Systems simulation methods for the economic evaluation of non-medicines and non-surgical interventions: a systematic literature review

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INTRODUCTION

Systems simulation methods provide a platform for virtual evaluation of intervention-induced changes in health and resource utilization over time incorporating competition, adaption, and learning of providers and users. Systems simulation may create useful predictions of value to inform funding decisions for the types of complex health interventions seen in public health and the third sector.

OBJECTIVE

To critique the application of agent based and system dynamics modelling in economic evaluations of complex, non-medicines and non-surgical interventions for health and wellbeing with a focus on quality of model reporting, economic evaluation reporting, and methods for reproducing health and health-related behaviours in model.

METHOD

34 healthcare, economics, and social science databases were systematically reviewed using pre-defined terms with no date limits. Data extraction and evaluation of reporting was via the CHEERS 2022 28-point checklist,[1] the 2023 ISPOR Task Force Guidance on the use of complex systems models for economic evaluations of public health interventions,[2] and a qualitative review of parameters and model logic for health and related behaviours.

RESULTS

From n=543 articles, n=17 studies met search strategy criteria (Fig. 1) with n=14 published since 2015. Interventions included mandatory physical education in schools, commuter cycling, and COVID-19 contract tracing.

Agent-based modelling featured in n=12 studies and system dynamics in n=6. There were n=4 instances of sequential hybrid models incorporating non-complex methods, and n=2 of complex hybrid models.

Complexity science methods were justified in all but one study.

Reporting of ISPOR standards for good model practice varied widely with stakeholder engagement, model verification, and calibration notably low (Fig 2). Sensitivity analyses were almost exclusively of costs and benefits with few instances of global sensitivity analyses.

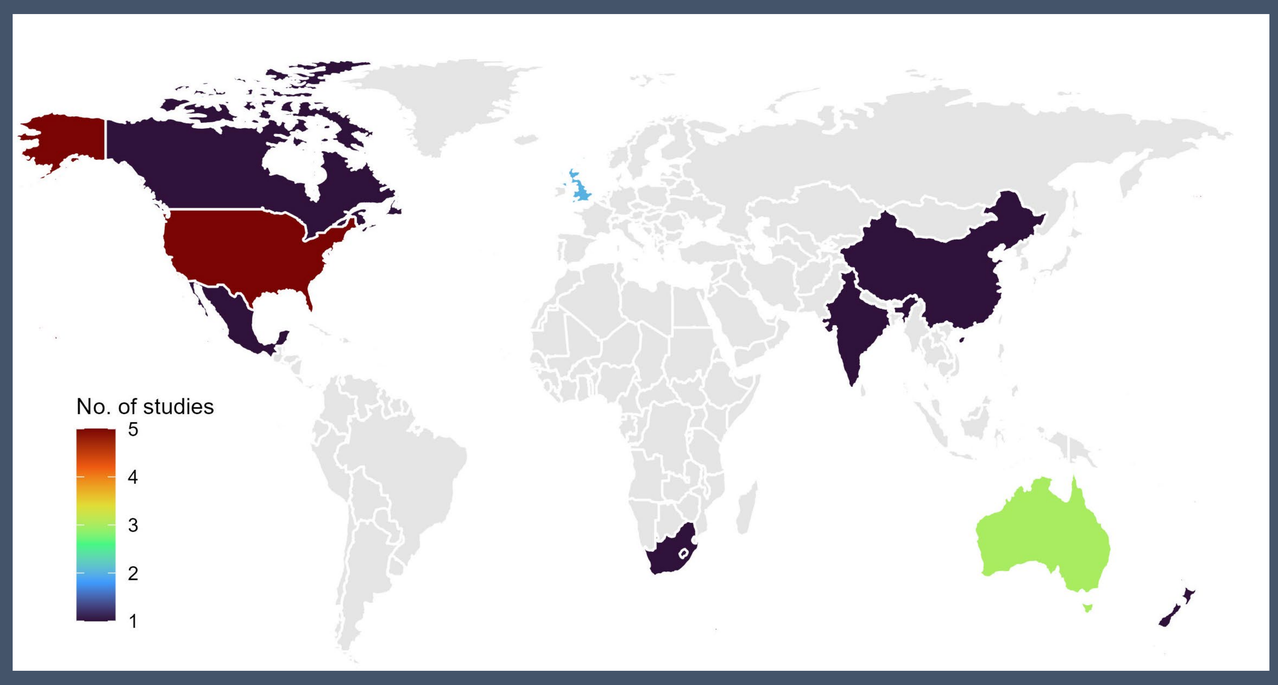

Figure 1: Study settings for evaluations found (no setting reported in n=2)

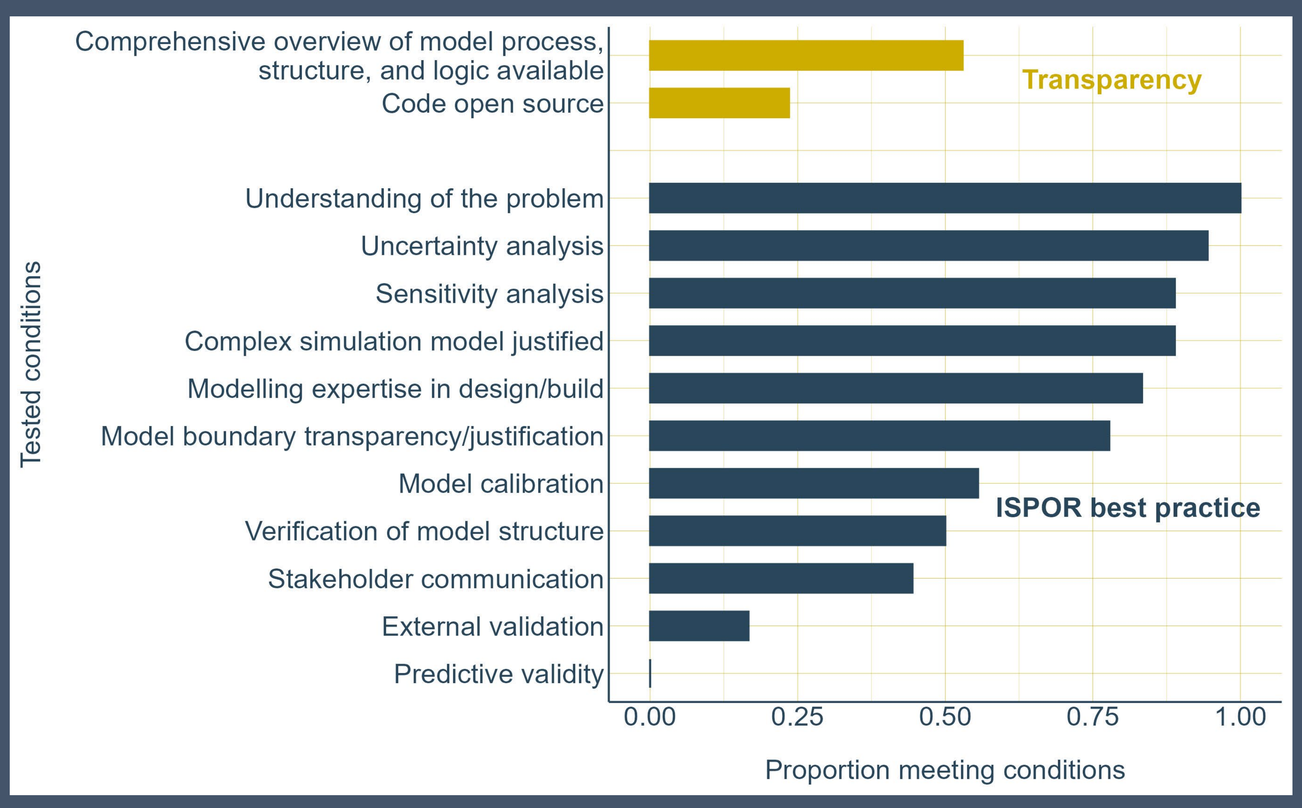

Figure 2: Compliance with model reporting standards

Reported use of the CHEERS checklist was modest (n=3).

- No studies reported on or justified exclusion of all 28-checklist items
- Reporting of time horizons, discounting, funder perspective, currency, and limitations were found in <75% of studies
- Explicit descriptions of studies as economic evaluations and descriptions of study populations were found in <50% of studies
- Heterogeneity of populations and distribution of outcomes featured in <25% of studies
- A health economics analysis plan was reported in n=1

Few studies included or linked to sufficient materials on model conceptualisation, building, structure, or logic to understand how health was modelled to emerge as a function of the intervention. Low availability of model documentation limited a comprehensive evaluation of techniques used to reproduce health-changing and resources utilization behaviours modelled.

CONCLUSIONS

The use of complexity science methods for economic evaluations of complex, non-medicine interventions is increasing but reporting quality and model transparency are modest. Additionally, few studies exploited the capabilities of simulation to explore equity of outcomes.

Future economic evaluations would benefit from guidance on standardised formatting of model documentation including how theory informed model logic, sources of theories for modelled behaviours, parameter value sources, validation, and the use of global sensitivity analysis potentially held within health economics analysis plans. This would help advance the method and support decision-maker appraisal of the usefulness of models and model findings.

REFERENCES

1. Husereau D, Drummond M, Augustovski F, de Bekker-Grob E, Briggs AH, Carswell C, Caulley L, Chaiyakunapruk N, Greenberg D, Loder E, Mauskopf J. Consolidated Health Economic Evaluation Reporting Standards 2022 (CHEERS 2022) statement: updated reporting guidance for health economic evaluations. MDM Policy & Practice. 2022 Jan;7(1):23814683211061097.
2. Breeze PR, Squires H, Ennis K, Meier P, Hayes K, Lomax N, Shiell A, Kee F, de Vocht F, O'Flaherty M, Gilbert N. Guidance on the use of complex systems models for economic evaluations of public health interventions. Health economics. 2023 Jul;32(7):1603-25.

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