Modelling the expected net benefits of interventions to reduce the burden of medication errors


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

CRD summary
The study examined the clinical and economic impact of three approaches (computerised physician order entry, additional ward pharmacists and bar coding) to reduce medication errors in hospitals. The authors concluded that interventions aimed at reducing medication errors have the potential for cost-effectiveness. The quality of the methodology appears good, although more information on the sources used for the clinical estimates would have been useful. The authors’ conclusions depend strongly on the assumptions made, but the extensive sensitivity analysis corroborates the model findings.

Type of economic evaluation
Cost-benefit analysis

Study objective
The aim of the study was to examine the clinical and economic impact of three approaches to reducing medication errors in hospitals. The approaches were computerised physician order entry (CPOE), additional ward pharmacists and bar coding. Medical errors included wrong prescription of drugs, dosages and/or frequency.

Interventions
The three interventions under examination were CPOE, additional pharmacists participating on ward rounds and a bar coding system. The three interventions were compared against a baseline no-intervention scenario.

Location/setting
UK/hospital.

Methods
Analytical approach:
The authors stated that the framework of the analysis was a prospective hazard and improvement analysis (PHIA). This describes the quantitative representation of pathways leading to hazards, to which interventions that aim to reduce hazards can be applied. The structure of the decision tree model was depicted. A 5-year time horizon was considered. The authors stated that the perspective of the health care system (i.e. the National Health Service, NHS) was adopted in the analysis.

Effectiveness data:
The approach used to identify relevant sources of the effectiveness of the intervention was described in full in a separate paper. The authors stated that these estimates were subjectively defined on the basis of evidence from the literature, augmented with data from an expert elicitation workshop. The key clinical estimates were the rates of preventable adverse drug events (pADEs).

Monetary benefit and utility valuations:
As no relevant published data were found, utility valuations used in the analysis were subjectively defined by the authors. Then, a monetary value of between £20,000 and £30,000 was assigned to each quality-adjusted life-year (QALY) gained, based on the guidelines of the National Institute for Clinical Excellence (NICE). Minimum and maximum values were specified in order to take account of the uncertainty around utility values.
Measure of benefit:
The summary benefit measure was the QALYs. These were estimated on the basis of authors' opinions and were converted to monetary values, as already reported. Two scenarios for each severity category were considered; these reflected the lower and upper estimates of the QALY effects. The authors calculated the economic value of the health lost as a result of a pADE. The incidence of pADEs was also reported as a model output required in the calculation of QALYs.

Cost data:
The analysis included the costs associated with the implementation of the three interventions and the costs of medication errors and treatment of pADE. The cost-savings associated with reduced treatment for pADEs were also factored into the analysis. Other categories of costs were efficiency effects related to CPOE systems and NHS litigation costs of medication errors. The costs of CPOE and bar coding were derived from US studies, while the costs of additional pharmacists were based on national UK salaries. The whole cost analysis assumed an acute hospital size of 400 beds with around 14 wards. Other costs came from relevant national sources. The price year was 2006. The costs were in UK pounds sterling (£).

Analysis of uncertainty:
A Monte Carlo simulation was undertaken using pre-specified probability distributions for model inputs of the non-intervention scenario. Details on the probabilistic calibration of the model were presented in a separate article. The results were presented using maximum and minimum intervention costs.

Results
In a 400-bed hospital with approximately 162,000 prescriptions per year, the incidence of pADEs was 432 (range: 224 to 650) with no intervention, 263 (range: 123 to 416) with CPOE, 286 (range: 149 to 438) with ward pharmacists and 362 (range: 186 to 557) with bar coding. Thus, all the interventions were effective in reducing medication errors.

The cost of the intervention was estimated at between £0.275 and £3.85 million (first year) for CPOE, between £0.21 and £0.37 million for ward pharmacists and between £0.434 and £0.724 (first year) for bar coding.

Annual cost-savings due to reduced treatment costs of pADEs were about £0.2 million for each intervention. Thus, when the analysis considered only health care service costs, none of the three interventions produced positive net benefits, especially assuming the upper limit of intervention costs. However, the predicted annual mean monetary loss due to pADEs in terms of health gains was £17 million for no intervention, £10.5 million with CPOE, £11.3 million with ward pharmacists and £14.35 million with bar coding. Therefore, when the economic value of health lost was included in the analysis, all the interventions led to economic benefits in comparison with the current no-intervention scenario, with mean net benefits of £31.5, £27.25, and £13.1 million over a 5-year timeframe for CPOE, ward pharmacists and bar coding, respectively.

Authors' conclusions
The authors concluded that interventions aimed at reducing medication errors have the potential for cost-effectiveness, especially when including the monetary value of lost health. The authors stated that future studies should collect data on both the severity of pADEs occurring at different intervention groups and the monetary value attached to the prevention of these effects.

CRD commentary
Interventions:
The selection of the comparators appears to have been appropriate. The no-intervention scenario is likely to represent the standard approach in several medical institutions. A description of the three alternative strategies under examination was provided.

Effectiveness/benefits:
Little information on the derivation of the clinical estimates was provided, as the bulk of the clinical analysis was published in a separate study. Thus, from the information provided in the present paper, it is not possible to judge the validity and robustness of these estimates. The approach used to derive the benefit measure was partially described and...
followed recommendations by NICE, which use QALYs as the most appropriate benefit measure.

**Costs:**
The economic analysis appears to have been consistent with the authors' stated perspective. Data on the sources of the costs were presented clearly, although the costs were not broken down but, instead, presented as macro-categories. The price year was reported, which will help if replicating the analysis in other time periods. The whole cost analysis referred to a large acute hospital and may not be generalisable to smaller institutions providing different services.

**Analysis and results:**
The synthesis of the costs and benefits followed the approach of the net benefit that was clearly described. The results of the analysis were presented for different scenarios, which enhances the external validity of the study. The structure and key pathways of the decision model were explicitly described and commented upon. The authors acknowledged that the study was limited by the need for assumptions and the lack of high-quality data on clinical estimates.

**Concluding remarks:**
The quality of the methodology appears good, although more information on the sources used for clinical estimates is needed. The authors’ conclusions depend strongly on the assumptions made, but the extensive sensitivity analysis corroborates the model findings.

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**Bibliographic details**

**Other publications of related interest**


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