reset
Recliners	Patient room	Daily and discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Respiratory therapy equipment	Patient room	Daily and discharge	Respiratory care	Disinfectant wipes	Disinfectant wipes	Per department policy	Respiratory care		Mark Complete	Reset
Scale	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Seizure pad	Patient room	Daily and discharge	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Side rails	Patient room	Daily and discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Sit to stand	Patient room	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Stretchers	Hospitalwide	After use and between patients	Transport	Disinfectant wipes	Disinfectant wipes	Per department policy	Transport		Mark Complete	Reset
Suction canister wall mount	Patient room	Discharge	EVS	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Telephone	Unit and Patient room	Daily and discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Toys	Units	After use and between patients	Child life	See Toy policy	See Toy policy	See Toy policy	Child life		Mark Complete	Reset
Transfer board	Unit	After use and between patients	Nursing	Disinfectant wipes	Disinfectant wipes	Disinfectant wipes	Nursing		Mark Complete	Reset
Trash	Patient room	Daily and discharge	EVS	Dimension 11	Dispatch disinfectant	Dispatch disinfectant	EVS		Mark Complete	Reset
Unit staff refrigerator	Unit	As needed	Nursing	Disinfectant wipes	Disinfectant wipes	N/A	Nursing		Mark Complete	Reset
Ventilator	Patient room	Daily and discharge	Respiratory care	Disinfectant wipes	Disinfectant wipes	Per department policy	Respiratory care		Mark Complete	Reset
Video laryngoscope	ICU	After use and between patients	ICU Fellows	N/A	Disinfectant wipes	N/A	Fellows		Mark Complete	Reset
Walker	Patient room	Daily and discharge	Rehab	Disinfectant wipes	Disinfectant wipes	Per department policy	Rehabilitation medicine		Mark Complete	Reset
Wheelchair	Hospitalwide	After use and between patients	Transport	Disinfectant wipes	Disinfectant wipes	Per department policy	Transport		Mark Complete	Reset