Internal Validation of the Metabo-Reno-Cardiovascular Disease Model: Risk of Recurrent Cardiovascular Events in a Population With and Without Diabetes

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Background

- The Metabo-Reno-Cardiovascular Disease Model (MRCDM) is a patient-level model with individuals with or without diabetes (type 1 or 2), obesity (defined by BMI), CVD or chronic kidney disease.
- It was developed to predict the risk of complications and mortality in these individuals.
- The SMART-REACH equation was implemented to predict the risk of recurrent major cardiovascular events and interventions (MACE+) in patients with established CVD[1].

Objectives

- This study aims to validate the prediction of recurrent CVD events using the SMART-REACH equation in the MRCDM.

Methods

- The MRCDM is a microsimulation model, with specific disease submodules and complications represented within a structure of Markov Health states.
- Individuals that enter the model can be with or without diabetes (type 2), obesity, CVD and chronic kidney disease.
- Six different cohorts were evaluated, differing in baseline comorbidities: glycemic status, history of coronary heart disease (CHD – this includes history of myocardial infarction (MI), stable and unstable angina, coronary revascularization), cerebrovascular disease (CeVD – this includes history of stroke and transient ischemic attack), and peripheral artery disease (PAD – this includes intermittent claudication and peripheral revascularization procedures).
- The 3 cohorts were populated with the same baseline characteristics, coming from the SMART and REACH studies.
- Static risk factor progressions were applied.
- The time horizon was ten years.
- MRCDM predicted cumulative incidences (CI) of recurrent CVD were compared with observed risks predicted on the Extended SMART risk score calculator available online[2].
- In the MRCDM, the risk is updated annually reflecting the progression of age, lipids, blood pressure and other risk factors. To mimic this natural evolution also the age was adapted every year in the online 10-year risk calculator.
- MRCDM assumes that, if a MI occurs in patients with a history of stroke, it is called the first MI, despite that it is a recurrent CVD.
- The same logic applies for patients with a history of CHD. In case they have a recurrent CVD that is a stroke, it will be their first stroke

Table 1 – MRCDM Cohort inputs

Baseline characteristics	Value
Start age (years)	67
Proportion male (%)	68
Proportion of patients with type 2 diabetes (%)	37
Proportion smokers (%)	17
SBP (mmHg)	136
DBP (mmHg)	78
Total cholesterol (mg/dL)	185
HDL (mg/dL)	46
LDL (mg/dL)	112
Triglycerides (mg/dL)	134
BMI (kg/m²)	28.3
eGFR (mL/min/1.73m²)	76
CRP (mg/L)	2

HbA1c: hemoglobin A1c, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, BMI: Body mass index, eGFR: Estimated glomerular filtration rate

Results

- In Table 2, the Extended SMART risk score calculator predicted 10-year risks of recurrent CVD, and the predictions obtained with the MRCDM using the SMART-REACH equation for recurrent events are shown.
- For the six cohorts (patients with a history of CHD, a history of CeVD and a history of PAD), the 10-year predictions obtained with the MRCDM are very close to the predictions made by the online risk calculator.
- A relative difference of 2 to 3% was observed between MRCDM predictions and the online calculator.

Table 2 – Ten-year risk score calculator and MRCDM predicted recurrent CVD events

	History of CHD (e.g. MI)		History of CeVD (eg. stroke)		History of PAD (e.g. .IC)	
MRCDM outcome predictions	T2D	No T2D	T2D	No T2D	T2D	No T2D
MI	0%	0%	13%	10%	18%	14%
Recurrent MI	23%	21%	0%	0%	0%	0%
Stable angina	6%	5%	8%	6%	12%	9%
Unstable angina	5%	4%	3%	2%	4%	3%
Stroke	6%	6%	0%	0%	18%	18%
Recurrent stroke	0%	0%	8%	8%	0%	0%
TIA	2%	2%	2%	2%	5%	5%
PAD	9%	5%	7%	4%	0%	0%
Total	58%	49%	51%	43%	40%	33%
Composite (mix T2D and No T2D)	45%		36%		52%	
SMART-REACH online calculator						
Predicted 10-year incidence	46%		37%		54%	

CeVS: Cerebrovascular Disease; CHD: Coronary Heart Disease; CVD: Cardiovascular Disease; IC: Intermittent claudication ; MI: Myocardial Infarction; PAD: Peripheral Arterial Disease; T2D : Type 2 Diabetes; TIA: Transient Ischemic Attack;

Conclusions

- **MRCDM predictions are similar to the outcomes from the Extended SMART risk score calculator, with a variation of 2-3%.**
- **This exercise has proven the internal validity of these predictions within the MRCDM.**

Want to know more about the MRCDM?
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References

1. Van 't Klooster et al. Predicting 10-year risk of recurrent cardiovascular events and cardiovascular interventions in patients with established cardiovascular disease: results from UCC-SMART and REACH. International Journal of Cardiology 325 (2021) 140–148
2. https://www.internationaljournalofcardiology.com/article/S0167-5273(20)33834-1/fulltext