Communicating Personalized Risk Factors for Lifestyle Coaching

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BACKGROUND
chronic non-communicable diseases

- such as cardiovascular disease, cancer, diabetes and chronic respiratory disease
- in 2014, WHO reports
  - they were responsible for 38 million deaths per year (68% of all deaths) in 2012
  - they are projected to increase to 52 million by 2030
  - the total number of people with diabetes has risen from 108 million in 1980 to 442 million in 2014
- lifestyle related diseases, such as diabetes and cardiovascular diseases, constitute part of chronic non-communicable diseases and depends on lifestyle behaviours
- behavioural risk factors are responsible for about 80% of cardiovascular disease with significant cost to healthcare systems
  - including unhealthy diet, physical inactivity, and tobacco and alcohol use
- small changes in lifestyle can make an important difference towards health improvement and disease reduction
CARRE PROJECT
CARRE
Cardiorenal comorbidity management via empowerment and shared informed decision

FP7-ICT-2013-611140
consortium: 6 partners from 4 EU countries
coordinator: Eleni Kaldoudi (DUTH)
budget: 3,210,470€
http://carre-project.eu/
CARRE approach

- Medical evidence aggregation
- Evidence based medical literature
- Personal health information
- Quantified self
- Social media

Patient empowerment & decision support services

Comorbidity model visualization (generic and personalized)

Data harvesting & interlinking

- Private
- Public

Medical evidence aggregation

LOD

Weight
Physical activity
Blood pressure
Glucose

Educational resources

PubMed

MedlinePlus

Trusted Health Information for You

Evidential resources
FAMILIARIZATION WITH RISK FACTORS
modelling health risk factors

Disorder 1 (as a risk factor) leads to Disorder 2 (as a probable consequence) under certain conditions with a probability x.

Risk factors are reported in medical literature (top level evidence: systematic reviews with meta-analysis).
modelling health risk factors

- condition
- disorder
- genetic
- biomedical
- demographic
- behavioural
- intervention
- environmental

- observable
- observable condition

- type of risk element

- risk evidence
  - source
  - risk element
  - target
  - risk element
  - causes, is an issue in, ...

- risk element
  - measures the state of risk element
  - characterizes

- risk ratio
  - risk evidence
  - has risk ratio
  - has evidence source
  - has risk evidence

- evidence source

- ratio type
- ratio value
- confidence interval
- adjustment for

- observable condition
  - satisfies observable condition
  - 1...N

- observable
  - 1...N
risk factor identification methodology

search ground knowledge to identify major risk factors (guidelines and their literature: KDIGO, KDOQI, ACC/AHA, NICE, ESC, EASD, ADA)

identify major risk factors (keywords)

search PubMed: condition A AND condition B (limited to systematic reviews with metaanalyses)

if result found:

no

search again for next update (1 year)

yes

include relevant risk evidence from latest and highest level

if result found:

no

include all risk evidences from the most recent

yes
some of the major related conditions

1. Acute kidney injury
2. Acute myocardial infarction
3. Age
4. Albuminuria
5. Anaemia
6. Angina pectoris
7. Asthma
8. Atrial fibrillation
9. Chronic kidney disease
10. Chronic obstructive pulmonary disease
11. Cholelithiasis
12. Colorectal Cancer
13. Coronary and carotid revascularisation
14. Death
15. Depression
16. Diabetes
17. Diabetic nephropathy
18. Drugs
19. Dyslipidemia
20. Family history
21. Heart Failure
22. Hyperkalemia
23. Hypertension
24. Hyperuricemia
25. Hypoglycaemia
26. Ischemic heart disease
27. Ischemic stroke
28. Left ventricular hypertrophy
29. Obesity
30. Obstructive Sleep Apnoea
31. Myocardial infarction
32. Osteoarthritis
33. Pancreatic Cancer
34. Peripheral Arterial Disease
35. Physical activity
36. Smoking
37. ...
RISK EVIDENCES EXAMPLES
Obesity can cause diabetes when $23 \leq \text{BMI} \leq 34$, with a risk ratio of 1.61.

Obesity can cause heart failure when $25 \leq \text{BMI} \leq 30$ AND sex=female, with a risk ratio of 2.50.

Obesity can cause hypertension when $99.4 \leq \text{Waist Circumference} \leq 106.2$ AND sex=male, with a risk ratio of 2.50.
hypertension

causes

chronic renal disease

risk ratio = 2.00

when systolic BB $\geq$ 140 mmHg AND/OR diastolic BB $\geq$ 90 mmHg

smoking

is an issue in

chronic renal disease

risk ratio = 2.40

when smoking status = current AND sex=male

so far... 250 major risk associations (or evidences) identified in medical literature (which involve more than 50 health conditions and 70 related observables) as included in the CARRE risk evidence repository
CARRE RISK EVIDENCE REPOSITORY

https://entry.duth.carre-project.eu
CARRE risk evidence repository
CARRE risk evidence repository

Risk evidences

Risk factor: age (is an issue in) ischemic heart disease
Observable: age (years), sex
Observable condition: age (years) ≥ 59 AND age (years) ≥ 54 AND sex = female

Ratio type: relative risk
Ratio value: 5.63
Confidence Interval lower: 3.35
Confidence Interval upper: 9.08

In adjusted for age, study year, and area, smoking, HDL cholesterol ratio, systolic blood pressure, BMI, diabetes

Source: 10065764

Enter by: Kalopis Pphi
Reviewed by: Stelane Roumelioti, Giorgitsi Iacoulomate, Pournis Passadaski

Article: 10065764 link to PubMed


sex, age, cardiovascular risk factors, and coronary heart disease: a prospective follow-up study of 14,786 middle-aged men and women in Finland.

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BACKGROUND: Coronary heart disease (CHD) is markedly more common in men than in women. In both sexes, CHD risk increases with age, but the increase is sharper in women. We analyzed the extent to which major cardiovascular risk factors can explain the sex difference and the age-related increase in CHD risk.

METHODS AND RESULTS: The study cohort consists of 14,786 Finnish men and women aged 25 to 64 years at baseline. The following cardiovascular risk factors were determined: smoking, serum total cholesterol, HDL cholesterol, blood pressure, body mass index, and diabetes. Risk factor measurements were done in 1983 or 1997, and the cohorts were followed up until the end of 1994. The Cox proportional hazards model was used to assess the relation between risk factors and CHD risk. CHD incidence in men compared with women was approximately 3 times higher and mortality was approximately 5 times higher. Most of the risk factors were more favorable in women, but the sex difference in risk factor levels diminished with increasing age. Differences in risk factors between sexes, particularly in HDL cholesterol and smoking, explained nearly half of the difference in CHD risk between men and women. Differences in serum total cholesterol level, blood pressure, body mass index, and diabetes prevalence explained about one-third of the age-related increase in CHD risk among men and 50% to 60% among women.

CONCLUSIONS: Differences in major cardiovascular risk factors explained a substantial part of the sex difference in CHD risk. An increase in risk factor levels was associated with the age-related increase in CHD incidence and mortality in both sexes but to a larger extent in women.

PMID: 10065764 [PubMed - indexed for MEDLINE]
CARRE risk evidence repository
CARRE RDF SPARQL endpoint

https://devices.duth.carre-project.eu/sparql
RISK COACH MOBILE APPLICATION
privacy by design architecture*

implementation

- implemented for Android mobile devices
  - compiled for Android 7.1 (API level 25)
  - backward compatibility until Android 4.4w (API Level 20)

- animated graphs produced using MPAndroidChart library
  https://github.com/PhilJay/MPAndroidChart

- retrieval of data performed using OkHttp library through the CARRE SPAQL Endpoint
  https://square.github.io/okhttp/
mobile application functionalities (1/4)
mobile application functionalities (2/4)
mobile application functionalities (3/4)
mobile application functionalities (4/4)
anyone who wants to try it?

download

http://www.drosatos.info/files/papers/carremobile.rar

password

HealthInf2018
### Table 22. Mean differences between the two visits on quality of life (PCS and MCS), health literacy (HLT) and empowerment (EMP) for the CARRE arm, calculated as a percentage of the value at baseline.

<table>
<thead>
<tr>
<th>Visit 2 – Visit 1: E2 – E1*</th>
<th>PCS</th>
<th>MCS</th>
<th>HLT</th>
<th>EMP</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E2 = CARRE arm after (visit 2), E1 = CARRE arm at baseline (visit 1)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DUTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Population</td>
<td>2.2%</td>
<td>-0.9%</td>
<td>7.7%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Metabolic Syndrome</td>
<td>-0.8%</td>
<td>-0.6%</td>
<td>1.6%</td>
<td>14.0%</td>
</tr>
<tr>
<td>HF or CKD</td>
<td>10.3%</td>
<td>-1.4%</td>
<td>30.5%</td>
<td>17.4%</td>
</tr>
<tr>
<td>VULSK</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Population</td>
<td>1.4%</td>
<td>2.5%</td>
<td>11.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Metabolic Syndrome</td>
<td>-0.5%</td>
<td>1.6%</td>
<td>6.3%</td>
<td>10.6%</td>
</tr>
<tr>
<td>HF or CKD</td>
<td>3.5%</td>
<td>3.7%</td>
<td>17.8%</td>
<td>-5.0%</td>
</tr>
<tr>
<td>POOLED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Population</td>
<td>1.7%</td>
<td>1.0%</td>
<td>9.8%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Metabolic Syndrome</td>
<td>-0.6%</td>
<td>0.4%</td>
<td>3.7%</td>
<td>12.4%</td>
</tr>
<tr>
<td>HF or CKD</td>
<td>5.7%</td>
<td>1.8%</td>
<td>21.3%</td>
<td>1.8%</td>
</tr>
</tbody>
</table>

*bold red lettering highlights significant differences (p<.05), p values obtained by comparing values within each arm using paired samples t-test, see Table 18, Table 19, and Table 20 for values of mean differences and p values.
work in progress

- perform a randomized controlled trial that will evaluate:
  - the efficacy of communicating health risks to the general public via the personalized application

- The aim of the study is to assess user satisfaction and efficacy of the application to empower people and coach them towards a healthier lifestyle

- study primary objectives
  - increase health literacy
  - increase level of patient empowerment

- study secondary objectives
  - improve lifestyle habits
  - test for application acceptability and user satisfaction
Acknowledgement

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CARRE Project: Personalized patient empowerment and shared decision support for cardiorenal disease and comorbidities
www.carre-project.eu