Automated detection tool to identify surgical site infection

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Although the past few decades have seen progress in healthcare-associated infection (HAI) prevention, these infections still affect about one out of every 25 hospitalized patients, resulting in serious illness, death, and excessive healthcare expenditures.[1] Evidence abounds regarding gaps between what is recommended and what is practiced relative to prevention of infection. Infection preventionists (IPs) are needed to bridge these gaps between practices and evidence-based interventions.

To bridge this gap, the APIC IP Competency Model recommends that IPs should be dedicated primarily to activities directly affecting prevention and control of infections, leadership, and training of staff and patients.[2] The model suggests that ample time should be dedicated to managing data and information in order to assess effectiveness of the infection prevention program and identify opportunity areas.[3] However, in the current era of increasing public reporting mandates, much of the IP's time is spent in data collation, case finding, and reporting (surveillance).[4] While surveillance of HAIs is an essential component of infection prevention and control programs, it should not be the primary focus.[5] Manual review of health records to collect all of the information required by the Centers for Disease Control and Prevention (CDC) for reporting of surgical infections, as well as reviewing the records to identify surgical infections is labor-intensive, often requiring a significant amount of an IP's time.[6] The use of medical informatics to support these functions increases efficiency by automating some aspects of surveillance, including infection detection (case finding) and collation of denominator data elements.[7] Utilizing electronic medical record (EMR) systems to develop home-grown infection detection and denominator tools can be an economical alternative or adjunct to purchase of off-the-shelf infection control data mining software.

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PROJECT

To support best use of IPs' time, one large integrated healthcare system developed two home-grown partially automated infection surveillance tools. One tool is designed to detect potential surgical infections, and the other collates the numerous data elements required by the National Healthcare Safety Network (NHSN) for reporting surgical procedures. These Excel tools were developed using the EMR. The tools are viewed as adjunctive to the infection control "data mining" software used by some of the organization's hospitals, and as an alternative to the purchase of data mining software in the system's ambulatory facilities.

The surgical infection detection tool uses the following triggers to identify potential infections:

1. Antibiotic administered >48 hours and ≤ 30 days post op (≤ 90 days for procedure involving implant).
2. Wound culture ordered (all cultures ordered, not just positive) post op within 30 days of surgical procedure with ***no*** implant; ordered within 90 days of surgical procedure ***with*** implant.

3 Diagnosis of surgical infection by International Classification of Diseases, 9th edition (ICD 9) and/or Current Procedure Terminology (CPT) code within 30 days post op (within 90 days for procedures involving implants).

4 For patients who receive care at contract hospitals: Diagnosis of surgical infection in claims data within 30 days (within 90 days for procedures involving implants).

The tool was designed as a screen, to reduce the number of medical records that need to be reviewed to perform infection case finding. The tool can be filtered to apply one or all of the above triggers to identify potential surgical infection cases among all patients who received any surgical procedure(s) for a given time frame (e.g., month).

The surgical denominator tool was designed to collate all elements required by for reporting of surgical procedures to NHSN. These include: medical record number, name of patient, outpatient: yes or no, procedure description, procedure date, medical center or ambulatory surgery center name, procedure room, department specialty (e.g., orthopedics, surgeon), name or identification number, wound class (e.g., clean, clean contaminated, contaminated), ASA class (e.g., 0–3), total duration (e.g., hours and minutes for surgical procedure from open to close of incision). The tool must be converted from Excel to Character Separated Value (CSV) file before uploading it to NHSN.

Through a process of validation, the automated surveillance tools have been found to out-perform manual infection case finding and manual denominator data collection and reporting to NHSN. In addition, at one hospital in our system, it has also been found to out-perform the data mining software in detecting surgical infections, due presumably to the more sophisticated set of infection detection triggers used by the home-grown tool. However, in both hospitals and ambulatory facilities the infection detection tool has been designed and is used as a screening tool only. Final surgical infection case finding/confirmation is performed by the local IP.

The process used to validate the surgical infection detection tool involved comparison of infection cases identified by the automated infection detection tool, with infection cases identified by manual review of the medical records for all procedures performed in one category (e.g., hernia repair) for three, one-month periods. Manual review of the electronic medical records for all cases included searching the following sections for any indication of surgical infection: physician progress notes, nursing flow sheet, laboratory results, any documentation of hypopyon (cataract procedures only), antibiotic orders, and physician orders. At the end of the validation period, the following information was provided:

- Number of procedures during the validation period (three months).
- Number of surgical infections identified during the manual review.
- Number of surgical infections identified using the automated infection detection tool.
- Which method identified more infections.
- Which triggers in the automated infection detection tool were most useful in identifying the surgical infections.

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- If the automated infection detection tool missed some surgical infection cases, were there any commonalities in the cases that might help us add or change trigger(s) to make the tool more effective in detection of infection?

IPs performing the validation were asked whether the automated tool saved time when compared to manual record review, and if so, we requested that they estimate the time saved. In all cases, the automated tools were estimated to reduce surveillance time by at least 80 percent when compared to strictly manual surveillance and reporting to NHSN. In addition to saving time, the tools have been valuable in identifying outbreaks that otherwise would have been missed, and have permitted surgical surveillance of more procedures than otherwise would have been possible.

CONCLUSIONS

Evidence supporting the effectiveness of computerized surveillance for identifying patients with various types of HAIs dates back as far as 1986.[8] Home-grown and off-the-shelf data mining tools are generally observed to improve surveillance efforts when compared to a manual method, by decreasing the clerical burden for IPs while increasing the sensitivity and accuracy of infection detection.[9-11] PS

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