Journal of Hospital Infection (2009) **72**, 337–341

Available online at www.sciencedirect.com

ScienceDirect

www.elsevierhealth.com/journals/jhin

Automated system to identify *Clostridium difficile* infection among hospitalised patients

Y. Yadav [a,b], K.W. Garey [a,b,c,*], T.K. Dao-Tran [b], V. Kaila [b], K.Y.E. Gbito [a], H.L. DuPont [a,b,d]

[a] *University of Texas School of Public Health, Houston, Texas, USA*
[b] *St Luke's Episcopal Hospital, Houston, Texas, USA*
[c] *University of Houston College of Pharmacy, Houston, Texas, USA*
[d] *Baylor College of Medicine, Houston, Texas, USA*

Received 4 December 2008; accepted 23 April 2009
Available online 10 July 2009

KEYWORDS
Clostridium difficile infection;
Diarrhoea;
Nosocomial infections;
Risk factors

Summary The purpose of this study was to assess whether data on stool frequency collected electronically could identify patients at high risk for *Clostridium difficile* infection (CDI). All patients with reports of diarrhoea were assessed prospectively for number of stools per day and number of diarrhoea days. *C. difficile* testing was requested independently from study investigators. Number of days with diarrhoea and maximum number of unformed stools was assessed as a CDI predictor. A total of 605 patients were identified with active diarrhoea of whom 64 (10.6%) were diagnosed with CDI. In univariate analysis, the maximum number of stools and number of diarrhoea days was associated with increased risk of CDI. Compared to patients with three diarrhoea stools per day (CDI incidence: 6.3%), CDI increased to 13.4% in patients with four or more diarrhoea stools per day [odds ratio (OR): 2.3; 95% confidence interval (CI): 1.3–4.2; $P = 0.0054$]. Compared to patients with one day of diarrhoea (CDI incidence: 6.3%), CDI increased to 17.4% in patients with two diarrhoea days (OR: 3.1; 95% CI: 1.7–5.6) and to 27.1% in patients with three or more diarrhoea days (OR: 5.5; 95% CI: 2.6–11.7). These results were validated using logistic regression with number of days with diarrhoea identified as the most important predictor. Using an electronic data capture technique, number of days of diarrhoea and maximum number of diarrhoea stools in a 24 h time period were able to identify a patient population at high risk for CDI.

* Corresponding author. Address: University of Houston College of Pharmacy/Texas Medical Center, 1441 Moursund Street, Houston, TX 77030, USA. Tel.: +1 713 795 8386; fax: +1 713 795 8383.
E-mail address: kgarey@uh.edu

0195-6701/$ - see front matter
doi:10.1016/j.jhin.2009.04.017

Introduction

Clostridium difficile is the most common cause of infectious diarrhoea in hospitalised patients and accounts for ~3 million cases of diarrhoea and colitis each year.[1,2] *C. difficile* infection (CDI) is also the most common aetiological cause of antibiotic-associated diarrhoea (AAD), occurring in ~25% of patients with AAD.[3,4] The diagnosis of CDI is generally based on the detection of toxin A and B in faecal samples from subjects with diarrhoea. The tissue culture cytotoxicity assay, which detects toxin B, is considered the 'gold standard' due to its high specificity (99–100%) and sensitivity (80–90%) although immunoassays are more commonly employed due to lower costs and faster results.[5–7]

A number of other factors cause diarrhoea in hospitalised patients including pathological conditions such as ulcerative colitis and Crohn's disease, receipt of enteral nutrition, drugs including antibiotics and oncological agents, and extended hospitalisations.[8] These variables may occur simultaneously in patients, making CDI diagnosis difficult and decisions on who to test for CDI problematic. Up to 50% of patients with diarrhoea and CDI may not be tested for *C. difficile* toxins, probably due to the overlap of other potential causes of diarrhoea. At the same time, ~90% of hospitalised patients that are tested for *C. difficile* toxins test negative for CDI.[9–11] This testing dilemma increases laboratory diagnostics costs, delays eventual diagnosis of CDI, and may also impact on prescribing of empiric therapy directed against *C. difficile*. Based on these past studies, we were interested in creating an electronic network that would enable us to detect patients with diarrhoea that were most likely to test CDI positive. At a 700-bed tertiary care university-affiliated hospital in Houston, Texas, a computerised system of tracking number of stools per day was initiated on all patients hospitalised outside of the intensive care unit (ICU). The purpose of this project was to assess whether use of this system would enable us to correctly identify patients with diarrhoea due to CDI compared to other potential causes. This research may enable increased diagnostic accuracy, improve infection control efforts, may help guide empiric anti-CDI therapy, and could potentially identify patients who should be tested for CDI electronically. The objective of this study was to identify risk factors for CDI in hospitalised patients with diarrhoea, focusing on frequency and duration of diarrhoea.

Methods

The study was carried out at a 700-bed tertiary care teaching hospital at the Texas Medical Center in Houston, Texas, USA between May to September 2007. All patients were admitted for at least 24 h and were aged >18 years. This study was approved by the Institutional Review Board of St Luke's Episcopal Hospital (SLEH).

Evaluation of diarrhoea

Daily stool counts for all non-ICU patients were available via electronic data entered by floor nurses on stool counts. All patients with reports of more than three stools per 24 h were assessed prospectively for diarrhoea. Diarrhoea was defined as three or more loose, unformed bowel movements in the 24 h pre-enrolment. Data collected included the number of diarrhoea stools per day and number of days with diarrhoea.

C. difficile infection

C. difficile testing was requested by the attending physician upon clinical suspicion of CDI independent from study investigators assessing diarrhoea. Patients on broad-spectrum antibiotics experiencing diarrhoea are routinely tested for *C. difficile* toxin. The routine hospital test for *C. difficile* is the tissue culture cell cytotoxicity assay using a fibroblast cell line (Diagnostic Hybrids, Inc., Athens, OH, USA) with antitoxin neutralisation (Tech-Lab, Blacksburn, VA, USA).[12] The clinical microbiology laboratory department at the hospital maintains a database of all *C. difficile* test results (positive and negative) that includes patient demographics, hospital room location, and the date the specimen was collected.

Other collected variables

The information technology department at SLEH provided data on patient demographics (age, gender, race), antibiotic usage during current hospitalisation, requirement for dialysis, central venous catheter, or total parenteral nutrition, mechanical ventilation, surgical procedures, and any ICU admission prior to the evaluation for diarrhoea.

Statistical analysis

The collected data was stored using MS Access (Microsoft Corp., Seattle, WA, USA) and analysed