CLOROX HEALTHCARE™

Bleach-Based Disinfectants in Healthcare Settings

Summary of Clinical Evidence

CLOROXPRO™

TABLE OF CONTENTS:

Implementation of a series of interventions that included enhanced and supervised cleaning of CDI rooms with Clorox Healthcare® Bleach Germicidal Wipes and UV disinfection resulted in a dramatic reduction in *C. difficile* contamination.

Practice + Product = Perfection. A sporicidal disinfectant such as bleach is preferred in *C. difficile*-infected rooms but educating staff on their correct use is important.

III. The value of ready-to-use disinfectant products

Use of ready-to-use Clorox Healthcare® Bleach Germicidal Wipes significantly increases compliance, reduces the time to clean, ensures surfaces are wet for the contact time, and can potentially saves costs.

IV. Patient and staff satisfaction with bleach wipes

Clorox Healthcare® Bleach Germicidal Wipes can be used for daily and discharge cleaning of patient rooms with little impact on patient and staff satisfaction

I. The use of bleach on surfaces to address *Clostridium difficile* infections and contamination

Twice daily disinfection of high-touch surfaces and terminal cleaning of patient rooms with chlorine-based products as part of a bundled approach were found to be the most effective interventions, resulting in a 45% to 85% reduction in *C. difficile* infections (CDI).

Systematic review

Purpose:
To evaluate studies published since 2009 that investigated the impact of interventions on CDI rates in acute care hospitals.

Methods:
A search of Ovid, MEDLINE, EMBASE, The Cochrane Library, CINAHL, the ISI Web of Knowledge, and grey literature databases from January 1, 2009 to August 1, 2015. The quality of studies was assessed using QI-Minimum Quality Criteria Set (QI-MQCS). Interventions were grouped thematically and meta-analyses performed where possible.

Results:
Of the 3326 studies screened, 46 were ultimately included. The QI-MQCS score averaged 82%.

Twice daily disinfection of high-touch surfaces (including bed rails) and terminal cleaning of patient rooms with chlorine-based products were found to be the most effective interventions, resulting in a 45% to 85% reduction in CDI. Antimicrobial stewardship and the bundling of interventions also showed promise, but chlorhexidine bathing and intensified handwashing programs were not effective.

Reference:
Louh IK**,** Greendyke WG, Hermann EA, et al. Clostridium Difficile Infection in Acute Care Hospitals: Systematic Review and Best Practices for Prevention. Infection Control and Hospital Epidemiology, 2017; 38(4):476-482.

Routine use of Clorox Healthcare® Fuzion Cleaner Disinfectant, a spray formulation of bleach in non-*C. difficile* infection rooms reduces *C. difficile* spore contamination

Facility: Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH

Purpose:
To measure *C. difficile* spore contamination in non-*C.difficile* infection (CDI) patient rooms when a quaternary ammonium chloride (quat) disinfectant was used to clean, and test the hypothesis that routine use of Clorox Healthcare Fuzion Cleaner Disinfectant would reduce contamination

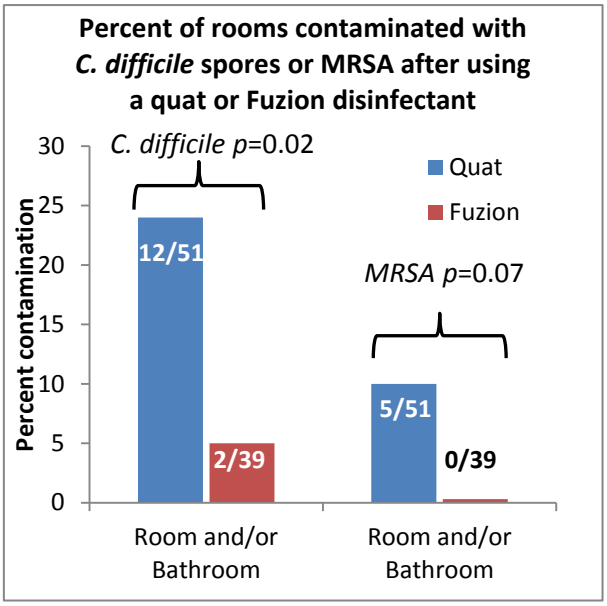
Methods:
Prior to May 1, 2018, *C. difficile* spore and MRSA contamination on high touch surfaces in in non-CDI patient rooms and bathrooms was measured when a quat disinfectant was used for postdischarge cleaning and disinfection. After May 1, 2018, non-CDI rooms were cleaned with Clorox Healthcare® Fuzion Cleaner Disinfectant and *C. difficile* spore and MRSA contamination measured. The efficacy of Fuzion against *C. difficile* spores was measured along with Clorox Healthcare® Bleach Germicidal Wipes (0.65% sodium hypochlorite), and Diversey Avert Sporicidal Disinfectant Cleaner (1.31% sodium hypochlorite) using the AOAC International Germicidal Spray Products as Disinfectants test (AOAC 961.02).* Ten EVS personnel were surveyed regarding their opinion of odor and residue on surfaces of products.

Results:
For *C. difficile* contamination, use of Fuzion resulted in a statistically significant reduction in the proportion of rooms contaminated from 24 % (12/51 with quat) to 5% (2/39 with Fuzion).

For MRSA contamination, when the quat disinfectant was used, 10% (5/51 rooms and/or bathrooms) were contaminated. When Fuzion was used, there was a non-significant trend towards a reduction in contamination (0%, 0/39 rooms, p=0.07).

All three disinfectants killed ≥6log$_{10}$ *C. difficile* spores in the in vitro test.

All ten EVS personnel noted that Fuzion left less residue than the other bleach products, and that this was an advantage. Four of the ten noted that Fuzion had a more tolerable odor than the other products.



The use of sporicidal disinfectants on surfaces for all postdischarge room disinfection might be helpful in reducing the risk for *C. difficile* transmission from contaminated surfaces.

Reference:

Ng Wong YK, Alhmidi H, Mana TSC, Cadnum JL, Jencson AL, Donskey CJ. Impact of routine use of a spray formulation of bleach on Clostridium difficile spore contamination in non-C difficile infection rooms. American Journal of Infection Control, 2019 Jan 31. pii: S0196-6553(18)31205-7.

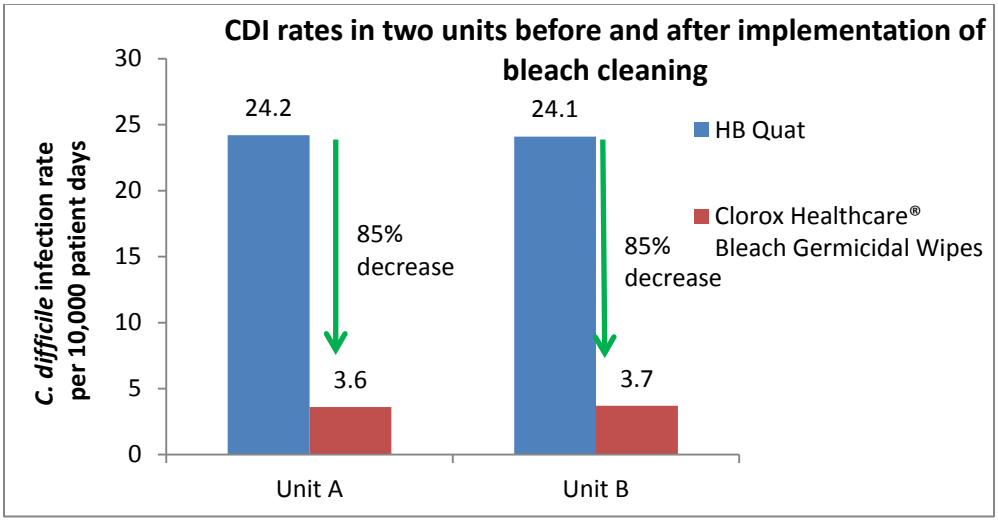
Implementation of daily and discharge cleaning with Clorox Healthcare® Bleach Germicidal Wipes on surfaces, as part of an intervention bundle, resulted in an 85% decrease in CDI rates.

Facility: St. Mary's Hospital, Rochester, MN

Purpose:
Determine whether a targeted surface-cleaning strategy using bleach-based wipes could reduce rates of Clostridium difficile infection (CDI) incidence on two units of a 1,249-bed hospital where CDI was highly endemic.

Methods:
In the two hospital units, a before and after intervention was performed. The intervention compared CDI rates between a 12 month period of daily and discharge patient room cleaning using a quat disinfectant (HB-Quat) and a 12 month period of daily and discharge cleaning with 0.55% (5500ppm) Clorox Healthcare Bleach Germicidal Wipes.

Results:
In each unit, implementation of bleach surface cleaning protocol resulted in an 85% decrease in CDI rates, from around 24 cases per 10,000 patient days to just under 4 cases per 10,000 patient days.



The median time between hospital-acquired CDI cases increased from 8 to 80 days. The unit with the highest rate of CDI incidence in the hospital went 318 days without a hospital acquired case. The seven-fold reduction in the rate of hospital-acquired CDI meant that 27 cases of CDI were averted in the 12 month intervention period. $135,000 to $216,000 of excess costs were averted (assuming an incremental cost of a hospital-acquired CDI of $5,000 to $8,000).

Reference:
Orenstein R, Aronhalt KC, McManus JE, Fedraw LA. A Targeted Strategy to Wipe out Clostridium Difficile." Infection Control and Hospital Epidemiology 2011; 32(11):1137–1139.

Implementation of a three-part bundle that included the use of a ready-to-use bleach disinfecting solution on surfaces led to a 40% reduction that was sustained for 21 months.

Facility: Brigham and Women's Hospital, Boston, MA.

Purpose:
To evaluate prevention and treatment bundles to decrease the incidence of CDI and the mortality associated with CDI

Methods: A three part intervention consisting of an educational campaign, a prevention bundle, and a treatment bundle was implemented. Bundle interventions were aligned with guidelines from the Society of Healthcare Epidemiologists and the Infectious Disease Society of America. The prevention bundle included cleaning the rooms of *C. difficile* patients who were on contact precautions with a bleach-based cleaning and disinfecting agent.*

Results:
Implementation of the program led to a decrease in *C. difficile* cases from 1.1 to 0.66 cases per 1,000 patient days, a 40% reduction that was sustained for 21 months, despite the hospital recording an increase in Charlson morbidity scores.

Checklists to ensure that bundle interventions were identified as a simple tool to help hospitals tackle *C. difficile* and the authors described a number of ways to increase their use and value.

Reference:
Abbett SK, Yokoe DS, Lipsitz SR, Bader AM, Berry WR, Tamplin EM, Gawande AA. Proposed Checklist of Hospital Interventions to Decrease the Incidence of Healthcare-Associated Clostridium Difficile Infection. Infection Control and Hospital Epidemiology 2009; 30(11):1062–1069.

Implementation of routine bleach cleaning on surfaces as part of an infection control bundle resulted in a 61% decrease in the rate of *C. difficile*-associated diarrhea.

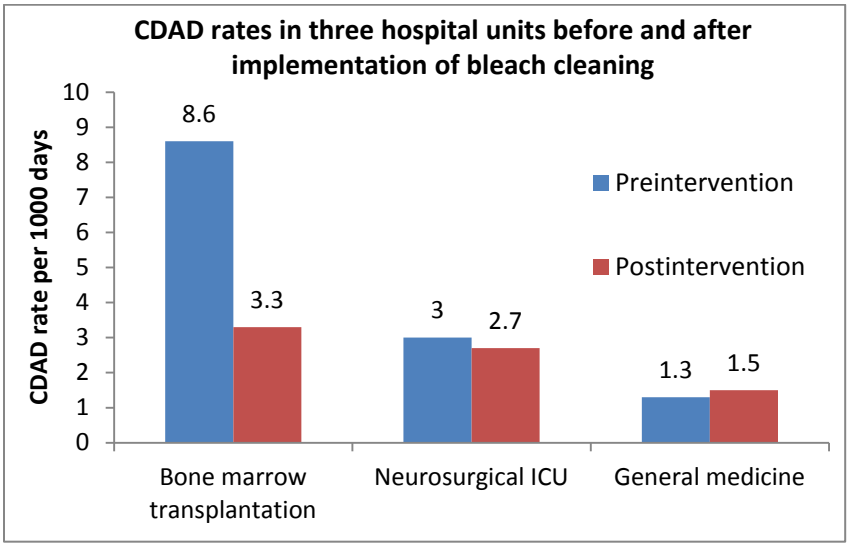
Facility: Barnes-Jewish Hospital, St. Louis, MO.

Purpose:
To evaluate whether the routine use of hypochlorite (bleach) solution on surfaces can reduce the incidence of *C. difficile*-associated diarrhea (CDAD) in hospital units.

Methods:
Using a before and after design, patient rooms in the bone marrow transplantation unit, the neurosurgical intensive care unit (ICU), and a general medicine unit were routinely cleaned with a quaternary ammonium solution for nine months, followed by nine months routine cleaning with a 1:10 dilution of hypochlorite (bleach) solution. Patients were evaluated for the presence of CDAD and disease rates were adjusted for other potential risk factors.

Results:
In the bone marrow transplant unit, implementation of routine bleach cleaning resulted in a statistically significant 61% decrease in the CDAD rate. No decrease was observed in the other two units which had much lower baseline CDAD rates.

When the original quaternary ammonium disinfectant was reinstated in the bone marrow transplantation unit, the CDAD rate increased back to the pre-intervention levels. However, implementing bleach cleaning again reduced the rate to 3.1 per 1000 patient days.



Following the study, the hospital implemented routine bleach cleaning in all units with CDAD rates ≥3 per 1000 patient days.

Reference:
Mayfield, JL, et al. Environmental Control to Reduce Transmission of Clostridium Difficile. Clinical Infectious Diseases, 2000; 31(4):995–1000.

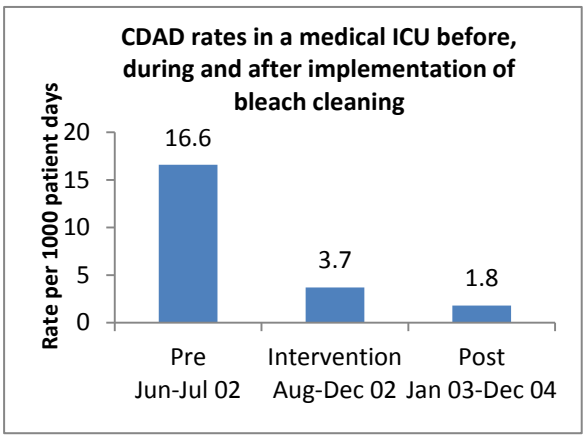
Implementation of bleach cleaning protocols as part of a multifaceted approach was associated with an almost 80% decrease in *C.difficile*-associated diarrhea incidence rates.

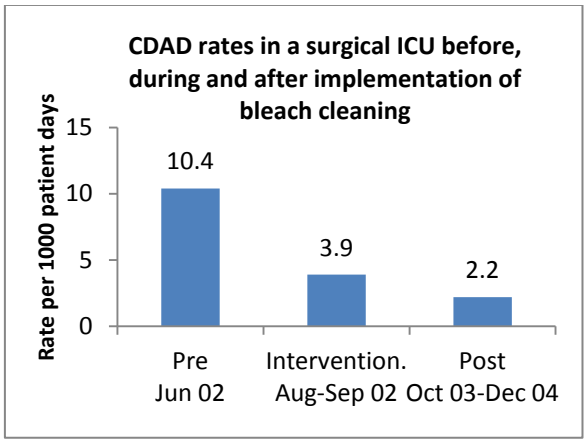
Faciity: Barnes-Jewish Hospital, St. Louis, MO.

Purpose:
To evaluate the impact of environmental disinfection with hypochlorite (bleach) on units that had experienced increases in *C. difficile*-associated diarrhea (CDAD) rates.

Methods:
In the medical ICU, patient rooms, the nursing station, conference room, waiting rooms were cleaned with 1:10 dilution of household bleach (5000ppm). Medical equipment was cleaned with a bleach wipe (Hype-Wipe, ca. 1:10 dilution). After five months, only rooms of CDAD patients were cleaned with bleach. In the surgical ICU, CDAD patient rooms and equipment bleach was used for two months.

Results:
Implementation of the bleach cleaning protocols was associated with an almost 80% decrease in CDAD incidence rates which was sustained over a two year post-intervention period.





The use of bleach may be effective at reducing CDAD in situations where the disease is endemic or hyperendemic, such as during an outbreak.

Reference:
Mullen KM, et al. “Use of Hypochlorite Solution to Decrease Rates of Clostridium Difficile-Associated Diarrhea.” Infection Control and Hospital Epidemiology, 2007; 28(2):205–207.

C. difficile rates and associated mortality decreased following the implementation of a series of multidisciplinary interventions, including enhanced environmental disinfection with Dispatch Bleach Disinfectant

Facility: Rhode Island Hospital, Providence, RI.

Purpose:
To evaluate the impact of a multidisciplinary approach to reduce the risk of *C. difficile* infections

Methods:
The hospital implemented a five-year *C. difficile* infection control plan consisting of six major interventions. The plan included infection-control education for healthcare workers and EVS staff and enhanced daily and discharge cleaning of patient rooms with bleach-based products including Dispatch Disinfectant.* After one year, bleach cleaning was expanded to all rooms instead of just isolation rooms. An equipment-cleaning index to assign cleaning and disinfection responsibilities was also developed.

Results:
By Q3 2012, the CDI rate had decreased 70% from its peak of 12.2 cases per 1000 discharges to 3.6 cases per 1000 discharges in Q2 2006.

In 2011, the yearly mortality of patients with hospital-acquired *C. difficile* had decreased by 64% to 19, from its peak of 52 in 2006.

The results suggest that *C. difficile* rates could be decreased with the implementation of a series of multidisciplinary interventions, including enhanced environmental disinfection.

* Clorox Healthcare note: Dispatch Bleach Disinfectant (0.65% sodium hypochlorite, 6500ppm) is now marketed as Clorox Healthcare® Bleach Germicidal Cleaner.

Reference:
Mermel LA, Jefferson J, Blanchard K, Parenteau S, Mathis B, Chapin K, Machan JT. Reducing Clostridium difficile Incidence, Colectomies, and Mortality in the Hospital Setting: A Successful Multidisciplinary Approach. Joint Commission Journal on Quality and Patient Safety, 2013; 39(7): 298-305.

A collaborative multifaceted approach to prevent *C. difficile* infection (CDI) resulted in a significant reduction in the mean hospital-onset CDI rate and up to $6.8 million in cost savings

Facilities: 35 acute care hospitals in the New York Metropolitan area.

Purpose:
To evaluate a collaborative multifaceted approach to prevent *C. difficile* infection (CDI) in acute care hospitals in the New York metropolitan area over 22 months.

Methods:
Each hospital joining the Collaborative established an interdisiciplinary team comprising of IPs, physician and nurse champions, and EVS and transport support staff to drive CDI reduction efforts. A steering committee guided the Collaborative. A two-component *C. difficile* bundle was implemented in each hospital:

I. The Infection Prevention Bundle included contact precautions for patients with diarrhea, adherence to hand hygiene protocol, isolating or cohorting for CDI (confirmed or suspected) patients,

II. The Environmental Cleaning Bundle included standardized daily and terminal cleaning of high-touch surfaces in patient rooms and bathrooms, with a hypochlorite–based disinfectant and other standard protocols.

CDI rates were calculated for four definitions of cases (1) hospital-onset, hospital-associated ("hospital-onset"), (2) nonhospital-associated, (3) community-onset, hospital-associated, and (4) recurrent CDI. Bundle and environmental checklist compliance data were obtained through direct observation using the checklists.

Results:
Compliance with the protocols in each bundle was ≥95%. A significant reduction in the mean hospital-onset CDI rate was observed during the study. Hospitals that reported the highest CDI rates at the project's start generally demonstrated the greatest reductions of up to 50%. Significant reductions in the rates of the other types of CDI cases were not observed. There were an estimated 1,084 fewer cases of hospital-onset CDI than expected. Total cost savings for the Collaborative were estimated at $2.7 to $6.8 million based on costs attributable to *C. difficile.*

Reference:
Koll BS, Ruiz RE, Calfee DP, Jalon HS, Stricof RL, Adams A, Smith BA, Shin G, Gase K, Woods MK, Sirtalan I. Prevention of hospital-onset Clostridium difficile infection in the New York metropolitan region using a collaborative intervention model. Journal of Healthcare Quality, 2014; 36(3):35-45.

II. The importance of education, training, supervision and correct use of bleach products

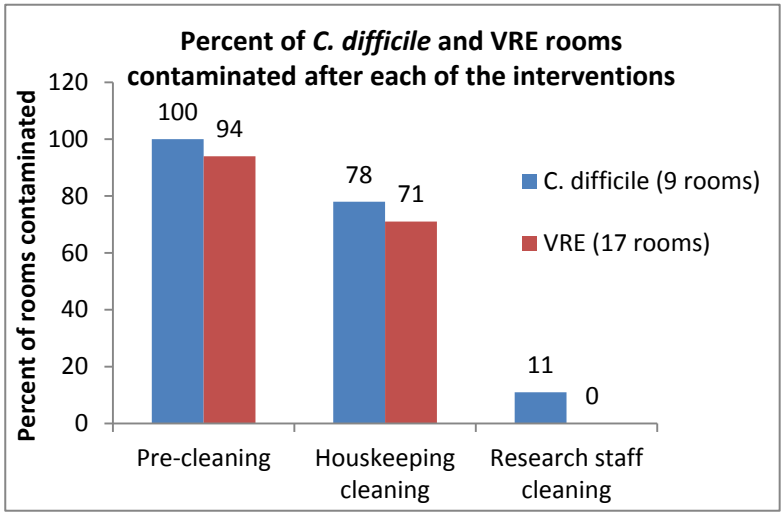
Simple educational interventions for housekeeping staff on the importance of environmental cleaning, assessing cleaning, and providing feedback can result in improved decontamination of environmental surfaces

Facility: Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH.

Purpose:
To assess the adequacy of cleaning practices in rooms of patients with CDAD and vancomycin-resistant *Enterococcus* (VRE) colonization or infection after implementation of two cleaning methods.

Methods:
Cultures were taken from commonly touched surfaces (i.e., bedrails, telephones, call buttons, door knobs, toilet seats and bedside tables) in rooms of patients with CDAD and VRE colonization or infection at three timepoints: (1) before housekeeping cleaning; (2) after housekeeping cleaning with 10% bleach (Sunstorm, State Chemical) (CDI rooms) and quaternary ammonium chloride (HDQ Neutral) solutions (VRE rooms); (3) after research staff cleaned with ready-to-use Dispatch Disinfectant (now Clorox Healthcare® Bleach Germicidal Cleaner)(CDI and VRE rooms). Housekeeping staff then received education on environmental cleaning and feedback, and during a 10 week follow-up period, additional cultures were collected before and after cleaning.

Results:
Rooms with VRE and CDI patients were still heavily contaminated after cleaning by housekeeping staff. Contamination was further reduced to zero (VRE rooms) or 11% (CDI rooms) after cleaning by research staff. Both Sunstorm and Dispatch Disinfectant were shown in the lab to kill *C. difficile.* After the educational intervention was administered to housekeeping staff, the low rates of environmental contamination observed after cleaning by research staff were maintained when rooms were cleaned by housekeeping.



Simple educational interventions for housekeeping staff on the importance of environmental cleaning, assessing cleaning, and providing feedback can result in improved decontamination of environmental surfaces.

Reference:
Eckstein BC, Adams DA, Eckstein EC, Rao A, Sethi AK, Yadavalli GK, Donskey CJ. Reduction of Clostridium difficile and vancomycin-resistant Enterococcus contamination of environmental surfaces after an intervention to improve cleaning methods. BMC Infectious Diseases, 2007 Jun 21;7:61.

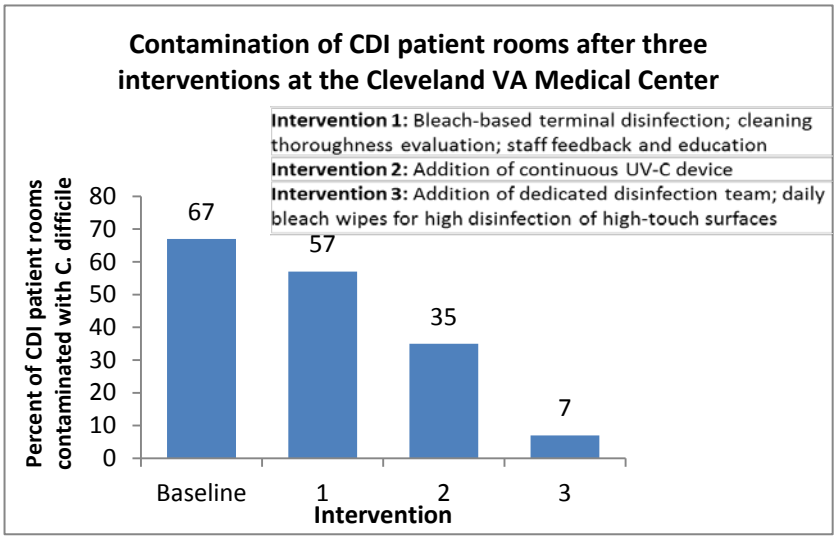
Implementation of a series of interventions that included enhanced and supervised cleaning of CDI rooms with Clorox Healthcare® Bleach Germicidal Wipes and UV disinfection resulted in a dramatic reduction in *C. difficile* contamination

Facility: Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH.

Purpose:
To evaluate the impact of sequential cleaning and disinfection interventions implemented in a hospital.

Methods:
Three sequential tiered interventions were implemented during a 21 month period: (1) fluorescent markers to assess thoroughness of cleaning; (2) the addition of an ultraviolet disinfection device for CDI rooms; (3) the addition of enhanced daily cleaning and supervised terminal cleaning of CDI rooms using Clorox Healthcare Bleach Germicidal Wipes. Cultures were sampled from CDI rooms after cleaning and disinfection

Results:
The fluorescent marker intervention improved the thoroughness of cleaning of high-touch surfaces (from 47% to 81% marker removal), relative to the baseline period. During the baseline period, 67% of CDI rooms had positive cultures after disinfection. After interventions 1, 2 and 3 the percentages of CDI rooms, this decreased by 57%, 35% and 7%, respectively. This represents reductions in the prevalence of positive cultures from CDI rooms of 14%, 48% and 89% for interventions 1, 2 and 3, respectively.



An intervention that included formation of a dedicated daily disinfection team and implementation of a standardized process for clearing CDI rooms that included bleach cleaning achieved consistent CDI room disinfection. Culturing provides a valuable tool to drive improvements in environmental disinfection.

Reference:
Sitzlar B, Deshpande A, Fertelli D, Kundrapu S, Sethi AK, Donskey CJ. An environmental disinfection odyssey: evaluation of sequential interventions to improve disinfection of Clostridium difficile isolation rooms. Infection Control and Hospital Epidemiology, 2013; 34(5):459-65.

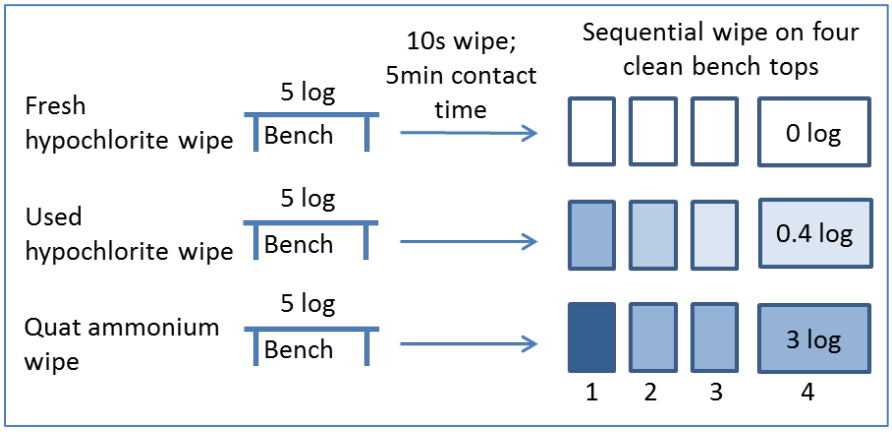
Practice + Product = Perfection. A sporicidal disinfectant such as bleach is preferred in *C. difficile*-infected rooms but educating staff on their correct use is important.

Location: Laboratory study

Purpose:
To investigate the potential for cross-contamination of *C. difficile* spores onto clean surfaces by improper use of disinfectant wipes during regular cleaning process.

Methods:
Clorox Healthcare® Bleach Germicidal wipes (0.55% sodium hypochlorite) and Virex® II 256 quaternary ammonium chloride disinfectant saturated onto Kimtech wipes (Kimberly Clark®) were tested against laboratory *C. difficile* strain VA-17 under varying conditions (i.e., fresh or used Clorox Healthcare® Bleach Germicidal Wipe; Kimtech wipe saturated with disinfectant or water).

A bench top pre-inoculated with 5 $\log_{10}$ *C. difficile* was manually wiped with each of wipes for 10 seconds. The same wipe was then used to wipe a clean bench top. Each bench-top (inoculated and clean) was allowed 5 minutes of contact time before sampling with a sterile cotton swab.



Results:
Use of fresh (i.e., pre-moistened) Clorox Healthcare® Bleach Germicidal Wipes on surfaces consistently reduced *C. difficile* spores to undetectable levels on the inoculated bench-top after 5 minutes of contact time, with no transfer to clean bench tops. A used hypochlorite wipe left 0.4 $\log_{10}$ *C. difficile* spores on the fourth bench top. In contrast, large numbers of spores were transferred to all four sequential clean sites by wipes moistened with Virex® II 256 disinfectant quat ammonium wipe, with 3 $\log_{10}$ measured on the fourth surface.

Use of a sporicidal disinfectant such as bleach on surfaces is preferred in *C. difficile*-infected rooms but correct practices are essential to ensure proper decontamination.

Reference:
Cadnum JL, Hurless KN, Kundrapu S, Donskey CJ. Transfer of Clostridium difficile spores by nonsporicidal wipes and improperly used hypochlorite wipes: practice + product = perfection. Infection Control and Hospital Epidemiology, 2013; 34(4):441-2.

III. The value of ready-to-use disinfectant products.

Use of ready-to-use Clorox Healthcare® Bleach Germicidal Wipes significantly increases compliance, reduces the time to clean, ensures surfaces are wet for the contact time, and can potentially saves costs.

Facility: University of Louisville School of Medicine, Louisville, KY

Purpose:
To evaluate compliance to cleaning protocols when using ready-to-use (RTU) wipes or the bucket method to clean and disinfect (CD) patient rooms, and timeliness and costs of using the RTU wipe method versus the bucket method.

Methods:
Environmental services staff were randomized to use either ready-to-use (RTU) wipes or the bucket method with the same sodium hypochlorite cleaner/disinfectant solution in each.

Participants were asked to clean and disinfect 6 sites in a number of patient rooms. Designated sites were marked with invisible fluorescent marker without the employee's knowledge to measure compliance based on removal of a residual fluorescent marker viewable under an ultraviolet light. Compliance points were awarded; 0 points for no removal, 1 point for partial removal, and 2 points for complete removal for a total of 12 points.

Time to clean, and the time a surface stayed wet after application of the disinfection (up to 10 mins) was measured. Time-related cost savings were calculated based on an employee cleaning 15 rooms per day, allowing 20 minutes per room, and at an employee wage of $10 per hour.

Results:
The RTU disinfectant wipe product provided operational benefits over the bucket method. There was significantly higher compliance with cleaning and disinfection (CD) processes (10.6 vs 8 compliance points respectively) and it took significantly less time to complete the CD process (178 seconds vs 231 seconds).

Surfaces wiped with the RTU wipes remained wet for more than 10 minutes (surpassing all contact time), compared to four minutes for the bucket method. Potential time-related cost savings from using the wipes were estimated at $38.58 per employee per day.

This study demonstrates that the use of RTU wipes on surfaces significantly increases compliance with CD practices, reduces the CD time for a patient room, ensures longer surface wetness times, and can potentially saves costs. A more rapid CD process can assist the facility with prompt patient transfers and/or admissions.

Reference:
Wiemken TL, Curran DR, Pacholski EB, Kelley RR, Abdelfattah RR, Carrico RM, Ramirez JA. The value of ready-to-use disinfectant wipes: compliance, employee time, and costs. American Journal of Infection Control, 2014; 42(3):329-30.

IV. Patient and staff satisfaction with bleach wipes

Clorox Healthcare® Bleach Germicidal Wipes can be used for daily and discharge cleaning of patient rooms with little impact on patient and staff satisfaction

Facility: Mayo Clinic, Rochester, NY.

Purpose: To assess the satisfaction of patients and environmental service (EVS) staff with bleach wipes used to clean CDI patient rooms as part of a "Wipe Out" *C. difficile* project on medical and hematology/oncology units.

Methods:
EVS staff were trained in the use of bleach wipes containing 0.55% sodium hypochlorite (5,500 ppm) for daily and terminal patient room cleaning of high-touch surfaces in all rooms in five patient care units. Training included education, competency and verification, disinfecting process design, and surface hygiene testing. Patients and EVS staff were surveyed before and after the implementation of the intervention to assess satisfaction and tolerance of the bleach wipe product used during room cleaning.

Results:
Amongst patients, 91% were very satisfied with how well their rooms were cleaned every day. Bleach wipes were well-tolerated by 100% of patients surveyed on the medical units and less well-tolerated by patients (22%) on the hematology-oncology units.

EVS staff (N=6) reported less satisfaction and more respiratory irritation from using the bleach wipes; however, later their satisfaction improved.

Bleach wipes can be used for both daily and discharge cleaning of patient rooms with little impact on patient or staff satisfaction.

Reference: Aronhalt KC, McManus J, Orenstein R, Faller R, Link M. Patient and environmental service employee satisfaction of using germicidal bleach wipes for patient room cleaning. Journal of Healthcare Quality, 2013; 35(6):30-6.