A framework for developing open source economic models of mental health systems

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Abstract

Summary: There is strong in principle support for open source health economic models, but practical barriers limit their availability. We propose a set of principles and standards for the implementation of open source health economic models that are TIMELY - Transparent, Iterative, Modular, Epitomised and Yielding. We then describe a software framework that we have developed for developing TIMELY models in youth mental health and illustrate this framework with an open source utility mapping project.

Data: Data

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1 Introduction

Computational models have become an essential tool for healthcare policy development [1]. Although influential and widely used, these models routinely contain errors [2], are rarely adequately validated [3], can be difficult to reproduce [4–6] and are likely to be infrequently updated or revised [7]. To help address these issues, there is increasing in principle support for open source health economics models (OSHEMs) that grant open access to and liberal permissions to re-use model source code [8]. However, in-practice implementation of OSHEMs remains rare [9–11]. Barriers to adoption include concerns about intellectual property, confidentiality, model misuse and the resources required to support open source implementations [8,12]. As many health economic models are owned by pharmaceutical companies and consultancies, commercial considerations may also limit adoption of OSHEMs [11].

There is also a need to develop good practice guidance for implementing OSHEMs [13], which is currently scarce and piecemeal. Current health economist best practice guidelines on model transparency was published ten years ago [14] and contained recommendations on technical and non-technical model documentation but not about how model code and data are to be shared. More recent and more general guidance recommends the sharing of model code and data using repositories such as GitHub and Zenodo as well as the use of version control systems such as Git across the development lifecycle of a modelling project [1]. A coding framework for OSHEMs developed in the language R includes standardised approaches to directory structure and naming conventions[15].

As part of a project to develop an open source model of youth mental health, we have developed a framework that consolidates and refines these and other recommended standards for OSHEMs and provides a set of tools to help implement models that conform to these standards. In this paper we describe the rationale for and content of the framework we have developed and illustrate its practical application with a worked example.

2 Motivation

MH systems design is not a pharma led project - less concerns about commercial ownership

Mental disorders impose high health, social and economic burdens worldwide [16,17]. Much of this burden is potentially avertable [18], but poorly financed and organised mental health systems are ill-equiped for this challenge[19,20]. The large and widespread additional mental health burdens recently observed during the COVID pandemic[21] and predicted as a potential future consequence of global heating [22], highlight the need to improve the resilience and adaptability of these systems. To help stem growing demand for mental health services, policymakers have also been encouraged to place greater emphasis on tackling the social determinants of mental disorder[23].

Realising significant improvements in population mental health may in part depend on gaining better understanding of the systems in which mental disorder emerges and is treated [24]. Currently, the theoretical basis for understanding these systems is weak [25]. Strikingly, it remains unclear why increased investments in mental health care have yet to discernably reduce the prevalence and burden of mental disorders[26]. The literature about how the requirements, characteristics and performance of mental health services are shaped by spatiotemporal context is underdeveloped [27]. There is insufficient evidence to identify the social determinants of mental disorders most amenable to preventative interventions, and for which population sub-groups such interventions would be most effective [28].

Mental health simulation studies rarely explore the features and behaviours of complex systems [29], with mental health economic models predominantly addressing issues relating to the affordability and value for money of individual programs [30]. Single purpose models that assume static systems, even when sufficiently robust to be formally incorporated into Government resource planning processes, may be inadequate for the decision support needs of policymakers and service planners seeking to successfully identify, prioritise, sequence and target multiple elements of complex reform programs [31].

Multi-application, dynamic systems modelling approaches can provide insights about inter-dependencies between candidate policy settings that static models of isolated scenarios cannot [32]. However, greater use of these types of models may require adaptation on the part of funders, modellers and decision-makers. The complexity of multi-application systems models may make them particularly prone to errors [33], thus requiring greater investments in model transparency and validation [14]. These types of models can be highly resource intensive to develop and may also never be truly “finished”, instead requiring ongoing updates to remain relevant to evolving decision contexts [34] and to meet additional feature requests from end-users. The development, validation and maintenance of these types of models may be simply too onerous and long term a burden to remain the responsibility of a single modelling team and might benefit from collaborations across multiple modelling teams, and perhaps the general mental health modelling field. Similarly, more attention to developing partnerships between modellers and decision-makers across the life-cycle of a modelling project can help ensure multi-purpose models can address priority decision topics and have user-interfaces that meet the needs of non-technical users.

3 TIMELY principles and standards

4 ready4 Framework

5 Application

5.1 readyforwhatsnext

5.2 Worked example

6 Discussion

Availability of data and materials

Ethics approval

Details on ethics approvals go here.

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Conflict of Interest

None declared.

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A Appendix