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Syndromic surveillance of surgical site infections — A case study in coronary artery bypass graft patients

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Electronic data

Summary *Objective:* There is a wealth of data routinely collected and stored by healthcare facilities, which are not consistently exploited for surveillance of healthcare associated infections (HCAI). Syndromic surveillance has not yet been widely applied to HCAI. This study aimed to create syndromic surveillance for surgical site infections (SSI) following coronary artery bypass graft (CABG) procedures.
Methods: A cohort of CABG patients from Imperial College Healthcare NHS Trust was investigated. Data from the local Patient Administration System, Laboratory Information Management System, radiology department, cardiac registry and Health Protection Agency SSI surveillance were linked. This data was explored for biological markers and proxies of infection, which were used to develop syndromic surveillance algorithms; sensitivity analysis was used to determine the best algorithms.
Results: 303 patients were included, with a SSI incidence of 6.6%. Wound culture requests, raised platelet and fibrinogen levels were all found to be good indicators of SSI. Two algorithms were generated, one to detect all SSI (sensitivity: 90%; specificity: 93.8%) and one to detect organ space infections specifically (sensitivity: 100%; specificity: 98.5%).
Conclusion: Data which is routinely collected and stored in healthcare facilities can be used for syndromic surveillance of SSI, allowing for an efficient surveillance system without the need for resource intensive data collection.

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Introduction

Healthcare systems routinely collect and store copious amounts of information, much of which is in an electronic format. At present this information is not routinely used or exploited for healthcare associated infection surveillance,[1] with most systems still relying on traditional active clinical surveillance methods. Syndromic surveillance is the term assigned to surveillance which uses real-time (or close to) routine electronic data for the identification, monitoring and reporting of infectious events.[2]

Syndromic surveillance, whilst widely adopted in specific types of infectious disease surveillance, is still a relatively new concept for healthcare associated infections and has not yet been applied to surgical site infections. Several studies have investigated the use of biological markers of infection for the early detection of post-surgical infectious complications.[3–5] The biological markers which have been successfully used include C-reactive protein (CRP), white blood cell count (WBC), procalcitonin (PCT) and erythrocyte sedimentation rate (ESR).[6,7]

In England, the proportion of healthcare associated infections (HCAI) which are attributable to surgical site infections (SSI) have increased from one prevalence survey to the next, with the most recent showing that 15.7% of HCAI are SSI.[8] Specifically in patients undergoing coronary artery bypass graft (CABG) procedures, prevalence of SSI globally range from 0.49% to 18.8%.[9–12] In England, the surveillance of SSI following CABG procedures is voluntary and reports a prevalence of 4.4%.[13] As less invasive interventions for coronary artery disease have become first line treatments for coronary artery diseases, those patients undergoing CABG procedures are likely to be higher risk or have a more severe condition[14]; they could therefore be more vulnerable to infection.

Currently, there are two data sources in England which collect information relating specifically to CABG patients and both contain information on SSI. These are the National Cardiac Register and the Health Protection Agency (HPA) SSI surveillance programme. Despite submission to the National Cardiac Registry being near complete, it has been acknowledged that reporting of post-operative complications can have up to 15% missing data.[15]

The aim of this study was to develop syndromic surveillance of SSI (superficial, deep and organ space) following coronary artery bypass graft procedures, using routinely collected and stored hospital data. This could allow for an efficient, real-time surveillance method for SSI.

Method

This study was carried out Imperial College Healthcare NHS Trust, a group of hospitals with 1540 beds. Ethical approval for the use of linked anonymised local patient data for research was granted by St. Mary's Research Ethics Committee [REC: 09/H0712/85]. The study design was a retrospective cohort study.

Data sources

The following local electronic data sources were used for this study: Patient Administration System (PAS); Laboratory Information Management System (LIMS); Radiology data; HPA SSI surveillance data; cardiac registry data. The PAS data contained information on all patients admissions and discharges, including information on operations and procedures (OPCS codes) and diagnoses (ICD-10 codes). This information goes on to form Hospital Episode Statistics (HES) data, a national dataset with mandated submission from all hospitals in England.

The radiology data contained all diagnostic imaging requests, including the date of request, date of investigation and patient specialty. This data was used as daily binary variables of request e.g. chest x-ray request, and did not contain any indication of the results.

The laboratory data contained information from the haematology, blood biochemistry, and microbiology departments. Biological markers for each patient were presented as daily averages, and turned into binary variables to indicate if the daily average value exceeded a pre-defined 'threshold for infection'. The markers investigated were: WBC (including individual component counts of eosinophils, basophils, lymphocytes and neutrophils), the international normalised ratio (INR), ESR, platelets, fibrinogen, creatinine, haematocrit, serum albumin and CRP. PCT tests are not currently carried out at our hospitals and could therefore not be included.

The microbiology data was converted into binary indicators of daily wound culture request. Other microbiological requests, such as blood, were not included in an attempt to reduce the number of non-wound infections detected. Results of the culture requests were not investigated in order to simplify the possible algorithms and reduce the uncertainty around colonisation and infection, which could not be distinguished from the laboratory data alone. All radiology and microbiology requests and biological marker tests were considered from the day of surgery until 35 days post-surgery; this was to include all those tests relevant to patients diagnosed with an SSI within 30 days of surgery.

The HPA SSI surveillance data originates from a voluntary national surveillance system and contains information on select risks of SSI (e.g. duration of operation) and clinical diagnosis of surgical site infection. It also contains post-discharge surveillance for SSI[16]; these data are collected weekly and submitted by the Infection Prevention and Control department.

The cardiac registry contains detailed information relating to CABG procedures, including comorbidities, operative features and post-operative events. It contains information about SSI, recording deep sternal wound infections and re-operation due to infection; it does not however have a post-discharge surveillance element. This data source is collected and maintained voluntarily by the cardiac surgeons.[17]

Defining the patient population

All those patients defined by the cardiac registry and HPA SSI surveillance as having had a coronary artery bypass graft procedure (regardless of method) between 1st January and 30th June 2011 were considered for inclusion. These patients were linked to the PAS, laboratory and radiology data; three patients (0.9%) did not link to the PAS data were removed from the study.