Identifying Acute Myocardial Infarctions from Coded Data in the EHR

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BACKGROUND

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- The Heart of New Ulm Project, which launched in 2009, is a 10-year community based demonstration project aimed at reducing myocardial infarctions (MI) and modifiable heart disease risk factors in the rural community of New Ulm, MN.
- Healthcare in the community is provided primarily by one healthcare system (Allina Health) that operates as New Ulm Medical Center, the only clinic and hospital located in the community.
- Recent examination of residents with visits in the NUMC system indicates 90% of the target population is served by NUMC allowing use of EHR data to serve as a surveillance system for the primary and secondary outcomes.
- The primary outcome (MI) will be measured using state data to compare trends in the target area to the rest of the state. However, due to lag time to get state data, the HONU project needed a way to assess trends in MI internally and to conduct a deeper analysis of how MI might be changing in the population (e.g., within gender, age groups, changes in severity of MI, recurrent and incident). Current methods to achieve this require MDs to review charts for all patients with a coded ICD9 of 410.

OBJECTIVES

We aimed to test methods to create more precise data extraction techniques to identify MI cases in order to reduce the number of chart reviews required.

METHODS

- Initial set of patients identified for chart review based on ICD-9 primary or secondary coded data of 410.xx.
- Manual chart review by MDs validated potential MI cases. **Valid MI is defined as a presentation of 2 of the following 3:
  - EKG Changes
  - Chest pain/other symptoms
  - High Troponin lab result
- Database review of extractable variables conducted.
- Comparisons of reportable variables and combinations thereof analyzed.

RESULTS

- Initial attempt to use Hospital Problem List data yielded a possible 8956 encounters and was thus discounted as a valid method for identification of Acute or Incident MI.
- Identification of initial set of patients for chart review.
  - Coded primary or secondary ICD-9 codes 410.xx from 2006 through 2012 – 410.x2 codes were excluded.
  - Total N = 386 encounters
  - Chart Review took about 64 MD hours to complete
- Chart Review yielded
  - 13 encounters were duplicates and removed from the dataset as these can be avoidable via future queries
  - 1 encounter was identified as Possible MI
  - 27 encounters had treatment outside of the Allina Health system but were left in for the analysis with the understanding that these will require chart review for validation
  - Final n for analysis using the EHR's database = 373 encounters
  - 167 encounters were identified as NOT Acute MI
  - 206 encounters identified as Acute MI
- 9 algorithms for extractable data were used:
  1. Non-canceled order for Angiogram w/Possible PCI
  2. Administrations of medications in the following therapeutic subclasses
     - Antianginal - Coronary Vasodilators (Nitrates)
     - Heparins
     - Beta Blockers Cardiac Selective
     - Platelet Aggregation Inhibitors - Thienopyridine Agents
  3. Stent placement or CABG procedure completed as determined by hospital billing data
  4. High troponin AND CABG
  5. High troponin AND stent
  6. High troponin AND either CABG OR stent
  7. High Troponin AND Heparin orderset used AND either CABG OR stent
  8. Acute Coronary Syndrome Order Set(s) use during the encounter
  9. Acute Coronary Syndrome Order Set(s) use during the encounter AND 410 Primary ICD9 AND either CABG OR stent

Table 1: Performance measures of Myocardial Infarction (MI) selection algorithms for 18+ yrs, n = 373

		MI Selection Algorithms								
	validated MI	1	2	3	4	5	6	7	8	9
Reviewed MI Cases (n (%))	206 (55.2)	128 (34.3)	351 (94.1)	155 (41.6)	93 (24.9)	96 (25.7)	17 (4.6)	125 (33.5)	69 (18.5)	186 (49.9)
sensitivity, %	ref	50.0	99.5	65.5	40.8	42.2	8.3	58.3	24.3	73.3
specificity, %	ref	85.0	12.6	88.0	94.6	94.6	100.0	97.0	88.6	79.0
positive predictive value, %	ref	80.5	58.4	87.1	90.3	90.6	100.0	96.0	72.5	81.2
true positives, n	206	103	205	135	84	87	17	120	50	151
true negatives, n	167	142	21	147	158	158	167	162	148	132
Hypothetical cases to validate, (n(%))		128 (34.3)	147 (39.4)	91 (24.4)	131 (35.1)	128 (34.3)	189 (50.7)	91 (24.4)	175 (46.9)	90 (24.1)

LIMITATIONS

- Patients treated outside of Allina Health's network will likely always need to be chart reviewed until a universal health record or reportable Natural Language Processing (NLP) is implemented.
- Patients may refuse treatment or may not be medically eligible for procedures such as a stent or CABG, thus will not have billing data which are criteria for algorithms.
- Patients may expire during the encounter which also may result in no billing data for procedures, order sets, medications, etc.

DISCUSSION

Determining Acute MI is a complicated question in cardiology. Often, a trained eye is needed to review non-extractable information for the presence of 2 of the 3 indicators of MI. For a majority of patients who survive an MI event, subsequent billing, workflow, and procedure documentation is promising for inclusion into a population for Acute MI.

The initial goal of determining Acute MI resulted in 3 potentially useful algorithms (#3,#7,#9), each of which would reduce the number of chart reviews required for determination of Acute MI to about 24% of the original n. However, this methodology is conceptual and could not be applied at this point to reduce review criteria since no criteria yielded 100% specificity and sensitivity.

Only a measure with a 100% positive predictive value (PPV) would eliminate the need to review cases if the goal was a precise measure of all true MI events. Of the measures reviewed, only 1 (#6) had a 100% PPV. In this case, we could eliminate only 17 cases from chart review; this equates to approximately 170 minutes of cardiologist time potentially saved and so is not without value. Furthermore, while several measures had high specificity or sensitivity, no algorithm had sufficiently high sensitivity and specificity to be used as a method to stand out as an appropriate methodology to estimate MI trends without conducting reviews.

Hearts Beat Back: The Heart of New Ulm Project is a collaborative partnership of Allina Hospitals & Clinics, the Minneapolis Heart Institute Foundation, the New Ulm Medical Center and the community of New Ulm.

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