CONCISE COMMUNICATION

Prospective Validation of Central Line–Days Derived From an Electronic Medical Record System

John M. Boyce, MD;[1,2] George Paci, RN;[1] Carl Feidner;[1] Lori Hubbard, RN;[1] Laurie Devin, RN;[1] Lenore Reilly, RN;[1] Anthony Gentile;[1] Jonathan M. Siner, MD[1,2]

Validation of the number of central line–days by hospitals is required by the National Healthcare Safety Network. A prospective study that compared a daily report of such days generated by an electronic medical record with observational audits by nurses revealed that the report was 100% sensitive and 99.9% specific.

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The Center for Medicare and Medicaid Services requires hospitals to report central line (CL)–associated bloodstream infection rates to the National Healthcare Safety Network as the number of CL-associated bloodstream infections per 1,000 CL-days. To ensure the validity of these rates, the National Healthcare Safety Network publishes criteria for defining CL-associated bloodstream infections and requires hospitals to validate methods used for determining the number of CL-days occurring.[1] Because daily observation of the number of patients with CLs is time consuming, many hospitals are seeking more efficient methods for reliably establishing the number of CL-days in their facility. Currently, there is a paucity of published data regarding the validity of using electronic medical record (EMR) systems to determine the number of CL-days in hospitals.[2–4] As a result, we conducted a study to validate the accuracy of a daily CL-day report generated by an EMR system.

METHODS

A prospective study was conducted at a 1,500-bed hospital that implemented an EMR system (Epic Systems) on its 2 campuses in 2013. Upon implementation of the EMR, infection control personnel visited all intensive care units for 2 weeks to compare ward-based patient-specific nursing documentation on the presence and type of patients' CLs with data documented by nurses in the lines/drains/airways field in each patient's electronic record. At the time of CL insertion, nurses enter data into fields regarding type, location, and laterality of CLs placed. On each shift, nurses review data in the lines/drains/airways field and update information as needed. An EMR report writer developed a daily, automated report listing all inpatients at 6 AM who have one or more CLs, the CL type(s) present, and presence of an arteriovenous fistula on the basis of data in the lines/drains/airways field. Daily EMR reports are reviewed by infection control personnel, patients with only an arteriovenous fistula are excluded, and the number of CL-days is calculated for each day.

To determine the validity of the EMR CL-days report, nurse managers performed audits by observation of each patient on their unit to determine whether patients had one or more CLs present. Nurses were given a printed list of patients on their unit and recorded whether or not each patient had one or more CLs in place. Observational audits by nurses were conducted in the morning on all nursing units except psychiatry units. Audits by nurses were conducted on 8 days over a period of 3 months. Paired audits performed on Mondays and Thursdays of the same week were conducted on 3 occasions (6 audits combined) and on Wednesday and Friday of the same week during another week. A paired Monday-Thursday sampling scheme has been found to yield accurate estimates of CL-days.[5] Nurses forwarded data sheets to Hospital Epidemiology for analysis. The number of CL-days observed by nurses on the 8 audit days was compared with the number of CL-days listed in the EMR reports printed on the same days.

RESULTS

Nursing audits were performed on 57 of the hospital's nursing units located on 2 campuses. Nursing staff did not submit data on 114 patients, who were excluded from the analysis. Also, we excluded 43 patients who were listed on daily EMR reports but for whom observations were not performed because they were not physically present on nursing units as they were undergoing hemodialysis, surgery, or diagnostic examinations at the time of nursing audits. The 8 audits performed by nurses revealed a total of 2,284 patients who had one or more CLs present (range per day, 252–317) and 6,033 patients without a CL. The EMR-generated reports listed a total of 2,288 CL-days (range per day, 255-317) on the 8 days on which nursing audits were conducted. On 6 of the 8 audit days, the number of CL-days listed in the EMR report matched exactly the number of CL-days reported by nurses. On one day, the EMR report listed 255 CL-days while nurse observations revealed 252 patients with one or more CLs (98.8% match). On another day, the EMR report listed 293 CL-days while nurses reported 292 patients with one or more CLs (99.7% match). Overall, of the 2,288 CL-days included in the EMR reports, 2,284 (99.8%) were reported by the nursing audits. All CL-days detected by nursing audits were included in EMR reports. The sensitivity and specificity of the EMR report were 100% and 99.9%, respectively.

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DISCUSSION

Our prospective study to validate the EMR report of the number of CL-days was unique in several respects. In 2007-2008, Wright et al[2] used an early version of the Epic EMR system to estimate CL-days and compared the results with infection preventionist reviews of the medical records of a random sample of patients for the presence of CLs. The infection preventionist reviewed nursing documentation fields, interdisciplinary team notes, laboratory data, and radiology dictations. Unlike our study, no direct observations of patients were performed.

A medical intensive care unit–based study by Hota et al[3] revealed that electronic models based on information in a proprietary clinical data warehouse correlated well with bedside observations of CL-days. A large study by Tejedor et al[4] compared the accuracy of CL reports generated from nursing documentation in a different EMR system (Cerner) with data obtained by nurses who initially conducted bedside observational audits 5 times a week, and then several times per month. Unlike in our study, Tejedor et al[4] did not state at which intervals and on which days of the week observational sampling was conducted. Although several CL-day sampling strategies have been described, we conducted most observational surveys on Mondays and Thursdays of the same week because this sampling strategy has yielded the best estimates of CL-days.[5–8] Tejedor et al[4] found that initial problems with the accuracy of the EMR reports of CL-days were corrected by a number of interventions, yielding revised reports with excellent accuracy. They emphasized the importance of validating EMR data on the number of CL-days.

We found that the number of CL-days listed in EMR reports, which are based on daily nursing documentation, matched data derived from bedside nursing audits 99.8% of the time. When the EMR report listed a patient as having a CL but nursing audits did not confirm this, patients' CLs may have been removed between the time the EMR report was generated at 6 AM and when nurses conducted their audits later in the morning. Limitations of the current EMR report include the need for infection preventionists to quickly review the report and exclude patients with only arteriovenous fistulas and that ports are listed whether accessed or not. Limitations of our study include the relatively small number of nursing audits performed and the fact that the study was conducted in only one hospital.

In conclusion, the present study suggests that automated reports of CL-days generated by use of lines/drains/airways data in the Epic EMR can provide accurate estimates of the number of CL-days.

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Affiliations: 1. Yale-New Haven Hospital, New Haven, Connecticut; 2. Yale University School of Medicine, New Haven, Connecticut.

Address correspondence to John M. Boyce, MD, Yale-New Haven Hospital, 20 York St, New Haven, CT 06510 (john.boyce@ynhh.org).

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REFERENCES

1. Centers for Disease Control and Prevention. National Healthcare Safety Network (NHSN) overview—2014. www.cdc.gov/nhsn/PDFs/pscManual/validation/pcsManual-2014-valid.pdf. Published 2014. Accessed January 10, 2015.
2. Wright MO, Fisher A, John M, Reynolds K, Peterson LR, Robicsek A. The electronic medical record as a tool for infection surveillance: successful automation of device-days. *Am J Infect Control* 2009;37:364–370.
3. Hota B, Harting B, Weinstein RA, et al. Electronic algorithmic prediction of central vascular catheter use. *Infect Control Hosp Epidemiol* 2010;31:4–11.
4. Tejedor SC, Garrett G, Jacob JT, et al. Electronic documentation of central venous catheter–days: validation is essential. *Infect Control Hosp Epidemiol* 2013;34:900–907.
5. Thompson ND, Edwards JR, Bamberg W, et al. Evaluating the accuracy of sampling to estimate central line–days: simplification of the National Healthcare Safety Network surveillance methods. *Infect Control Hosp Epidemiol* 2013;34:221–228.
6. Klevens RM, Tokars JI, Edwards J, Horan T. Sampling for collection of central line–day denominators in surveillance of healthcare-associated bloodstream infections. *Infect Control Hosp Epidemiol* 2006;27:338–342.
7. Shelly MA, Concannon C, Dumyati G. Device use ratio measured weekly can reliably estimate central line–days for central line–associated bloodstream infection rates. *Infect Control Hosp Epidemiol* 2011;32:727–730.
8. Backman LA, Nobert G, Melchreit R, Fekieta R, Dembry LM. Validation of the surveillance and reporting of central line-associated bloodstream infection denominator data. *Am J Infect Control* 2014;42:28–33.

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