Projecting costs of care burden of depression between 2023 and 2032 in Hong Kong: a time-inhomogeneous cohort Markov model using real-world evidence

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Why did we develop a new burden projection model for depression?

- Depression is ranked by the World Health Organisation as the No. 1 contributor of global disease burden by 2030, presenting significant non-fatal burden.
- 30% of patients worldwide do not respond to ≥2 antidepressant regimens and have treatment-resistant depression (TRD). TRD is associated with higher risk of mortality and medical cost compared to treatment-responsive depression. The higher risks of new-onset somatic and psychiatric comorbidities after TRD further intensify the economic burden due to depression.
- Most published models have not accounted for these features since they were purported to evaluate treatment cost-effectiveness rather than care burden projection. The short study timeframe of trial data also limited the follow-up for chronic events.

Aims & Objectives

We developed a time-inhomogeneous Markov model to:

1) Project the future 10-year costs of all-cause and psychiatric care among patients with depression from 2023 to 2032;
2) Identify the key drivers for cost-savings in care services for patients with depression.

The model addressed the trajectories linking TRD and post-TRD comorbidities based on primary real-world data (RWD). Findings will assist decision makers in early resource planning for the growing needs of health services.
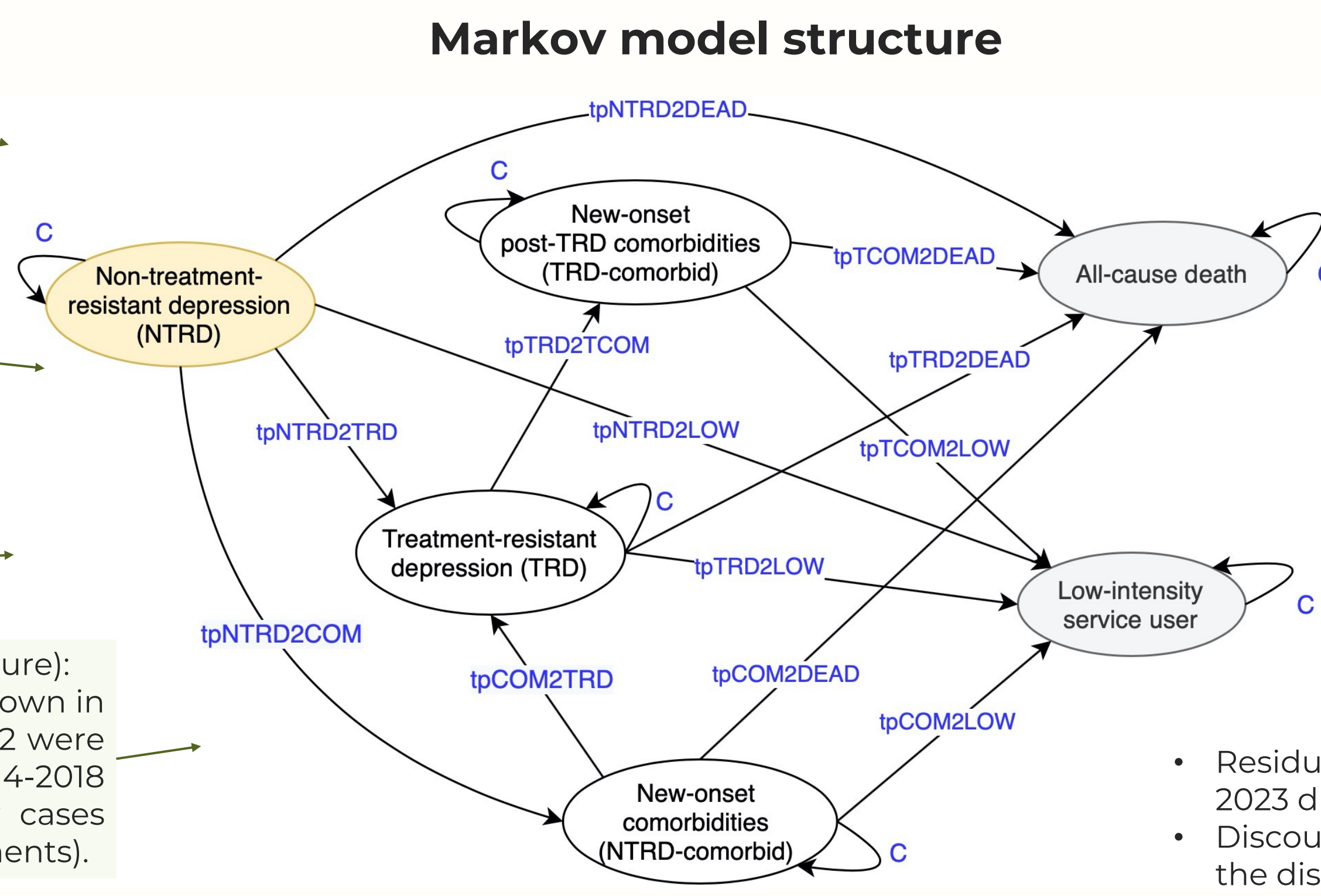
Methods

- We extracted a reference cohort from the CDARS database, containing 25,190 patients aged ≥10 years newly diagnosed with depression between 2014 and 2016. They were followed up from diagnosis until December 2020 for patterns of drug use, diagnoses, attendance and deaths to derive model inputs.

Time horizon:	10 years
Cycle length:	One year
Perspective:	Hong Kong public healthcare system payer
Outcomes:	Non-subsidized cumulative and annual costs of all-cause and psychiatric care valued in 2023.
RWD source:	Clinical Data and Analysis Reporting System (CDARS) – the universal electronic medical record database in Hong Kong.

Time-varying transition probabilities (from RWD): Used parametric survival modelling based on the follow-up of reference cohort to obtain time-to-event hazard from state to state. Hazards were converted into probabilities by $P(t)=S(t)/S(t-1)$ where $S(t)$ refers to the survival function.

Costs of care per state (from RWD): A cohort study matched TRD and non-TRD in 1:4 based on propensity score of age, sex and baseline medical history. Mean costs of care per state during follow-up were derived by negative binomial regression adjusting for the matched variables, TRD (Y/N) and post-TRD comorbidities (Y/N).

Utility weight per state (from literature): Targeted literature search on HRQoL articles on TRD and comorbidity development in depression.

Number of annual incident patients, 2014-2032 (from RWD/literature): Directly applied the actual no. of new patients from 2014 to 2018 shown in the CDARS database. Annual no. of new patients from 2019 to 2032 were projected by multiplying the mean five-year incidence during 2014-2018 by government population projections (Adjusted for extra new cases during 2019-2022 due to the COVID-19 pandemic and social movements).

Markov model structure

Closed cohort setting (base-case analysis):
- The model only studied a fixed cohort of new patients (2023) without introducing new patients in subsequent cycles.
- Reflects costing trend following natural disease history

Open cohort setting (Scenario analysis):
- The model introduced new cohorts of incident patients on a yearly basis consistent with calendar year.
- Reflects actual costs in the system contributed by new and pre-existing patients.

Deterministic (DSA) and probabilistic sensitivity analyses:
- Identify top factors influencing cost-savings.
- Identify possible range of outcomes.

- Residual pandemic impact was considered by assuming extra depression cases in 2023 due to slow economic recovery, which resolved from 2024 onwards.
- Discounting was not applied to allow for visualization of natural costing trend along the disease course.

Results

Patient flow and distribution between health states:
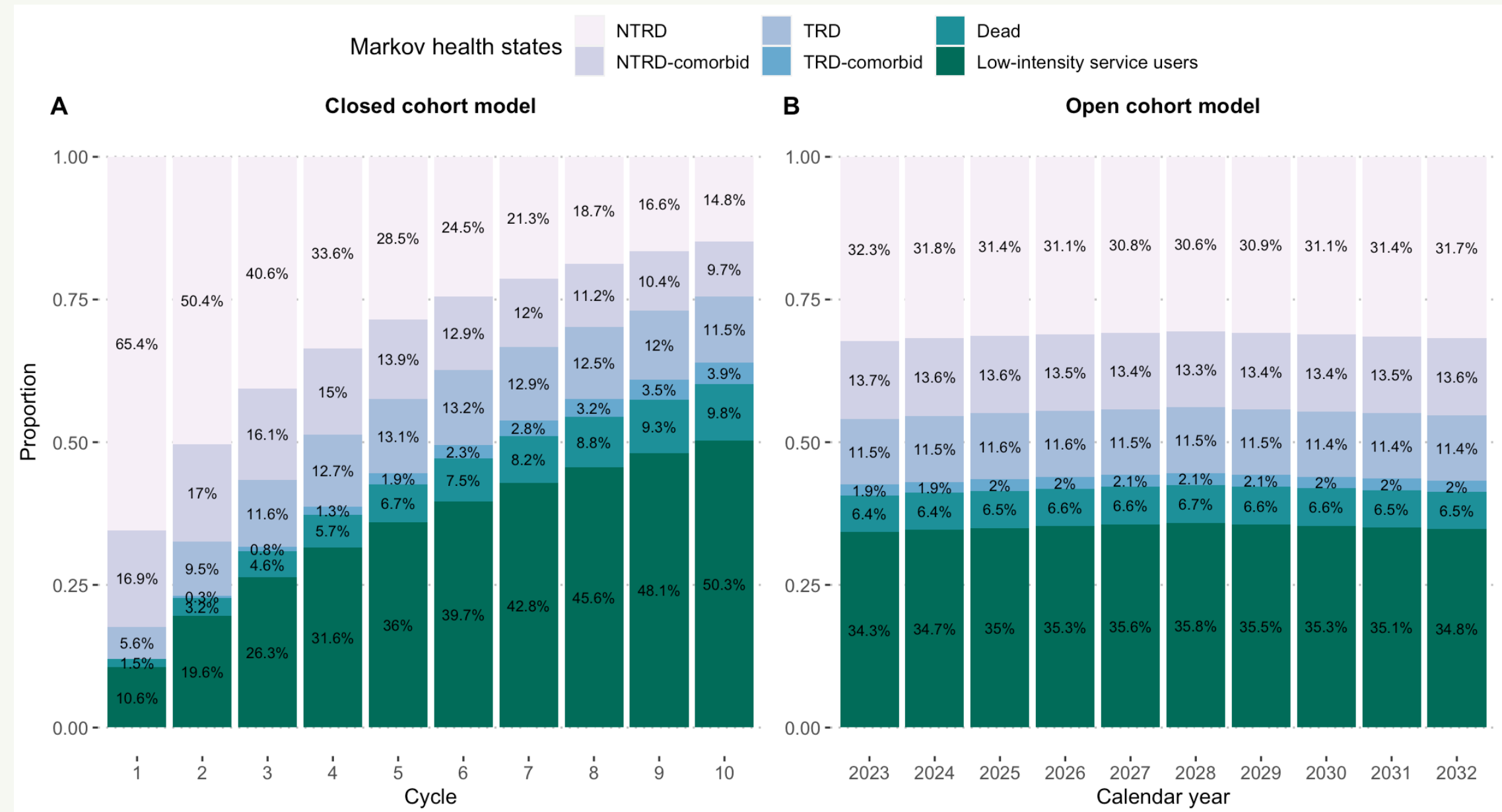

### Projected costs of care from 2023 to 2032:
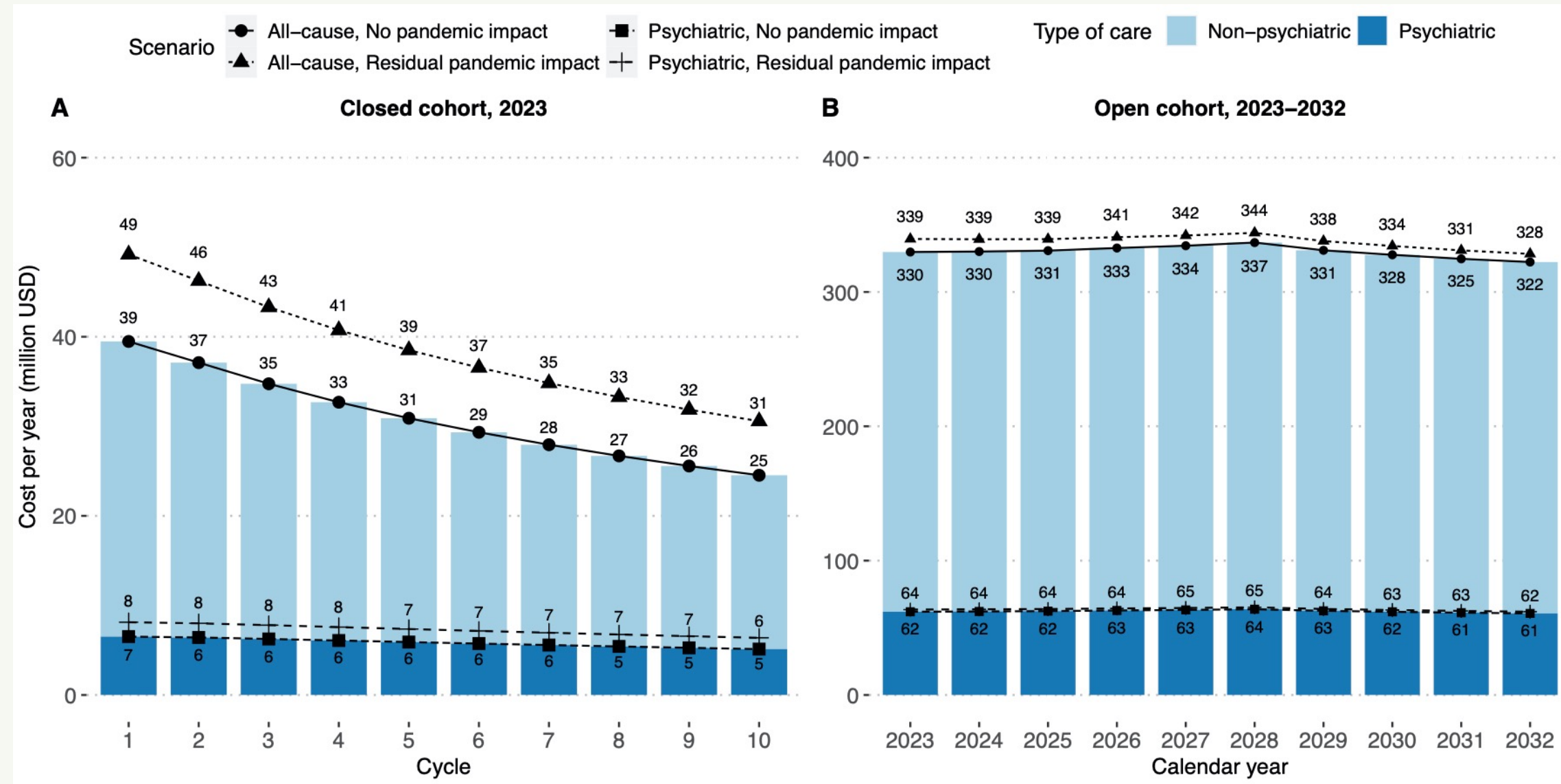
Cumulative and individual burden by subgroup

- **Closed cohort:** 9,217 new depression patients in 2023 will have cumulative costs of all-cause and psychiatric care reaching US$309 million and US$58 million by 2032. Costs will only decrease by 38% and 21% in all-cause and psychiatric care, implying a sustained care burden and disease chronicity.
- **Open cohort:** 55,849–57,896 active prevalent cases will live with depression per year, costing more than US$322 million and US$61 million in all-cause and psychiatric care annually. Despite a growing number of future depression patients, the annual costs will be steady due to the extra depression new cases during 2019-2022 which generated extra burden in the first few years of projection.
- **Overall:** ≤20% of cases living with TRD or comorbidities will contribute to 31–54% of total costs.
- **Subgroup analysis:** The highest collective burden will occur in the subgroup of middle-aged women with medical history, but the subgroup of older and adolescent men with medical history will have the highest individual costs.
- **DSA** showed that the annual number of new patients, transition probabilities from the non-TRD state to TRD, to comorbidities, and to low-intensity service users states were the key cost drivers.
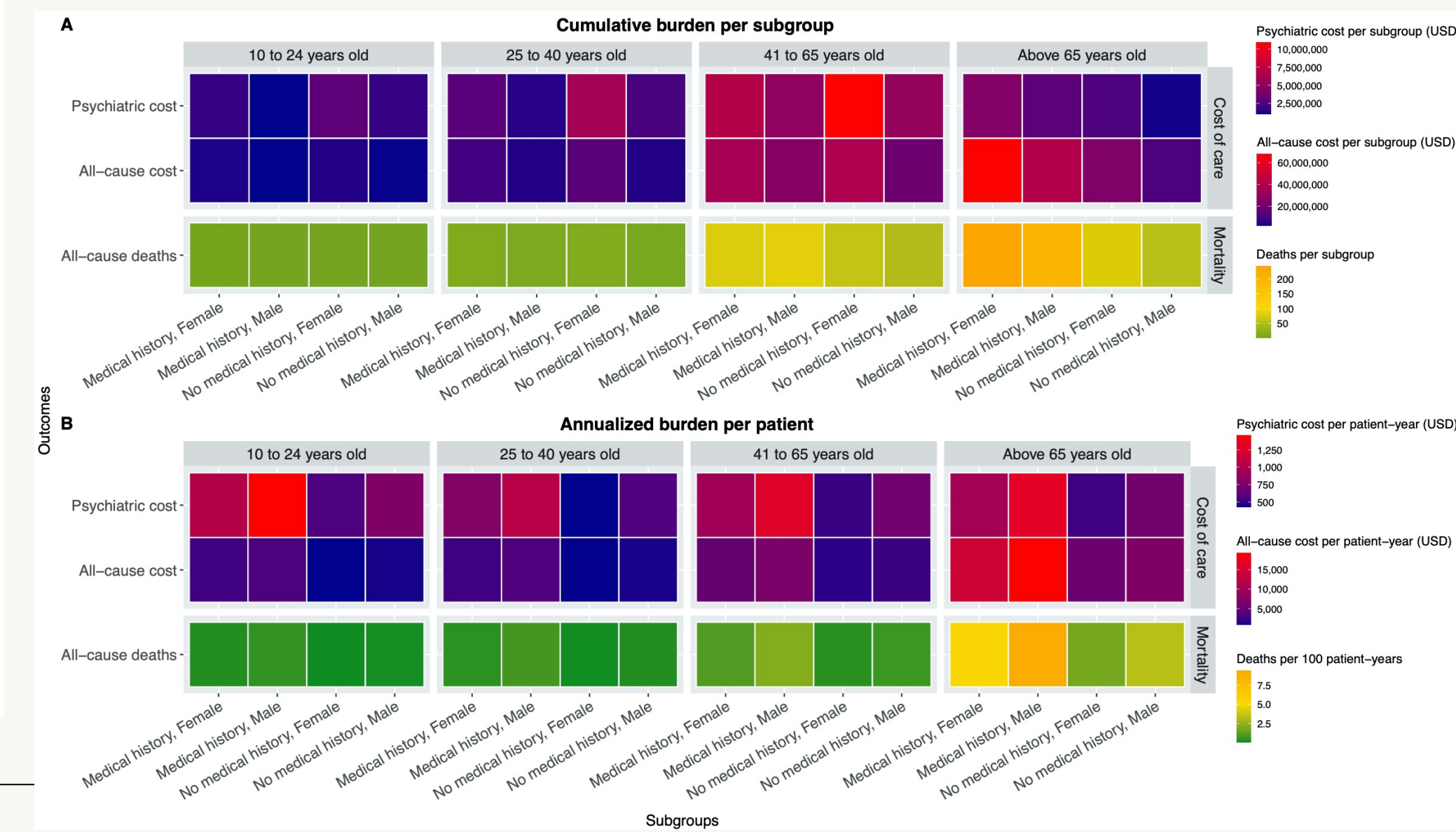
One-way DSA results:
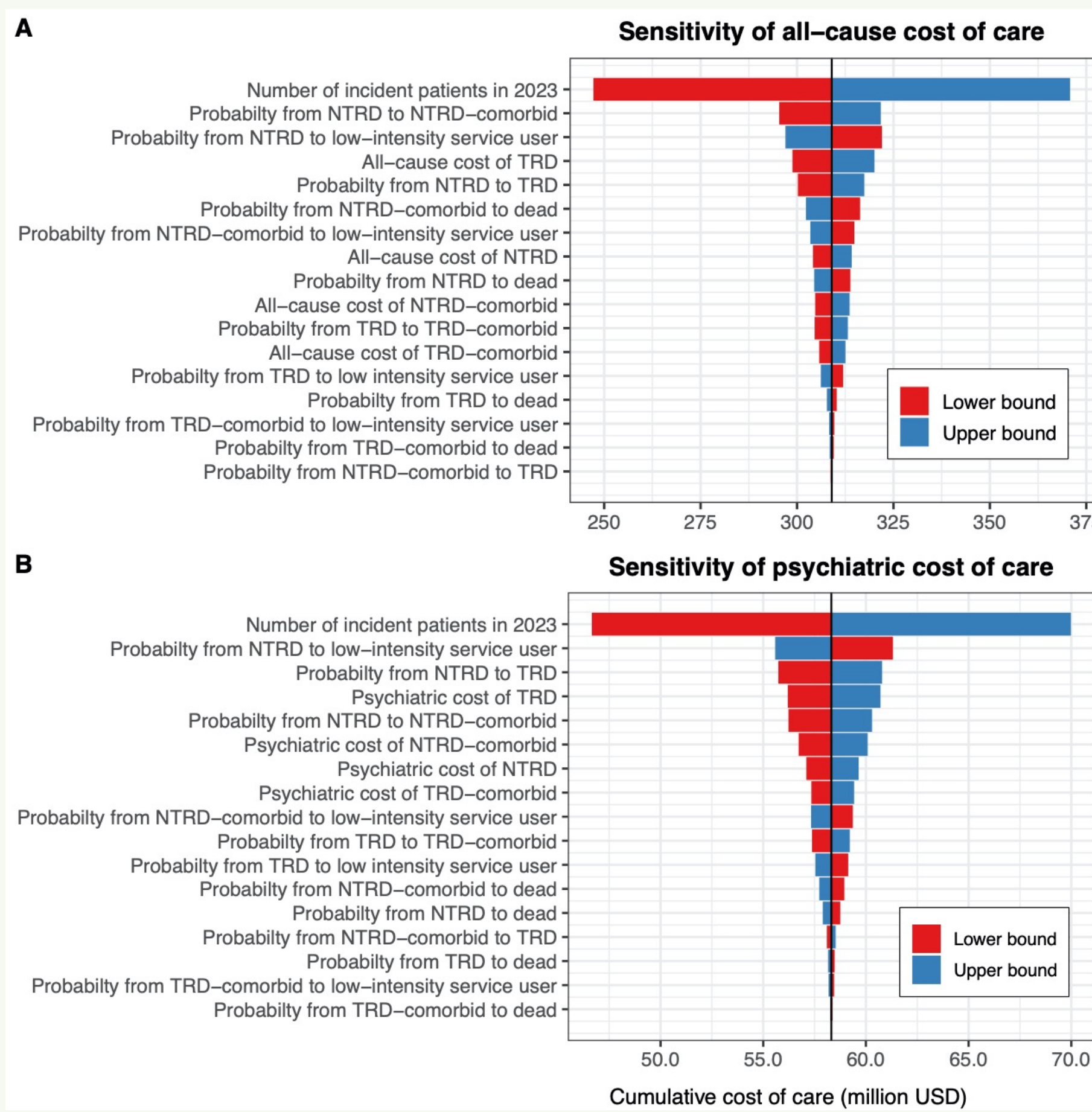
Model validation

- **Model structure:** Obtained face validity from local psychiatrists and health economists to ensure the modelled pathways feasibly reflected the actual clinical and economic context.
- **Comparison with local historical figures:** Projected number of prevalent patients (55,849–57,896 per year between 2023 and 2032) broadly aligns with the magnitude of the number of patients suffering from depression (64,700) in reported in 2021/22 by the Hong Kong government.
- **Comparison with local literature:** A local survey studying community-dwelling older adults estimated that the annual cost of all-cause healthcare and rehabilitation was USD6230 (valued in 2017/18) among patients with mild depression. Despite non-comparable results due to different study designs and patient categories, our study projected consistent costs of all-cause care per patient-year among older patients without medical history (USD5,349 and USD7,030 in women and men).

Conclusion

- Our projection model provides cost estimates over the next 10-year period to support resource allocation and budget planning to prepare for future care needs under alternative scenarios.
- TRD and comorbidity development will contribute to substantial costs in the real-world setting. These conditions deserve attention and appropriate resource allocation.
- Early intervention is key to cost-savings given the immense burden once patients proceed to TRD and/or comorbid health states.
- Our study demonstrates the value of applying RWE in chronic disease modelling.