Knowledge-based Surveillance for Preventing Postoperative Surgical Site Infection


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Hospital Acquired Infection (HAI)

• Not present or incubating prior to the patient being admitted to the hospital, but occurred within 48-72 hours after admittance to the hospital.

• ~1 in 20 patients acquires HAI

• Result in substantially increased medical costs
Goals

• i) Development of an integrated HAI Ontology
• ii) Mapping of local terminologies onto concepts in HAI Ontology
• iii) Development of ontology-powered, rule-based and statistical methods for case detection
• iv) Evaluation of accuracy of case detection methods
• v) Providing uniform semantic interface to the data via querying and browsing
Hospital Acquired Infection - Knowledge In-Use (HAIKU) Project - Overview
Sites of HAIs

- Urinary Tract  40%
- Surgical Wound  25%
- Respiratory Tract  20%
- Bacteremia  3%
- Others  12%

SSI’s & SSI Surveillance

• Surgical site infections are common, increase poor outcomes & costs

• Surveillance helps to prevent SSI
  – Enumerate, report, analyze SSI cases
  – Review of clinical info to confirm SSI status
    • Labour-intensive
    • Surveillance can be focused on high-probability patients by using clinical data to “trigger” review

Source: Greg W. Rose
SSI Classification

Source: CDC Guideline
“Trigger Factors” for SSI Surveillance

Risk Factors
- e.g. obesity
- female gender
- diabetes mellitus

Identification Factors
- e.g. readmission
- microbiology
- antibiotic use

Source: Greg W. Rose
Ottawa Hospital Data Warehouse

• Relational database
  – Contains pharmacy, radiology, dictations, administrative data
  – Linked by common identifier keys
  – Enables complex modeling using integrated health care data
  – This knowledge can be used for IT-supported work flow transformation

Source: Greg W. Rose
Controlled Vocabularies

HL7 Reference Information Model

SNOMED

ICD9.chrisendres.com
Free online searchable 2009 ICD-9-CM

HAI Ontology

Foundational Model of Anatomy

Infectious Disease Ontology

Unified Medical Language System® (UMLS®)
Partial view of the major components of the HAI ontology for surveillance of SSIs
## Application Scenarios

<table>
<thead>
<tr>
<th>Category</th>
<th>Potential Use</th>
<th>Potential Users</th>
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</thead>
<tbody>
<tr>
<td>(I) HAI case identification</td>
<td>- Case enumeration</td>
<td>- IPCP</td>
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<tr>
<td></td>
<td>- Care/product evaluation</td>
<td>- Public health</td>
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<td></td>
<td>- Intervention (e.g., outbreak analysis) and outcome analysis</td>
<td>- Medical staff</td>
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<tr>
<td></td>
<td></td>
<td>- Health care workers (HCW), Manufacturers</td>
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<tr>
<td></td>
<td></td>
<td>- Patients/lawyers/risk management</td>
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<tr>
<td></td>
<td></td>
<td>- Researchers</td>
</tr>
<tr>
<td>(II) Risk/causative factor identification/evaluation</td>
<td>- To evaluate outcomes singly or across multiple HAIs</td>
<td>- IPCP</td>
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<td>- To look for modifiable risk factors</td>
<td>- Medical staff</td>
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<td>- To look for interactions between risk factors</td>
<td>- HCW</td>
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<td>- To evaluate the strength of association or attributable risk</td>
<td>- Manufacturers</td>
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<td>- Researchers</td>
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<tr>
<td>(III) Diagnostic factor identification/evaluation</td>
<td>- Calculation of diagnostic accuracy of factors for surveillance or clinical purposes</td>
<td>- IPCP</td>
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<tr>
<td></td>
<td>- Creation of models or algorithms for case detection</td>
<td>- Medical staff</td>
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<tr>
<td></td>
<td>- Identification of new detection method</td>
<td>- HCW</td>
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<tr>
<td></td>
<td>- Evaluation of interactions among/between identification factors and risk factors</td>
<td>- Manufacturers</td>
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<td>- Researchers</td>
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</tbody>
</table>
Sample Queries

(I)

• What are the common patient-associated risk factors for both SSIs and CAUTIs?
• What effect has installation of new alcohol hand gel dispensers had on the Serratia SSI incidence in Cardiac Surgery Intensive Care Unit (CSICU)?
• Are patients with SSI at risk of developing severe sepsis?
• How many SSIs have been associated with our new brand of implantable ventricular assist device (VAD)?

(II)

• What potentially discontinuable medications are associated with development of SSI?
• Is there an interaction between hypoxia (decreased oxygen supply) and hypoalbuminemia (reduced serum albumin concentration) in the development of SSI?

(III)

• What combination of laboratory and radiographic findings best identifies cases of prosthetic hip infections following hip replacement surgery?
• Given that C-reactive protein elevation is sensitive and specific in patients with HAIs, what other potential acute phase reactants may be used for diagnosis?
• What effect does the use of drugs with anti-inflammatory side effects have on the sensitivity of CT (computed tomography) findings of post-operative abscess formation?
Acknowledgements

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Thank You!