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## SYSTEMATIC REVIEWS

## A Systematic Review of Research Guidelines in Decision-Analytic Modeling



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## ABSTRACT

**Background:** Decision-analytic modeling (DAM) has been increasingly used to aid decision making in health care. The growing use of modeling in economic evaluations has led to increased scrutiny of the methods used. **Objective:** The objective of this study was to perform a systematic review to identify and critically assess good practice guidelines, with particular emphasis on contemporary developments. **Methods:** A systematic review of English language articles was undertaken to identify articles presenting guidance for good practice in DAM in the evaluation of health care. The inclusion criteria were articles providing guidance or criteria against which to assess good practice in DAM and studies providing criteria or elements for good practice in some areas of DAM. The review covered the period January 1990 to March 2014 and included the following electronic bibliographic databases: Cochrane Library, Cochrane Methodology Register and Health Technology Assessment, NHS Economic Evaluation Database, MEDLINE, and PubMed

(Embase). Additional studies were identified by searching references. **Results:** Thirty-three articles were included in this review. A practical five-dimension framework was developed that describe the key elements of good research practice that should be considered and reported to increase the credibility of results obtained from DAM in the evaluation of health care. **Conclusions:** This study is the first to critically review all available guidelines and statements of good practice in DAM since 2006. The development of good practice guidelines is an ongoing process, and important efforts have been made to identify what is good practice and to keep these guidelines up to date.

**Keywords:** decision-analytic modeling, good practice, guidelines, methods, modeling.

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## Introduction

Decision-analytic modeling (DAM) in health care has been widely used to synthesize clinical and economic evidence and to inform resource allocation decisions for the purpose of allowing scarce health care resources to be allocated more efficiently [1]. In simple terms, in DAM, a model is structured to represent clinical pathways to examine whether an intervention, compared, for example, with current practice, is cost-effective [2]. Building a model requires consideration of important elements including the complexity of the clinical area, the available evidence related to the disease, as well as other issues such as the scope or boundaries of the model, the appropriate time horizon, the perspective of the analysis, the availability of data, and a formal synthesis of evidence within the model [2,3]. The increasing use of DAM in the economic evaluation of health care interventions and health technology assessments (HTAs) requires the use of sound analytic methods and consideration of the requirements of good practice.

The aim of this study was to perform a review to identify and critically assess good practice guidelines, highlighting areas in which these have failed to provide recommendations, with emphasis being given to more recent developments. In this study, we define DAM as a method that “uses mathematical relationships to define a series of possible consequences that would flow from a set of alternative options being evaluated” [4].

## Methods

A systematic review of articles written in English was undertaken with the aim of identifying published guidelines on DAM in health care. The following types of studies were included: guidelines for DAM or HTA and other published articles on good practice in DAM. On the basis of an assessment of their title and abstract (if available), articles were deemed potentially relevant for inclusion if they 1) provided general guidance in

Conflicts of interest: The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Health Economics Unit or the University of Birmingham.

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DAM for health care or HTA or 2) provided general criteria against which to assess good practice in DAM (e.g., a checklist).

This review excluded guidelines on 1) trials or economic evaluations alongside clinical trials, 2) other non-DAM studies including statistical or econometric models, and 3) conference abstracts or other non-DAM articles.

### Search Strategy

An initial exploratory approach was undertaken using search terms used in a previous review [5], and this helped inform the final search terms used in this review. The relevant literature was also obtained by checking the references of the included articles.

The following bibliographic databases were searched: The Cochrane Library, Cochrane Methodology Register, Cochrane Health Technology Assessments, NHS Economic Evaluation Database, Embase, and MEDLINE. To avoid duplication, the PROSPERO database of prospectively registered systematic reviews in health and social care was searched for any existing or ongoing reviews that addressed similar topics, and none was identified. This review covered the period from January 1990 to March 2014. This is a period that reflects the development of guidelines for DAM in health care and the consolidation of good practice guidelines.

### Selection of Articles for Review

Titles and abstracts (if available) were screened against the inclusion criteria to identify potentially relevant articles. In total, 33 studies, corresponding to general guidance or elements of good practice in DAM, were included in this review. A flowchart illustrating the study selection process is shown in Figure 1. The methodological quality of the articles included in this study was not comprehensively assessed using formal checklists because of the diversity of the literature included and the nature of the review.

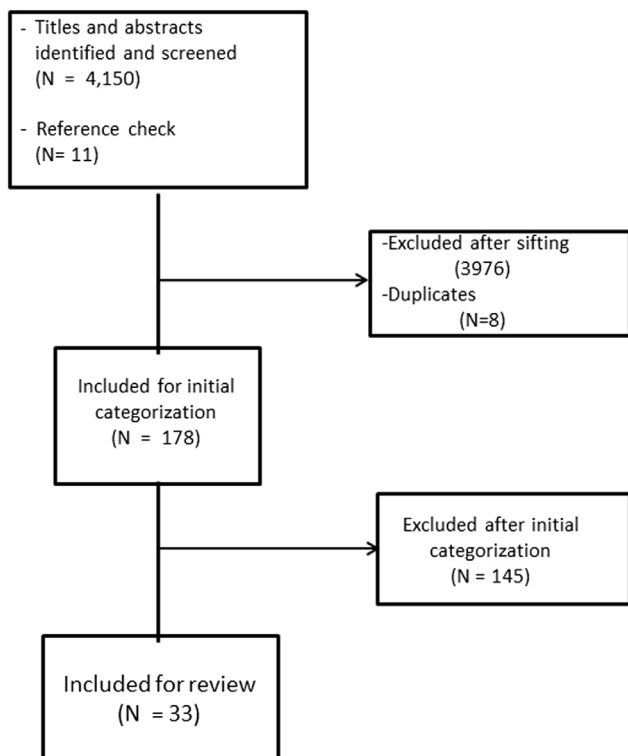


Fig. 1 – Flow chart.

### Data extraction

All studies were manually searched, and data were extracted by the first author from each article using a data extraction form. The data extraction form was developed to retrieve and organize information from each article on the basis of its main topic, model structure, model uncertainty, model transparency, and validation. The data extraction form was developed through a process in which the content of the articles informed the “areas” that the data were extracted under. This approach was used to ensure that the review did not miss any information related to the model-building process. The data were extracted as free text and in the form of a “yes/no” response.

### Results

The DAM guidelines identified in this study have responded to the need to reflect on how good practice in the field has been defined; the need to keep pace with the rapid progress in the way that economic evaluation methodology has progressed since the 1980s; and as a means to ensure that guidelines for good practice remain current, effective, and helpful. More comprehensive guidelines, for example, Philips et al. [5] or the set of the International Society for Pharmacoeconomics and Outcomes Research and the Society for Medical Decision Making (ISPOR-SMDM) guidelines, have been developed as part of bigger projects, that is, an HTA project involving experts from prestigious academic institutions or as part of a “task force,” respectively (see the Elements of Good Practice for DAM section).

Recommendations and statements of good practice have been proposed following the application of different methods; for example, Philips et al.’s synthesized good practice guidance and accompanying checklist resulted after taking each theme and subtheme identified in a systematic review of guidelines followed by technical discussions among the research team of its relevance in relation to the development of general guidelines [5]. Guidelines produced by ISPOR-SMDM resulted from a task force consisting of expert developers and experienced users of models from academia, industry, and government, with representation from many countries. A decision was made to divide the DAM topic into six components and working groups, respectively; three of these groups covered aspects relevant to all models such as the conceptualization of a model, the estimation of model parameters and handling of uncertainty, and the validation of models and issues of transparency. The other three components considered specific techniques: state-transition modeling, discrete event simulation, and dynamic transmission models. The working groups produced draft reports for each section, and in contrast to Philips et al. there was no systematic attempt to review the literature. The first draft of recommendations represented the opinions of the experts in the task force, and these were posted on the ISPOR and SMDM Web sites for comment by the general membership of the societies. A second group of experts—again, with broad representation of modelers and users of models—was invited to formally review the articles. Their comments were addressed and after receiving any additional comments and considering any further revisions, the final version of each article was prepared and released to the public (see the Elements of Good Practice for DAM section).

Of the 33 articles included in this review, 15 studies provided general guidelines for good practice or criteria in the form of a checklist. Eighteen articles were focused on particular elements of good practice, for example, model structure or uncertainty, or model transparency and validation.

### Elements of Good Practice for DAM

Fifteen studies provided general guidelines for good practice; 8 of the 15 guidelines were released before 2012 [5–13], with the

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