

Background. An estimated 293,300 healthcare-associated cases of *Clostridium difficile* infection (CDI) occur annually in the United States. Prior research on risk-prediction models for CDI have focused on a small number of risk factors with the goal of developing a model that works well across hospitals. We hypothesize that risk factors are, in part, hospital-specific. We applied a generalizable machine learning approach to discovering, or “learning”, hospital-specific risk-stratification models using electronic health record (EHR) data collected during the course of patient care from the Massachusetts General Hospital (MGH) and the University of Michigan Health System (UM).

Methods. We utilized EHR data from 115,958 adult inpatient admissions from 2012–2014 (MGH) and 258,050 adult inpatient admissions from 2010–2016 (UM) (Fig 1). We extracted patient demographics, admission details, patient history, and daily hospitalization details, resulting in 2,964 and 4,739 features in the MGH and UM models, respectively. We used L2 regularized logistic regression to learn the models and measured the discriminative performance of the models on a year of held-out data from each hospital.

Results. The MGH and UM models achieved AUROCs of 0.74 (CI: 0.73–0.75) and 0.77 (CI: 0.75–0.80), respectively. The relative importance of risk factors varied significantly across hospitals. In particular, in-hospital locations appeared in the set of top risk factors at one hospital and in the set of protective factors at the other. On average, both models were able to predict CDI five days in advance of clinical diagnosis (Fig 2).

Conclusion. We used EHR data to generate a daily estimate of the risk of CDI for each inpatient hospitalization. We applied a generalizable data-driven approach to existing data from two large institutions with different patient populations and different data formats and content. In contrast to approaches that focus on learning models that apply generally across hospitals, our proposed approach yields risk stratification models tailored to an institution's EHR system and patient population. In turn, these hospital-specific models could allow for earlier and more accurate identification of high-risk patients.

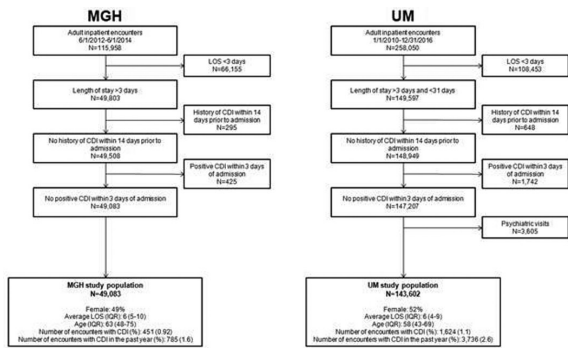


Fig. 1. Inclusion/Exclusion Criteria and Demographics of Study Populations. The inclusion/exclusion criteria for the study population at each institution are shown above, along with the demographics of the final study populations. The time frame for inclusion, length of stay duration requirements, and level of visit differed slightly between study populations. The same exclusion criteria were applied with regards to history of CDI within 14 days prior to admission and positive CDI within 3 days of admission for both study populations. The final study populations comprised of 49,807 and 143,602 adult inpatient encounters at MGH and UM, respectively.

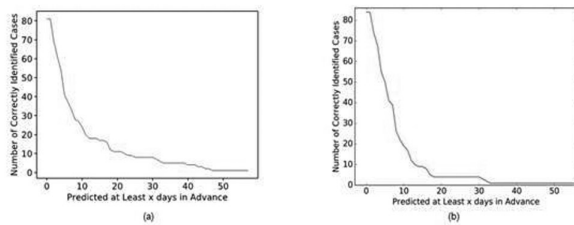


Fig. 2. Model Prediction of CDI in Advance. At a decision threshold based on the 99th percentile of daily risk, both the MGH and UM models achieve a sensitivity and specificity of approximately 30% and 90%, respectively. At this threshold, the figures above show the number of days each model is able to predict a positive CDI in advance of clinical diagnosis against the number of correctly identified cases of CDI. Both the MGH (a) and UM (b) models are capable of predicting the outcome well in advance.

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1314. *C. difficile* Screening for Colonization among Surgical Ward Admissions Is Feasible and Useful

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Background. Identification of patients colonized with *C. difficile* (CDcol) upon admission and initiation of precautions has been shown to decrease hospital-acquired *C. difficile* infection (HA-CDI) in a recent study. We implemented a quality improvement program screening new admissions to a surgical service and evaluated risk factors and outcomes associated with CDcol.

Methods. Prospective cohort of all patients admitted to the surgical wards including ICU over a 6 month period 10/16–4/17. Upon admission, a perirectal swab was sent for *C diff* PCR. Patients with positive screens were placed on contact precautions. CDcol patients were not treated. Testing for CDI was done as usual practice only in patients with diarrhea. Main outcome was prevalence of CDcol and relationship to HA-CDI.

Results. Of 708 surgical admissions, 585 (82.6%) patients were screened, 543 were eligible based on first admission; 19 (3.5%) were colonized. Recent surgical hospitalization (OR 13.2, 95% CI 3.4;52.1) and prior CDI (OR 19.5, 95% CI 2.9;127.7) were independent risk factors for CDcol. Antibiotic and PPI use were not associated. Of those with CDcol, 7 developed CDI (36.8%) compared with 5/524 (0.9%) screen negative patients (adj OR 60, 95% CI 12.6;286). CDcol combined with a prior h/o CDI allowed for detection of 8/12 (75%) cases of HA-CDI compared with 3/12 (25%) if only prior history was available. HA-CDI rates on surgical wards after one month post-implementation were 9.3/10,000 bed days of care compared with 12.2 in 2016 and 12.8 in 2015. No delays in bed flow were identified.

Conclusion. Admission CDcol prevalence was low in our surgical VA population but was strongly associated with development of HA-CDI. Prior CDI was the strongest risk factor for CDcol and HA-CDI. Knowledge of prior CDI and CDcol status identified 75% of patients who developed CDI, 3 times more than knowledge of prior CDI alone. In certain settings, CDcol screening could improve detection and early isolation of potential CDiff spreaders. Implementation required significant support from administration, nursing and the laboratory, and was successful based on screening percentage without impact on bed flow. Impact on facility CDI rates remains to be fully demonstrated.

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1315. Optimizing Environmental Hygiene to Successfully Decrease *Clostridium Difficile* Transmission

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Background. In light of the challenges involved in reducing healthcare onset *colstridium Difficile* infection (HO-CDI), we implemented a multifaceted hospital wide intervention program to optimize environmental hygiene in our 197 bed regional referral hospital.

Methods. Following an 18 month period during which HO-CDI rates were monitored, we simultaneously replaced routine quaternary ammonium cleaning of patient rooms with an environmentally non-damaging sporicidal peroxyacetic acid/hydrogen peroxide disinfectant, implemented an educational program for environmental services staff which included ongoing objective monitoring of the thoroughness of disinfection cleaning (TDC). We also evaluated cleaned environmental surface bioburden elimination, terminal room cleaning efficiency and HO-CDI rates.

Results. During the 33 month intervention period, TDC rapidly improved from 81% to 92% and remained greater than 88% during the remainder of the study ($P = .01$) (Figure 1.) Bioburden elimination of cleaned surfaces improved from 24% to 84% ($P = .03$) with sporadic use. Efficiency of terminal room cleaning improved by 33% (36minutes to 27 minutes) ($P = .02$). HO-CDI rates fell significantly during the intervention period from an average of 8.9 to 3.2 /10,000 patient-days ($P = .0001$, 95% CI 3.48 to 7.81) (Figure 2.) as did months without documented CDI cases ($P .02$). No changes in potential confounders including antibiotic use patterns, intensive care unit days, prevalence density of CDI at the time of admission, hand hygiene compliance rates, isolation practices and over all patient-days were identified.

Conclusion. In the context of a single site, quasi-experimental study design, this 44 month study documented a significant impact ($P = .0001$) of an objectively monitored hospital-wide sporicidal disinfection cleaning program on endemic HO-CDI. The program was also associated with significantly improved efficiency of cleaning and post cleaning bioburden elimination of cleaned patient zone surfaces. Assuming a continued incidence of HO-CDI without intervention, the program resulted in an average non-reimbursed cost savings of approximately \$ 10,000./month during the intervention period.

FIGURE 1.

