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# Retrospective Costing of Warfarin

**Abstract:**

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**Abstract**  
In Ireland, there are four anticoagulants available for prescribing to patients with atrial fibrillation for stroke prevention. A key feature of the three most recent anticoagulants is that monitoring is redundant. Despite this, there is continued prescribing of the incumbent anticoagulant, warfarin, which requires monitoring. Lack of information regarding the cost of monitoring, and the extra burden it places on health budgets and patients, motivated this costing study. Using micro costing, the costs of warfarin treatment (including monitoring) was disaggregated and isolated from both the patientsâ and health care providerâs perspectives in a Cork hospital. Costs to the health care provider per patient per clinic visited were 21.57. Patient costs incurred per patient per clinic were 48.50. Thus, the total costs per patient per visit were 70.07. This result reveals that while the pharmaceutical cost of warfarin is low; it is not an inexpensive therapy when monitoring costs are considered.

## Introduction

Traditionally in Ireland and the United Kingdom, atrial fibrillation (AF) patients have been anticoagulated with warfarin. Warfarin is well established in the market and has a low pharmaceutical cost base. However, patients prescribed warfarin require monitoring to ensure clinical effectiveness and to minimise bleeding risk, using the international normalisation ratio (INR). Recently however, relatively more expensive novel anticoagulants, with Factor Xa and direct thrombin inhibitors (Rivaroxabon (Xareltofi) , Dabigatran etexilate (Pradaxa) and Apixaban (Eliquisfi)), have come to market and have been deemed to be cost effective in the Irish health care system for the prevention of stroke in AF. These are given in a fixed dose and do not require monitoring. Despite these advances warfarin prescribing continues. The purpose of this study is to describe the costs incurred with monitoring warfarin so the full cost of warfarin treatment can be incorporated into adoption decisions. Using a micro costing approach this study disaggregates and isolates the costs of warfarin treatment from both the patientsâ and health care providerâs perspectives. To facilitate this study primary data was collected in an outpatientâs clinic at a Cork based hospital.

## Methods

A bottom up approach, using micro costing, is employed to estimate the costs associated with monitoring warfarin per incidence in a Cork based clinic. This requires identifying, measuring and valuing the resource impact of the treatment in monetary terms<sup>1,2</sup>. The resources identified are consistent with existing literature<sup>3,4</sup>. The quantity and value of the resources consumed are obtained from a combination of sources as recommended by Larg and Moss<sup>5</sup>. These include patient surveys; observational studies of health care professionals and hospital database.

In 2011 ethical approval was granted from the hospital ethics committee to conduct a survey amongst registered warfarin patients at the clinic in the Mercy University Hospital, Cork. The sampling frame included 178 patients over 18 years of age registered with the clinic. Using convenience sampling over a six month period a sample of 158 patients was collected. As the majority of the patients attending the clinic were elderly the data was collected using a semi-structured interview to accommodate different levels of literacy. Although time consuming it led to a more complete dataset than expected with observational or diary studies employed elsewhere<sup>6</sup>. To measure health care provider resources consumed an observational study was performed in the clinic in 2011. The resources measured here included consumables, laboratory analysis and labour resources (laboratory, nursing and administrative). Evidence from the hospitalâs Finance Department databases were employed to estimate the market prices and costs of the resources identified and measured in the observational study.

In addition to the usual parameter and structural uncertainties present<sup>6</sup>, external observational studies and convenience samples may yield biased cost estimates<sup>7</sup>. A probabilistic sensitivity analysis (PSA) was performed as a means of addressing these uncertainties in the parameters<sup>8</sup>. This required characterising uncertainty in input parameters; propagating uncertainty through the model using a Monte Carlo simulation and presenting the implications of parameter uncertainty<sup>9</sup>.

## Results

### Patient Costs

The results of the semi-structured interview revealed that there are three categories of patient costs: travel, waiting time and additional costs (including food). The average age of the patients in the sample was 70 years. From examining previous literature this age profile is typical of a population prescribed warfarin<sup>10</sup>. The average distance travelled to the clinic was 11.44km, with an associated standard deviation of 15.16km. The results revealed that 31% used public transport and the remainder used private transport as a means of travelling to the clinic. The average spend on public transport was 14.03 with an associated standard deviation of 5.93. Using public sector mileage rates of 0.64 per km, the average travel cost for using private transport was 5.02 (given that 69% of patients utilised private transport). In addition, 44% incurred parking expenses averaging at 4.25, with an associated standard deviation of 1.37.

The average time spent at the clinic (including waiting time) was 2.13 hours. From the patientâs perspective there is an opportunity cost associated with this time, irrespective of employment status<sup>11</sup> (7% in employment, 93% not in employment). In valuing this opportunity cost a distinction was made between those in employment, and not in employment. For those in employment, the opportunity cost was valued using the national average wage, 21.93<sup>12</sup>. While for those not in employment the national minimum wage, 8.65<sup>13</sup>, was applied. In addition, 35% of patients had a companion with them. To value the cost of their time the national average wage, 21.93<sup>14</sup>, was again applied. Finally, 25% of patients incurred additional costs (food etc.) averaging at 1.82, with an associated standard deviation of 4.07. Thus total patient costs incurred, per patient, per clinic attended was 47.16, with a standard deviation of 1.15 revealed in the probabilistic sensitivity analysis.

### Health Care Provider Costs

The costs to the health care provider were classified as laboratory, staffing and overhead costs. With regard to laboratory costs, the consumables identified were: syringes, test tubes, sample plates, reagent tubes and analysers. The observational study revealed one of each consumable is utilised per patient, per clinic visit. The costs for each consumable were sourced from the Finance Department in the hospital, shown on Table 1, averaging 0.64 per patient, per clinic<sup>15</sup>. There are also wage costs associated with the laboratory analysis. Using the Department of Health salary scales<sup>16</sup> the median point on the scale for a senior laboratory technician was selected, PRSI and pension costs were added (as per HIQA guidelines<sup>17</sup>) and the hourly cost was estimated as 27.77 (see Table 2, as per Government guidelines<sup>18</sup>). The observational study revealed that there are 25 patients per clinic and technicians can analyse 15 tests per hour. Therefore, the average cost of the laboratory analysis per clinic was 46.29 or 1.85 per patient, per clinic visit.

Staff costs were also incurred for nursing and administrative staff. The observational study conducted provided the

estimates of staffing resources and time. An administrator is employed for five hours per clinic at an hourly rate of 20.47 per hour (estimated as per HIQA<sup>1</sup> and Government guidelines<sup>2</sup>, Table 2). The costs per clinic were 102.37 and given 25 patients were scheduled per clinic; the average cost per patient, per visit was 4.09 (see Table 2). Similarly, at an hourly rate of 22.95 for a nurse (see Table 2) the cost per clinic was 344.25 with three nurses, which equates to 13.77 per patient, per clinic visit. Overheads were estimated at 40% of basic wage costs, as per HIQA guidelines<sup>3</sup>. As shown in Table 3, overheads were 30.35 per clinic (assuming one hour of overhead cost per clinic). This equates to 1.21 per patient per clinic visit. The total health care provider costs incurred, per patient, per clinic attended was 21.57 (the probabilistic sensitivity analysis revealed a standard deviation around this of 0.06).

With respect to assigning distributions to the parameters for the probabilistic sensitivity analysis: Beta distributions were applied to method of transport, parking and waiting time parameters where there was a probability of an event occurring. Gamma distributions were applied to the cost parameters as they were positive and continuous. The input parameters and 95% confidence intervals surrounding the outputs are presented on Table 4.

Discussion

Owing to population growth, aging populations and rising health care costs (including prescription drugs), health budgets worldwide are coming under increasing pressure to deliver value for money health care. Changing demographics like this result in a shift in health care demands. One condition which has received attention in this respect is thromboembolic cerebrovascular disease (stroke). It is estimated that stroke is the second most common causes of death worldwide and responsible<sup>4</sup> for 10% of deaths. While for those who survive there is a significant degree of disability resulting in dependence<sup>5,16</sup>. In Ireland it is estimated<sup>19</sup> that 10,000 individuals with stroke are admitted to hospitals per annum and strokes account for 7% of mortality<sup>11</sup>. Furthermore it is estimated that the total cost of managing stroke patients is Ireland is in excess of 1,044 million<sup>11</sup>. In light of this increased risk, AF patients are treated with anticoagulants like warfarin to reduce the risk of stroke<sup>20</sup>. The monthly pharmaceutical cost of warfarin is 2.13 per patient<sup>21</sup>, with additional monitoring warranted to ensure clinical effectiveness. Lack of information regarding monitoring costs, and the extra burden on health budgets and patients, motivated this costing study. Using micro costing the costs of warfarin treatment was disaggregated and isolated from both the patientsâ and health care providersâ perspectives in a Cork hospital.

This study using micro costing estimated the total cost of monitoring (including total patient and health care provider costs) per patient, per visit at 70.07 (the probabilistic sensitivity analysis revealed a standard deviation around this of 1.15). In addition, patients have on average two clinic visits per month and require in the first year of therapy an in-patient stay of 4-5 days at an estimated cost of 4,747 (given an average cost per bed day of 949, indicated 850 average cost per bed day, this is adjusted for inflation<sup>22</sup>). In contrast, novel anticoagulants do not incur these monitoring costs. Although the pharmaceutical cost of warfarin is low; our study reveals it is not an inexpensive therapy when monitoring costs are considered. This study highlights the significant costs of monitoring warfarin for patients and health care provider, which were not previously measured. With an aging population and an increased risk of the incidence of strokes, health care budgets are under increased pressure. This retrospective, single centre costing study demonstrates how by broadening the perspective of cost analyses the full costs of warfarin can be considered. Given their significance, such monitoring costs should be incorporated into adoption decisions at patient level and when considering the cost effectiveness and budget impact of alternative anticoagulants nationally.

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