CHOOSING THE RIGHT SOFTWARE FOR HTA ECONOMIC MODELS: A COMPARISON OF FOUR PROGRAMMES RECOMMENDED BY THE NATIONAL INSTITUTE OF HEALTH AND CARE EXCELLENCE

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INTRODUCTION

- The National Institute for Health and Care Excellence (NICE), in their recent guide to health technology appraisal (HTA), state that Excel, TreeAge, ‘R’ or WinBUGS/OpenBUGS are acceptable software for economic models for submissions1.
- Although NICE recommends a number of software applications, it is clear that Excel is currently the manufacturers’ preferred choice for economic models developed for HTA submissions².
- With the growing emphasis on open-source publishing of health economic models and the drive towards creating a database of health-economic models³ we aimed to first, assess the frequency of use of software applications in NICE HTA models and second, assess their suitability for producing stand-alone HTA decision-analytic models with a new focus on evaluating suitability from the perspective of producing openly available models.

OBJECTIVES

- To carry out a review of HTA submissions to quantify the frequency of use of each of the four software programmes.
- To compare each of the software programmes using a range of HTA, user and scientific community relevant criteria.

METHODS

- We reviewed the manufacturers’ submissions for all oncology related NICE technology appraisals published between September 2017 and September 2018 and documented the use of software programmes for developing HTA models.
- For each of the software programmes we found, we compared them across a range of criteria. First, we considered the HTA categories of reproducibility and transparency. We made our assessment from an open-source publishing viewpoint: therefore, we assessed reproducibility in terms of how easy it would be for the model to be reused and adapted if required, and we assessed transparency by considering how easy it would be for a collaborator or user to validate the model. We then compared the software on user-relevant criteria of cost, technical capability, processing speed and learning curve. Finally, we considered the ease of sharing and accessing a model built with each of the software programmes.

RESULTS

Review of submissions

- Excel was the dominant software in terms of frequency of use (see Figure 1). In the submissions reviewed, Excel was used in all but one.
- Where other software was used, it was in a supporting role to Excel, predominately due to the limitations of Excel (see Figure 2).
- If we consider those in the top 10% of submissions, TreeAge was mentioned in only one submission. BUGS software was only used to conduct network-meta-analysis. Due to this limitation in use, and the fact the R packages exist to interface with BUGS software without the need to code in the BUGS language⁴, we did not include it in our comparison of software programmes to create stand-alone HTA decision-analytic models.

Comparison of software programmes

- Excel: The interface means that it is easy to build a simple model from scratch. More complex models require the use of Visual Basic which is a more demanding task. The neat, difficulties, however, lies in adapting an existing model. Understanding the structure of the model and the underlying calculations is the main challenge.
- R: The structure of the model and the underlying calculations are all contained in the code script which can be readily shared for reproduction and adaptation. The model can be adapted readily by adding code. The plots that can be produced in R are more advanced and customisable than those that can be produced in either TreeAge or Excel. Excel is also more suitable for handling large datasets.
- TreeAge: Model components have been boiled down to building blocks which makes constructing a model easier but means there is less flexibility in the structure. Statistical computations need to be performed elsewhere and the results imported and used in the model.
- R: As a specialist statistical software, all aspects of the modelling can be conducted within R, including complex statistical evaluations. There is a vast range of well-documented packages available which allow users to utilise code already written by the R community, this can be immensely time-saving. The plots that can be produced in R are more advanced and customisable than those that can be produced in either TreeAge or Excel. Excel is also more suitable for handling large datasets.

Table 1. Time to Perform Probability Sensitivity Analysis on a complex cost-effectiveness model

- Although NICE recommends a number of software applications, it is clear that Excel is currently the manufacturers’ preferred choice for economic models developed for HTA submissions. However, it may not be the most suitable as the industry moves towards an open-source modelling framework.
- Most software programmes are suitable for some parts of the development of HTA-models, however some programmes are better than others across a range of HTA and user relevant criteria.
- The statistical limitations of Excel and TreeAge mean that additional software is often required as a result, additional documentation creates challenges for transparency and reproducibility.
- R software does not have these statistical limitations and all components of a model can be coded within R and therefore be conducted within the model. Simulations conducted by TreeAge within R, however, do not possess the same level of transparency and reproducibility required by NICE guidelines. Excel is also superior in terms of processing speed and cost since it is an open-source software.
- Network meta-analysis can be conducted within R, however, packages also exist to interact with BUGS software from R which is also an open-source software.

CONCLUSIONS

- Excel is still the dominant choice of software for decision-analytic models used in HTA submissions. However, it may not be the most suitable as the industry moves towards an open-source modelling framework.
- Most software programmes are suitable for some parts of the development of HTA-models, however some programmes are better than others across a range of HTA and user relevant criteria.
- The statistical limitations of Excel and TreeAge mean that additional software is often required as a result, additional documentation creates challenges for transparency and reproducibility.
- R software does not have these statistical limitations and all components of a model can be coded within R and therefore be conducted within the model. Simulations conducted by TreeAge within R, however, do not possess the same level of transparency and reproducibility required by NICE guidelines. Excel is also superior in terms of processing speed and cost since it is an open-source software.
- Network meta-analysis can be conducted within R, however, packages also exist to interact with BUGS software from TreeAge should be preferred.
- While R has a steeper learning curve in comparison to the other software, the time spent learning the programming language is often offset by the time saved in debugging and validating the model due to its transparent nature and runtime for larger and more complex models.
- Of importance to the wider scientific community, software programmes like R are also suited to sharing models online and therefore support both reproducibility and subsequent modification of economic models thus adding to the advancement of scientific research.

REFERENCES