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Practice Forum

Beyond the abacus: Leveraging the electronic medical record for central line day surveillance

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Manual counting is considered the gold standard for device day recording by the National Health Safety Network. We describe the development of a process for an electronic count of central line days across our ten-hospital health care system. Our validation process identified discordance between the electronic count and the manual count for 71% of patient care units. Adjudication of the count differences by chart review identified the electronic count to be correct 97% of the time.

Accurately counting central line days (CLD) is an often underappreciated component of central line–associated bloodstream infection (CLABSI) surveillance. This count, the number of patients with 1 or more central lines recorded at the same time every day, is mandated for public reporting and has traditionally been tabulated manually according to guidance from the National Healthcare Safety Network (NHSN).[1]

The decentralized, resource-intensive endeavor of patient care unit-based recording and collating CLD consumes over an estimated 1,000 nursing hours each month within our health care system (HCS). Although methodological standardization is essential, variation and human error may be inevitable. NHSN guidance for estimation of CLDs in the event of "missed days" implicitly recognizes the limitations of a manual count (MC).[2]

Opportunities exist with widespread adoption of the electronic medical record (EMR) to automate this task and harness bedside documentation. We sought to develop a process to generate and validate an electronic count (EC) of CLDs from the EMR for our HCS, and to assess the effect of changing counting methods on the CLABSI standardized infection ratio (SIR). The aim of this report is to describe the iterative process by which we developed and tuned a computerized report for CLDs.

METHODS

The Cleveland Clinic Health System consists of 9 hospitals in northeast Ohio and 1 in Florida including a 1,200 bed quaternary care referral center in Cleveland, Ohio. All hospitals share the same EMR (EPIC, Epic Systems Corporation, Verona, WI) with a universal data repository (Clarity, Epic Systems Corporation, Verona, WI).

At our health system, each hospital's patient care unit generates an MC of CLD on paper by tallying the number of patients with a central venous catheter at the same time every day and faxing the results monthly to a central location. Device days are then manually keyed into an infection prevention surveillance database (TheraDoc, Premier, Inc., Charlotte, NC) and uploaded to NHSN.

A total of 12 months (February 2017 to January 2018) of patient, encounter, central line flowsheet, and location data were joined and exported from Clarity. CLDs were calculated in a Microsoft Access (Microsoft Corp, Redmond, WA) database and summarized by month and unit. All patients with a central venous catheter from all patient care units (intensive care unit [ICU] and non-ICU) at 10 hospitals and were included in this project, excluding only neonatal ICU and pediatric rehabilitation locations.

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Month- and unit-matched MC CLDs were exported from TheraDoc and directly compared to their correspondent EC to determine concordance. Concordance was defined using the NHSN "5% rule," that is, a ≤5% difference between EC and MC for 3 consecutive months.[1] Discordant EC months were classified as "overcounts" or "undercounts" as compared with MCs.

A judgment sample of 544 patient charts from 41 adult and pediatric ICU and non-ICU locations at 3 hospitals was reviewed to determine the correct count. Charts were selected for review if patient was in a unit with >10% difference between EC and MC during the month selected, and the MC CLD daily tally sheets were available. The goal of chart review was to identify inaccurate ECs. By selecting months with a high degree of discrepancy, we were able to detect problems with the EC more effectively than would be possible using a random sampling of charts.

On days of overcount (EC > MC), the chart of each patient in the EC was reviewed. On days of undercount (EC < MC), every chart from a 7:05 AM unit census was reviewed. As incorrect ECs were discovered during chart reviews, the computer code used to generate the EC was revised to remedy errors. Count correctness was defined as agreement between the EC report and the patient location, and central line flowsheet in the chart each day of the hospitalization at 7:00 AM.

Data were managed and analyzed in Microsoft Excel (Microsoft Corp, Redmond, WA). Odds ratios of concordance by volume of CLDs were calculated using OpenEpi (version 3.01, Copyright 2003, 2008 Andrew G. Dean and Kevin M Sullivan, Atlanta, GA). Hospital-level CLABSI SIRs with EC for predicted infections were compared with SIRs with MC using the NHSN Statistics Calculator to test for a significant difference in the apparent burden of CLABSI between the 2 counting methods.

The Cleveland Clinic institutional review board reviewed this protocol and considered it to be minimal risk involving data collected as part of routine clinical practice.

RESULTS

During the 1-year study period, there were 208,167 EC CLD and 186,446 MC CLD from 137 ICU and non-ICU locations involving 23,055 patients at 10 hospitals (Table 1) for a total of 1,644 unit months. The median CLD per unit month was 94 by EC (range: 0-644) and 83 by MC (range: 0-586).

Median percent difference between EC and MC was +9.6% (interquartile range: +25%-0%). Four hundred eighty-five of 1,644 (29.5%) unit months' MCs and ECs were within ±5%. Concordance as defined by NHSN was met for 40 (29%) of 137 units. In discordant patient care units, there were 983 month overcounts and 183 month undercounts.

Chart review adjudication of count correctness between EC and MC was performed for 544 patients. Five hundred twenty-seven (97%) chart reviews demonstrated the EC as correct. Unit months with 1-75 CLD were associated with a lower odds of concordance than months with >75 CLDs (odds ratio: 0.479; 95% confidence interval: 0.371-0.618).

DISCUSSION

We sought to develop a pragmatic approach to EC of CLDs across a 10 hospital HCS. Our analysis included all 137 patient care units from 10 hospitals in a health system with a universal data repository, which allowed for a single computer program to eliminate the omission and interlocation variability associated with the MC methods. Our approach demonstrates that use of the EMR and centralization of the CLD counts was feasible, offered economies of scale, and was accurate. Further, our work shows that MCs, while attractive in their simplicity and applicability across different health care settings, should not be considered the gold standard for recording device days.

Previous work has established that the EMR can provide an accurate and reliable assessment of days-at-risk for device-related infection.[3] In contrast to our efforts at using real time clinical data to understand device use, other authors have suggested sampling for estimating CLD to limit the burden of an MC on caregivers.[4,5] We have demonstrated that an EC can eliminate the need for the even less cumbersome work required for sampling. We find it curious that use of an EC requires an extensive local validation before its deployment, whereas a more limited assessment of line days does not.[1]

Prescribed rules for validation require no more than a 5% difference between an EC and an MC. Selected chart reviews of discordant counts indicated EC as correct 97% of the time, even as EC and MC were not within ±5%. Concordance was half as likely to have been achieved in months with 1-75 CLD as in months with >75 CLDs. This finding is similar to the findings in the reports mentioned earlier that attempted to validate a sampling methodology.[4,5]

A concern regarding EC of device days is that an incorrect count will lead to lower reported device-related infection rates. Backman et al[6] reported on their experience of validating line days in Connecticut using a sample from 23 hospitals, and found both MC and EC of patient and device days to be higher than the validators' counts. Interestingly, there was no significant difference in the accuracy of the reviewed hospitals own EC versus MC methods, and thus no difference in reported rates. Similarly, we found no statistically significant difference in CLABSI SIRs with the different counting methods.

Beyond workforce efficiencies, another benefit of migrating to centralized ECs is that it opens the door to a better understanding of device use in hospitals. Use of the EMR for counting

Table 1
Twelve month manual count and electronic count central line days and standardized infection ratios at 10 hospitals

Hospital	Number of units	MC CLD	EC CLD	MC SIR	EC SIR	SIR ratio *P* value
A	6	2,722	2,932	2.14	2.00	.93
B	5	13,047	16,322	2.15	1.75	.49
C	58	125,182	135,115	1.30	1.18	.42
D	6	4,034	4,053	1.09	1.00	.92
E	15	13,157	17,486	0.61	0.46	.56
F	15	13,664	15,189	0.47	0.44	.90
G	9	1,865	1,943	0.93	0.83	.95
H	5	3,801	3,814	1.33	1.17	.99
I	13	3,845	5,132	1.01	0.74	.71
J	5	5,129	6,181	1.06	0.90	.80
Total	137	186,446	208,167	1.21	1.07	.21

CLD, central line days; *EC*, electronic count; *MC*, manual count; *SIR*, standardized infection ratios.

emphasizes the importance of accurate documentation and can move the prevention discussion beyond "patients with a line" who are at risk; it allows prevention efforts to inform decisions about vascular access strategy as type-specific use of different catheters becomes readily available. Higher level understanding of device use provides actionable data to better inform risk among a population of patients. The EMR can also facilitate the calculation of actual line days, thereby accounting for the increase risk of bloodstream infection in critically ill populations that require more than 1 central venous catheter for their care.[7]

CONCLUSIONS

ECs rely on accurate nursing documentation in the EMR, and this human factor is an inherent limitation to this approach. However, this limitation is no greater than the human factors involved with MCs across hospitals large and small in generating daily hand counts. Given the inherent difficulties of a person-dependent effort to count device days, we would need to undertake an initiative to improve the process of the MC to achieve validation of our EC methodology as per NHSN guidance. For instance, in late 2017, our organization underwent a months-long process of "EPIC optimization" to codify the many options for documenting devices with the goal of improving the accuracy of nursing documentation. Future investigations should examine whether these human-factor adjustments to EMR functionality can truly improve the accuracy of nursing documentation. In summary, it is time for hospital infection prevention programs to "move beyond the abacus," so as to leverage available data in the EMR to inform efforts to improve patient care.

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