Royal College of Surgeons in Ireland
Coláiste Ríoga na Máinleá in Éirinn

Risk prediction models to predict emergency hospital admission in community-dwelling adults

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Outline

- Why try to predict emergency admissions?
- Study aim
- Methods
- Results
- Summary
- Considerations when choosing a risk model
- Future work

Why predict emergency admissions?

- Escalating numbers internationally
- Patients: distressing, loss of functional independence, falls, hospital-acquired infections
- Policy: costly
- Targeting higher risk people in the community may reduce risk of future hospitalisation

The race is on....

03/15/2011

$3 Million Dare Asks Data Crunchers to Fix Healthcare

Can an algorithm prevent unneeded hospital stays?

By Morgon Mae Schultz

A network of California doctors is issuing a $3 million dare asking data miners to fix healthcare. The Heritage Health Prize, which stands to be the largest-yet data-modeling competition, will challenge participants to write an algorithm identifying patients most at risk for unnecessary hospitalization—an economically draining component of U.S. healthcare woes. Ultimately, the algorithm will alert doctors to intervene before hospitalization with healthier, far cheaper preventive action.

The Problem

Hospitals are costly. Jonathan Gluck, senior executive with Heritage Provider Network, the competition's sponsor, estimates that Americans spend between $30 billion and $40 billion annually on unnecessary hospitalizations. Unneeded admissions also put patients at risk for hospital-borne infections and divert resources from patients who really need them. More to the point, Heritage asserts, they're symptomatic of a system that treats sickness rather than keeping people healthy.

"With all that's going on with predictive modeling and data mining, the thought was, well, let's see if we can kind of think outside the box and get new people involved in trying to solve these problems," Gluck says. Some feared the algorithm will be used to avoid caring for costly patients, but Gluck stresses that

Evercare (UK)

- 62 practice cluster RCT
- Risk stratification
- Care managed by an advanced nurse practitioner
- Four year follow up (2001-2005)
  - High levels of satisfaction with the care received, especially the medication and psychological support provided
  - No reduction in hospital admissions

Guided care (US)

- N=850, multicentre RCT
- Patients targeted: age and multimorbidity
- Comprehensive assessment
- Nurse as care co-ordinator
- 20 month follow up (2006-2008)
  - Improved chronic care management, reduced caregiver strain, high levels of healthcare professional satisfaction
  - Overall, no change in rate of emergency admissions

Question

- Is the failure of trials to date to achieve anticipated reductions in emergency admissions due to the intervention or method of patient selection?

Study aim

- To perform a systematic review of validated risk prediction models for predicting emergency hospital admission in community-dwelling adults

Methods

- PRISMA guidelines

- Systematic literature search, MeSH and key words

- PubMed
- EMBASE
- Cinahl
- Cochrane library
- Additional databases

Inclusion criteria

- Population: Community-dwelling adults aged ≥18
- Risk prediction models, not contingent on an index hospital admission, with a derivation and at least one validation cohort
- Primary outcome: Emergency hospital admission
- Study design: Prospective or retrospective cohort studies

Data analysis

- No meta-analysis due to model heterogeneity

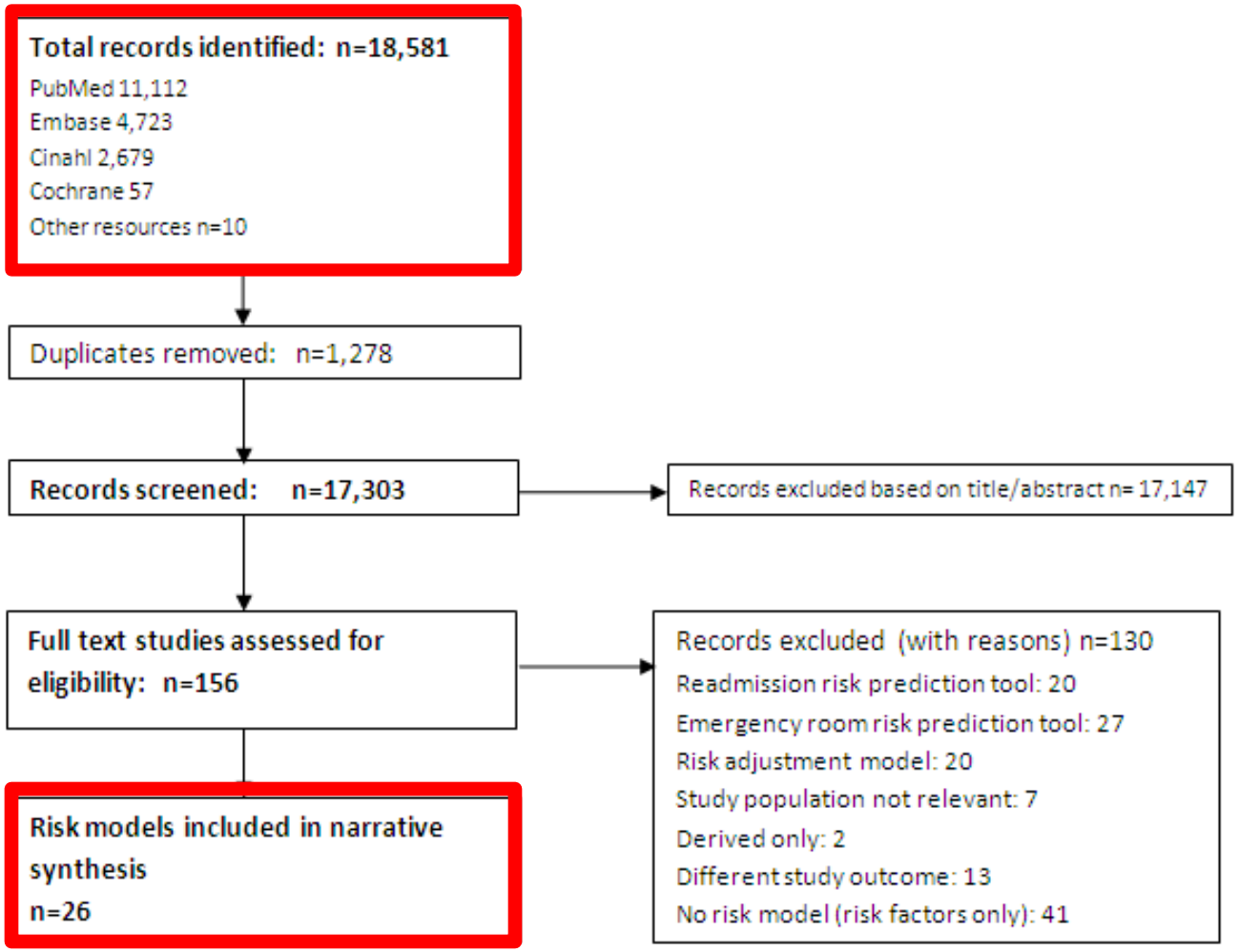
- Type of data used to derive model
- Model discrimination using c-statistic where available
- Variables considered for and included in final model

Methodological quality assessment

- McGinn checklists for clinical prediction rule studies
- Derivation or validation study
- Internal and external validity

Results

Figure 1: PRISMA flow diagram of included risk prediction models



Results

26 unique risk prediction models

- UK n=11, US n=10, Italy n=3, Spain n=1, Canada n=1
- 13/26 developed specifically for older people
- 20/26 published between 2003-2013

Data used

- Self report n=6
- Routine/primary data n=20

Results

Primary outcome

- 17/26 emergency hospital admission at 12 month follow-up
  - Range 90 days-4 years

- Comparison in same population
  - Two UK studies
  - Directly compared nationally developed models with locally adapted

Results: Predictor variables

Predictor variable	Number of models (total n=26)
1. Medical diagnoses	**23**
2. Previous hospital admission	**22**
3. Age	**22**
4. Gender	**17**
5. Multimorbidity	**11**
6. Polypharmacy	**11**
7. Non-medical factors *Functional status, self-rated health, Health-related quality of life*	**8**
8. Socioeconomic group	**5**

Results: Predictive accuracy

- 5/26 models; c-statistic>0.8

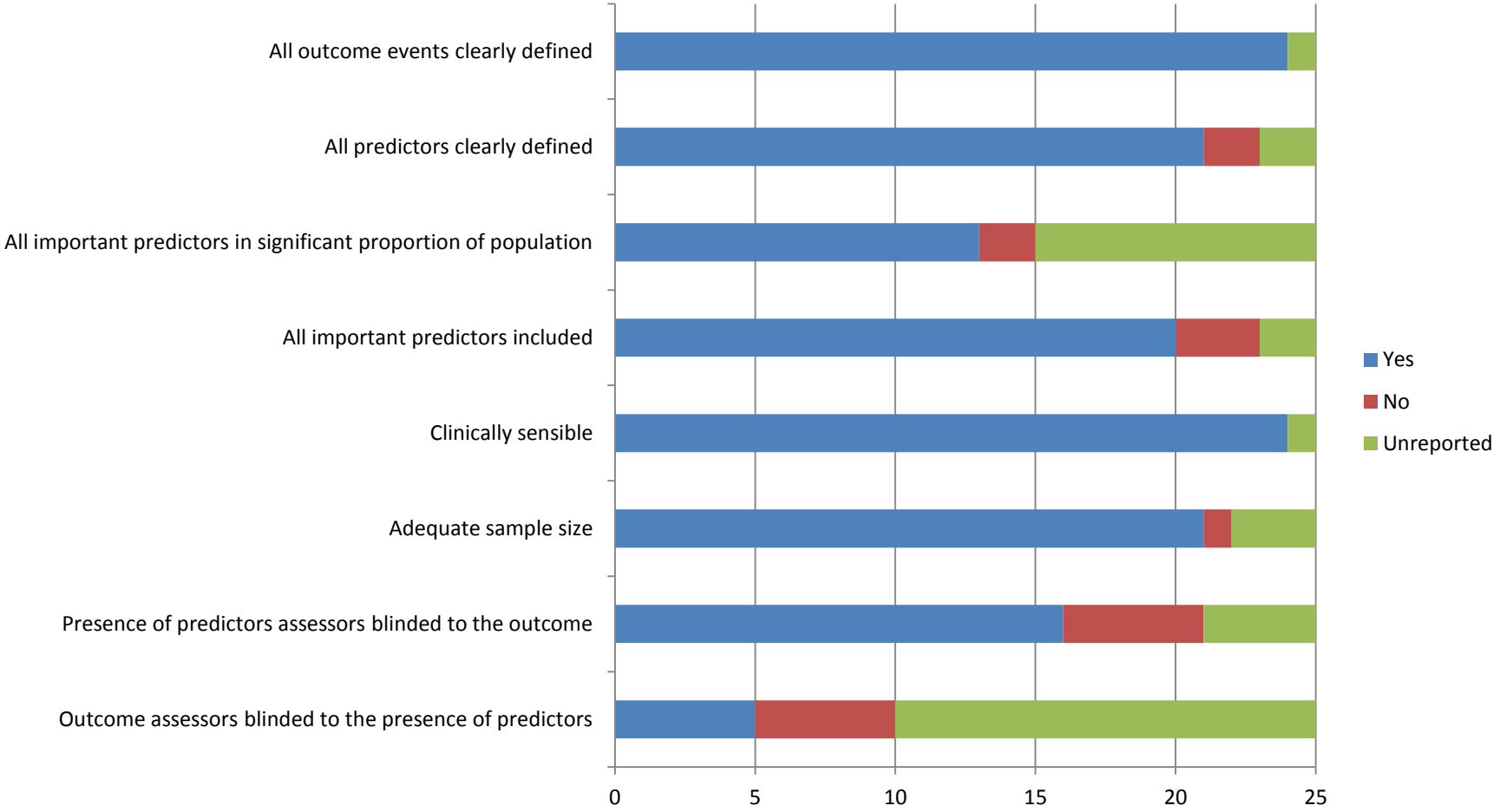
- All included similar variables;
  - Prior healthcare utilisation
  - Multimorbidity or polypharmacy variables
  - Named medical diagnoses or prescribed medications

- All used routine/primary data

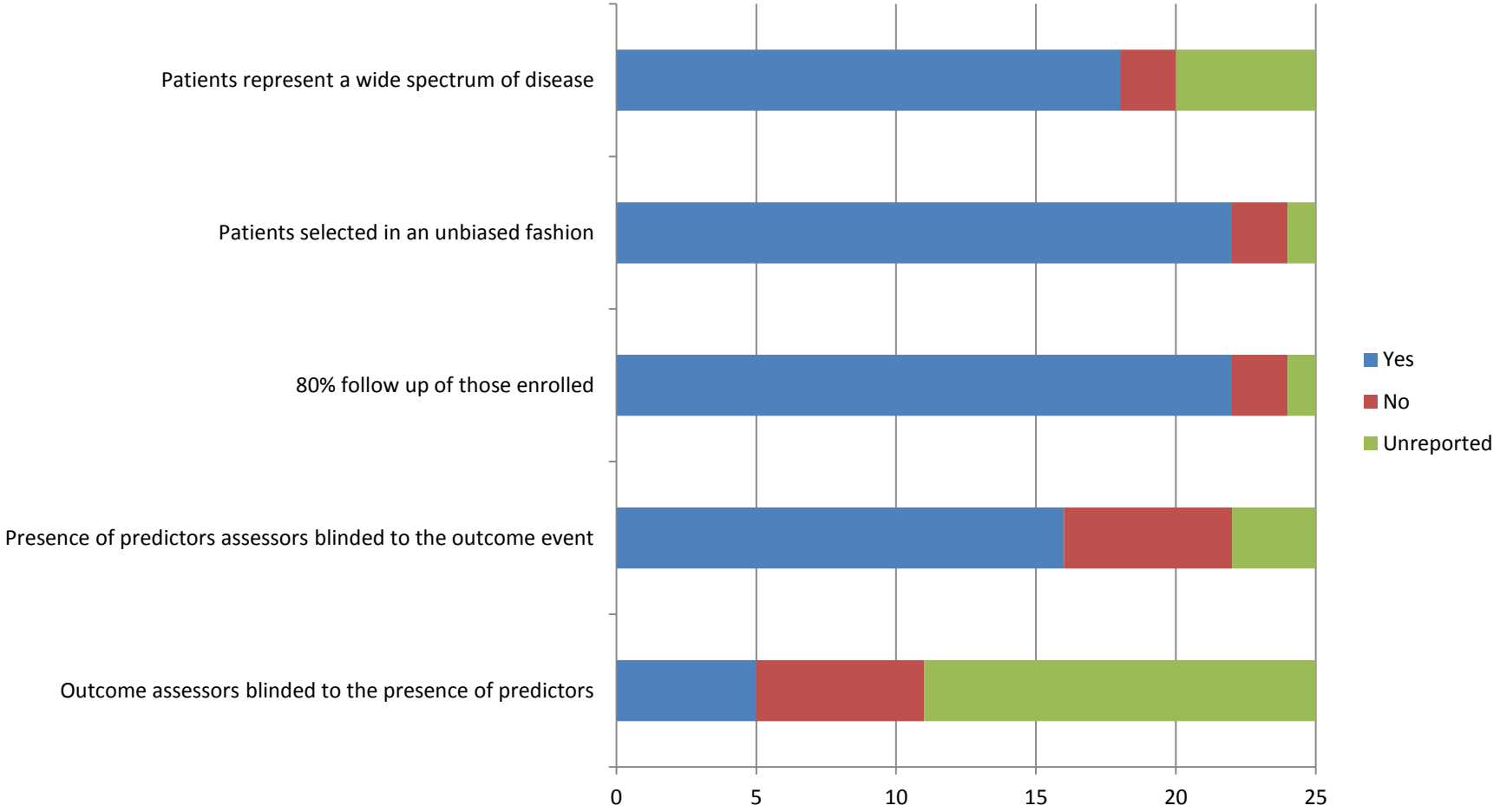
Results: Predictive accuracy

- 7/26 models; c-statistic 0.7-0.8
- Models derived routine/primary data performed better than those with self-report data
- Addition of general practice data seems to improve performance
- Addition of local factors seems to improve performance

Methodological quality assessment: Derivation studies



Methodological quality assessment: Validation studies

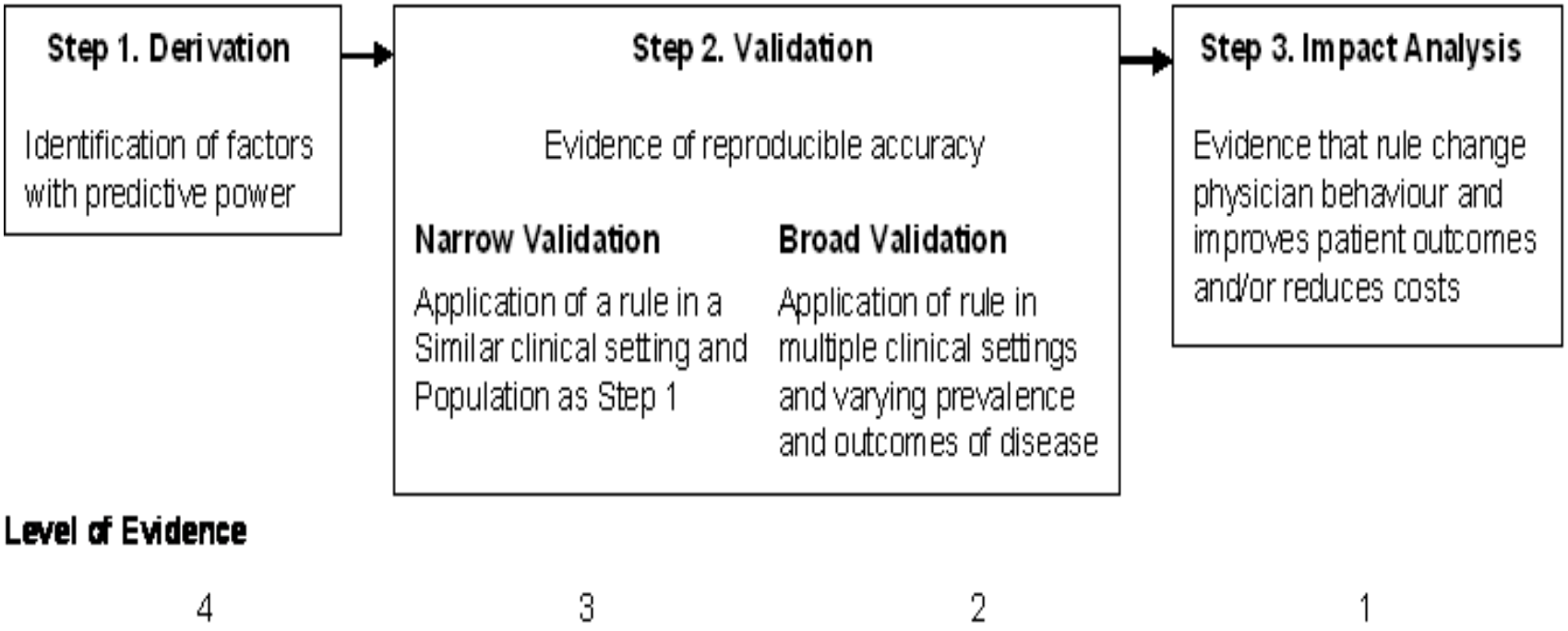


Summary

- 26 unique risk models identified
- Similar variables in five best performing models
- Models derived with routine/primary data better predictive accuracy than those using self-report data
- Addition of GP data and local factors seems to improve performance

Choice of risk model

- Predictive accuracy
- Level of evidence



Considerations when choosing a model

1. Type of data available
2. Coding system (ICPC-2, ICD-10)
3. Population of interest
4. Local factors consideration
5. Predictor variable availability

Future work

- Validate two risk models in an existing cohort of older community-dwelling people
- N=931

- Risk models
  - Adjusted Clinical Groupings (ACG) system
  - Probability of repeated admissions (Pra) model

Acknowledgements

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  - Health Research Board (HRB)