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Personalized health, active ageing, and independent living

Capturing Scientific Knowledge of Medical Risk Factors

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Knowledge Media Institute

What are we doing & why?

- A model of evidence-based medical risk
- Clinical research identifies *risk factors*
  - "If you smoke, your risk of *X* is increased by…"
- Used to advise patients on
  - Lifestyle changes
  - Risk mitigation
  - Chronic disease management

Existing risk prediction tools

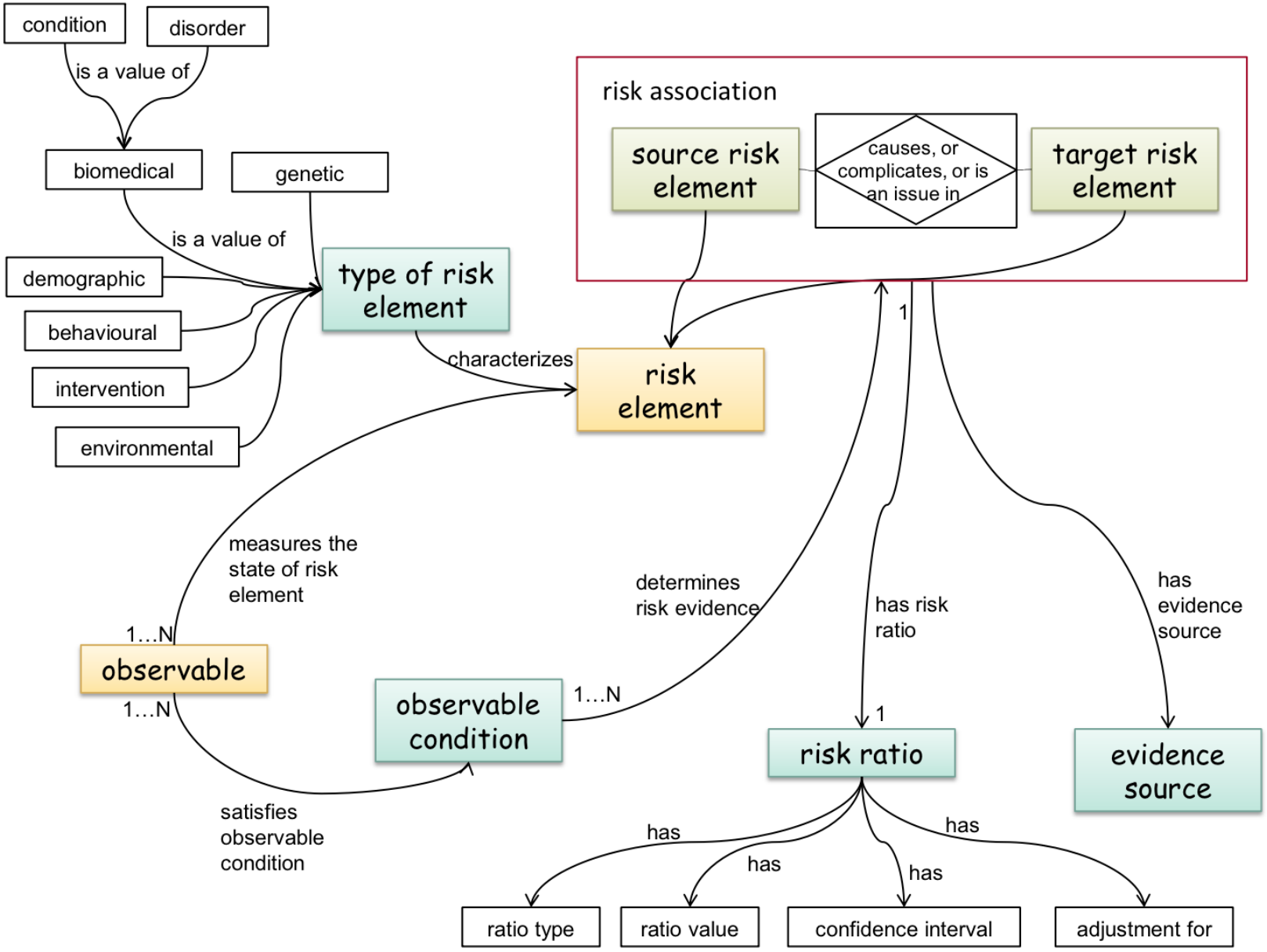
- Hardcoded statistical models
  - Input age, height, weight, some lifestyle factors…
  - Output a single probability & some general recommendations
- Less informative
- Not extensible
  - New science: new model/tool

CARRE
PERSONALIZED PATIENT EMPOWERMENT

- Cardiorenal patients
  - Elevated risks of comorbidities
- Risk calculation & decision support
  - Based on at-home monitoring
- Scientific contribution:
  - *Generalised* & *extensible* risk model
  - Capable of fine-grained & hypothetical reasoning

A sample risk factor association

- Diabetes causes ischemic heart disease
  - Diabetic and male: 2.82 x more likely to develop IHD
    - Confidence interval 2.35 – 3.38
    - Source: Pubmed ID 24859435
  - Diabetic and female: 2.16 x more likely to develop IHD
    - Confidence interval 1.82 – 2.56
    - Source: Pubmed ID 24859435
- Combine en masse for extensible risk calculation


condition
disorder
is a value of
biomedical
genetic
is a value of
demographic
behavioural
intervention
environmental
type of risk element
characterizes
risk element
risk association
source risk element
causes, or complicates, or is an issue in
target risk element
1
measures the state of risk element
1…N
observable
1…N
satisfies observable condition
observable condition
1…N
determines risk evidence
has risk ratio
1
risk ratio
has evidence source
evidence source
has
has
has
has
ratio type
ratio value
confidence interval
adjustment for

Types of risk factor

- Environmental
- Demographic
- Genetic
- Behavioural
- Biomedical

Observables

- How do we know when a risk factor applies to a patient?
  - Who fits the population criteria in the evidence?
- Observations of a patient
  - Manual or automatic
- Logical expression describing study population
  - E.g., “sex = “female” and diabetes = “diagnosed””

Capturing risk factors

- Clinician-defined literature search methodology
- Identify quantified risk factors & relevant population
- Custom (Drupal) forms reflecting model
  - Automatically convert into RDF and store
- Review
- Repeat..

How did it go?

- 93 risk factor associations
- Based on 45 different risk elements
- [Pause for valiant attempt at a demo]

How did it go?

- Relatively straightforward
- Identifying risk factors sometimes tricky
- Familiar language& natural model for clinicians
- Inconsistencies in clinical writing (“risk factor”)
- Biggest issue:
  - Logical expressions for grounding in observables

Observable expressions

- “Diagnosed AND/OR between 8% and 9%”
- In clinical literature but not easily made machine-readable
- OR not in clinical literature
  - Tacit knowledge in clinical process
- “?diabetes = “diagnosed” || (?HbA1c > 8 && ?HbA1c < 9)”

Lessons & future work

- "Hidden" clinical knowledge
- Standard clinical terminology hides some generalities
  - "Positive" risk factors
- Ongoing work on decision support/visualisation
- Easy to generalise to other areas of medicine
  - Outside medicine?
- Curation

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CARREhttp://www.carre-project.eu/

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http://www.isi.edu/ikcap/sciknow2015/#papers