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Estimating the Cost-Effectiveness of Implementation: Is Sufficient Evidence Available?

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ABSTRACT

Background: Timely implementation of recommended interventions can provide health benefits to patients and cost savings to the health service provider. Effective approaches to increase the implementation of guidance are needed. Since investment in activities that improve implementation competes for funding against other health generating interventions, it should be assessed in term of its costs and benefits. **Objective:** In 2010, the National Institute for Health and Care Excellence released a clinical guideline recommending natriuretic peptide (NP) testing in patients with suspected heart failure. However, its implementation in practice was variable across the National Health Service in England. This study demonstrates the use of multi-period analysis together with diffusion curves to estimate the value of investing in implementation activities to increase uptake of NP testing. **Methods:** Diffusion curves were estimated based on historic data to produce predictions of future utilization. The value of an implementation activity (given its expected costs and effectiveness) was estimated. Both a static population and a multi-period analysis were undertaken. **Results:** The value of implementation interventions encouraging the utilization of NP testing is shown to decrease over time as natural diffusion occurs. Sensitivity analyses indicated that the value of the implementation activity depends on its efficacy and on the population size. **Conclusions:** Value of implementation can help inform policy decisions of how to invest in implementation activities even in situations in which data are sparse. Multi-period analysis is essential to accurately quantify the time profile of the value of implementation given the natural diffusion of the intervention and the incidence of the disease.

Keywords: cost-effectiveness, heart failure, implementation, natriuretic peptide (NP) testing.

Introduction

International Adoption of Health Technologies

Problems with slow adoption of health technologies exist internationally. A study which examined the differential international diffusion of six health innovations found that rates of adoption varied significantly between innovations and countries [1]. The international OECD project found that there is widespread variation in the uptake and diffusion of healthcare technology amongst OECD countries, indicating that there are opportunities for more effective integration of such technologies into the health system. The report comments encouraging the uptake of the most efficient and effective healthcare technologies remains a significant policy challenge in many OECD countries [2].

Implementation of National Institute for Health and Care Excellence Clinical Guidelines

In England, the National Institute for Health and Care Excellence (NICE) produces clinical guidelines and technology appraisals for the UK National Health Service (NHS). Recommendations are made based on effectiveness and cost-effectiveness. Interventions (both treatments and diagnostics) which are recommended by NICE should be available to patients in England and Wales on the NHS. Indeed the NHS has an obligation to implement NICE technology assessments within three months of publication [3]. However, uptake of new guidance can be suboptimal [4–9]. For example, heat maps for the use of medical technologies and primary care medicines show that there is wide variation between the medicines patients can access in one part of England compared with other parts [4]. It also shows that implementation

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rates may vary between disease types; for example, cancer patients may be well informed and request new treatments. Cost-effective technologies can only benefit patients and the health care service if they are used in practice.

Timely implementation of recommended interventions has the potential for benefits in terms of gains in Quality-Adjusted Life-Years (QALYs) to patients and/or cost savings to the NHS. It is possible to ensure that technologies are used in practice by investing in implementation activities. Early work aimed at improving implementation was primarily focused at medical staff [10]. However, this has been supplemented by a wider range of policy initiatives aimed at promoting the uptake of health technologies [11]. These include: mandatory inclusion in the hospital formularies; financial incentives to providers (such as the Quality and Outcomes Framework (QOF) and Commissioning for Quality and Innovation (CQUIN) scheme); regulatory measures (such as the NICE compliance regime, benchmarking and leading by example); initiatives by local NHS organizations; and the NICE implementation program [11]. Further investment in initiatives designed to promote implementation may lead to benefits to patients and the NHS. The key question is: How and how much should be invested in implementation initiatives given that those funds could also be used for other health-generating activities?

Methods to Evaluate Implementation Initiatives

There are methods to evaluate whether it may be worth investing in initiatives to speed up implementation. Mason and colleagues developed a simple deterministic framework to show how the cost-effectiveness of behavior change was a function of population size, together with the cost-effectiveness of the health technology and the cost-effectiveness of the behavior change intervention [12]. More recently, Fenwick et al. developed a unified framework that brought together value of information methods with the issue of implementation. This framework allowed a probabilistic evaluation of investments in implementation initiatives as expressed through the concepts of expected value of perfect and specific implementation [13]. This framework was extended further by Hoomans et al and Willan and Eckermann and then applied to an NHS policy initiative by Walker et al. [14-16].

Walker et al. developed further the previous work on value of implementation to include patient subgroups, multiple patient cohorts over time, and the impact of natural diffusion [17]. Walker et al. defined three concepts, based on those proposed by Fenwick et al., which are described here. The *expected value of perfect implementation* represents the maximum that can be gained from achieving full implementation and as such represents a maximum the NHS would be willing to pay. The *expected value of actual implementation* represents the maximum the NHS can invest in implementation activities for specific increases in utilization (i.e., for a specified % increase). All things equal, the expected value of actual implementation is larger for interventions with more favorable cost-effectiveness estimates or with larger patient populations. The *value of the implementation activity* is the difference between the expected value of actual implementation and the cost of the implementation activity. The value of the implementation activity is larger the smaller the costs and the larger the increase in utilization (effectiveness).

This article reports on the application of the value of the implementation framework to the case study of natriuretic peptide (NP) testing for the diagnosis of chronic heart failure (HF) [18]. NP testing was deemed to be cost-effective but has variable uptake; hence, we were interested in knowing the value of investing in implementation activities to increase the uptake of NP testing. We note that the uptake of NP testing is changing over time in the absence of implementation activities (natural diffusion). Also, we wanted to estimate the investment for both the current prevalent population and future cohorts presenting (given the future natural diffusion). This case study demonstrates how to estimate the value of implementation for multiple patient cohorts over time.

Methods

First, the data and assumptions used for the NP testing case study are described in the next five subsections and subsequently single-period and multi-period analyses undertaken are described in the last subsection.

NP Testing for Suspected HF

B-type natriuretic peptides (B-type natriuretic peptide [BNP] or N-terminal pro–B-type natriuretic peptide [NTproBNP]), referred to as NPs, are markers of HF. In 2010, NICE released clinical guideline 108 (CG108) on the diagnosis and management of HF. One of the recommendations in CG108 is testing for NPs in patients with suspected HF without previous myocardial infarction (MI) in order to accelerate diagnosis and avoid unnecessary echocardiography [18].

The standard of care for trusts that are not yet utilising NP testing is not dependent on MI history. Typically either a NP test, electrocardiogram (ECG), or both are used to rule out HF for all patients independent of MI history. CG108 recommended that patients with previous MI be referred to specialist assessment and ECG within 2 weeks. CG108 recommends NP testing for patients without previous MI:

- If NP testing shows high levels (BNP $>$ 400 pg/ml or NTproBNP $>$ 2000 pg/ml), the patient is referred directly to specialist assessment and ECG within 2 weeks.
- If NP testing shows raised levels (BNP 100–400 pg/ml or NTproBNP 400–2000 pg/ml), the patient is referred to specialist assessment and ECG within 6 weeks.
- If NP testing shows normal levels (BNP $<$ 100 pg/ml or NTproBNP $<$ 400pg/ml), HF is unlikely and the patient is not referred further.

Cost and Effectiveness Data for NP Testing

The value of NP testing corresponds to the lifetime net benefit from using NP testing for the diagnosis of HF, as described in NICE CG108, for the average patient presenting with suspected HF. The economics of the diagnostic section of NICE CG108 was informed by the health technology assessment (HTA) report by Mant et al. [19]. However, the cost-effectiveness analysis did not match the decision problem faced by commissioners in two important ways: 1) use of diagnostic pathways was determined by MICE (Male, Infarction, Crepitations, Edema) score rather than by the history of MI as indicated in CG108 and in clinical practice and 2) in the comparison, current care is “do nothing” rather than ECG [20]. Consequently, the model and results from the Mant et al. HTA needed to be adapted to more closely represent the CG108. Whilst the lack of ECG as a comparator could not be resolved within this project, data obtained from the Mant et al. HTA on MICE score frequencies allowed cost-effectiveness by MI history to be estimated. The incremental values for CG108 versus “do nothing” for 1000 persons with suspected HF were calculated based on data from Mant et al. and are £3881 and +76.4 QALYs (See appendix for full details of calculations).