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5 Budget Impact Analysis

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Abstract

Cost-effectiveness and cost-utility analyses are useful in evaluating the efficiency of a technology in terms of its profile of acceptability in a given economic setting, but they are unable to assess the budget implications of a new health technology according to its actual recourse rate. This task should be performed by another analysis: the Budget Impact Analysis (BIA).
BIAs are generally used to compare a new healthcare intervention with the alternative treatments already available, evaluate the viability of a guideline in terms of financial consequences, and synthesize the available evidence.
BIAs apply to a specific context: Therefore, data about epidemiology, drug use, and reimbursements should be gathered by studies analyzing that particular area. Conversely, efficacy and safety data should come from clinical trials, meta-analyses, or real-world data.
Some steps characterize BIAs: definition of total, sick, and target population, analysis of healthcare resource utilization in the current and alternative scenarios, and calculation of the overall cost for each scenario. The results of a BIA are expressed in terms of difference between the resources absorbed by the scenario based on the progressive recourse to the new healthcare strategies and those in the scenario where the introduction of the new alternative is not considered.
Finally, a good budget impact model should be flexible, thus enabling different treatment mix scenarios, dynamic cohorts, subgroup analyses, and calculation after changes in the time span considered.

5.1 Introduction

While Cost-Effectiveness Analysis (CEA) and Cost-Utility Analysis (CUA) are useful tools to determine the economic sustainability profile of a new intervention as compared with the alternatives already available, they do not respond to the question whether the new healthcare intervention is financially

viable in the reference economic setting. In order to help the decision makers to assess if the efficient new health technology may be affordable, it is necessary to estimate the financial consequences within a specific context.

Budget Impact Analysis (BIA) predicts how a change in the mix of interventions used to treat a particular health condition will impact the trajectory of spending of that condition. In the last few years, the demand for BIAs increased, because decision makers must deal with poor financial resources, and BIA is helpful in assessing if the new healthcare intervention may reduce resource utilization in the short term.

"The purpose of BIA is to provide valid computing frameworks that allow users to understand the relation between the characteristics of their setting and the possible budget consequences of a new health technology or a change in usage of current health technologies" [Mauskopf, 2007].

BIA's aims are:

- Estimating the financial consequences of a healthcare intervention;
- Understanding the relation between the characteristics of a health scenario and the possible consequences for budget.

BIA's applications comprise, but are not limited to, the following:

- Comparing either a new healthcare intervention with current treatments or change in usage of current health technology;
- Estimating the financial consequences of a guideline in a particular healthcare scenario with the goal of showing if the clinical approach in adherence to guideline is affordable;
- Synthesizing the available knowledge at a particular point in time and providing a specific range of predictions based on realistic estimates of the input parameters.

Thus, BIA results should reflect scenarios that consist of specific assumptions and data inputs of interest to the decision-maker, especially those who are responsible for national, regional, or local healthcare budgets.

The modeling of a BIA can be illustrated in the following steps:

- Measure the total population at start where the BIA must assess the outcomes: It may be one country, region, or local area.
- Estimate the sick population (incidence and/or prevalence) in that area.
- Select the target population, i.e., patients eligible to receive the treatment whose budget impact is to be estimated.
- Analyze the amount of resources used in the current scenario and assess the amount of resources used with the treatment of interest.
- Apply these costs to obtain the overall cost for each scenario: The difference between two arms of interest is the budget impact estimate.

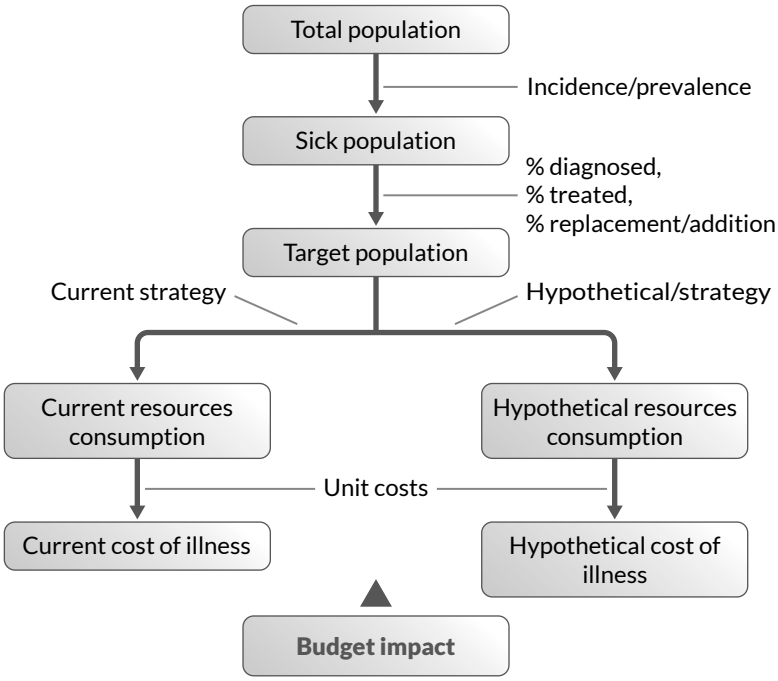

Figure 5.1. Budget Impact Analysis steps. Modified from [Mauskopf, 2007].

Aspects such as efficacy and safety might originate from clinical trials or better from meta-analyses, but other inputs, such as incidence and/or prevalence of disease, rescue medication use, hospitalized patients, conditions for reimbursing that change country by country or even region by region are local and derive from epidemiological sources, such as cohort studies, or cross-sectional studies or market research.

A good Budget Impact Model (BIM) must be flexible: It should allow comparing scenarios in which new interventions are added or substituted to either all existing interventions or only those in a particular drug class, in various proportions (different treatment mix scenarios); it should be designed to allow for examination of the effect of alternative assumptions about the nature and size of the treated population, which may also be allowed to evolve (dynamic cohort—patient enter or leave the model whether they preserve or not the inclusion criteria); it should allow for subgroup analysis by incorporating aspects such as disease severity, comorbidities, age, gender, etc.; and it must permit to estimate the budget impact after varying time spans from the in-

tervention introduction (often considering the expected adoption curve, i.e., the evolution of market shares over time).

5.2 Example: Budget Impact Analysis of Apixaban to Treat and Prevent Venous Thromboembolism in Italy

Venous ThromboEmbolism (VTE) is a condition burdened by elevated morbidity and mortality. It includes Pulmonary Embolism (PE) and Deep Vein Thrombosis (DVT). The standard treatment is the subcutaneous administration of Low-Molecular-Weight Heparin (LMWH) followed by Vitamin K Antagonists *per os* (VKA). However, the inconvenient route of LMWH administration and some possible drawbacks associated with VKAs, such as drug and food interactions, the need for International Normalized Ratio (INR) monitoring, the possible need of a consequent dose adjustment, and the risk for major bleeds, prompted the development and approval of Novel Oral AntiCoagulants (NOACs), that proved effective as the standard treatment and safer. In addition, INR monitoring is not required.

Among NOACs, apixaban, received the approval and reimbursement by the Italian Drug Agency (Agenzia Italiana del Farmaco—AIFA) for the treatment and prevention of recurrent VTE. The BIA that we chose to report here as an example [Bellone, 2016] aimed at assessing the impact of including apixaban in the armamentarium against VTE for the treatment of acute episodes and the prevention of recurrent VTE from the perspective of the Italian National Health System (NHS) in a 3-year period.

In this case, following the flow in Figure 5.1:

- The **total population** was calculated by applying the natural growth rates on the population living in Italy on the 1st January 2013.
- The **sick population** was obtained by applying 0.1% VTE incidence rate, according with an Italian study performed on a big sample size, to the total population.
- The **target population** was calculated after excluding the proportion of undiagnosed patients (30.6%) from the incident population. Patients were categorized as PE or DVT (33.3% and 66.7%) according with epidemiological estimates. Patients that were supposed to be not receiving a treatment were further excluded (0% PE and 2% DVT, based on assump-

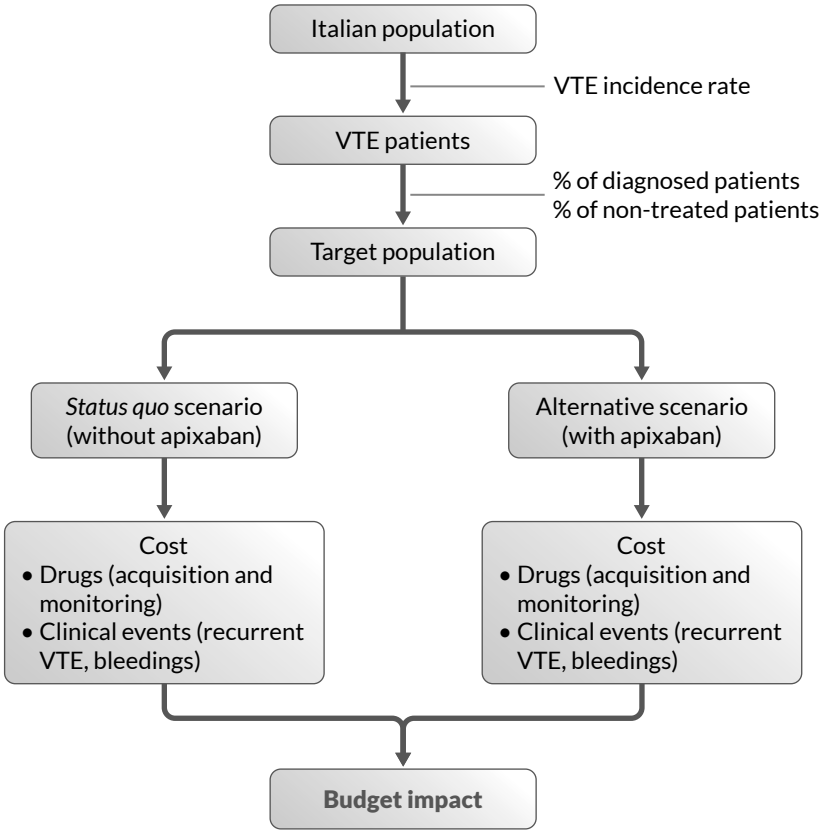

Figure 5.2. Scheme of the Budget Impact Analysis of apixaban in the context of Venous Thromboembolism (VTE).

tions). Therefore, the target population was 41,906, 42,073, and 42,241 for the first, second, and third year, respectively.

- A ***status quo* scenario** without apixaban and an **alternative scenario** with apixaban were built (Figure 5.2) where market shares were distributed by hypothesizing an increasing percentage of NOACs (only rivaroxaban and LMWH-dabigatran in the *status quo* scenario) and a decreasing proportion of LMWH-VKA over the 3-year period, according with the scheme reported in Table 5.1. The *status quo* scenario reproduces the actual pattern of healthcare resources consumption and the relevant costs for VTE management. Conversely, the alternative scenario reports the expected variations after the introduction of apixaban in the armamentarium against VTE.

	Status quo scenario (without apixaban)			Alternative scenario (with apixaban)		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
LMWH-VKA (%)	50.00	45.00	40.00	40.00	35.00	30.00
NOACs (%)	50.00	55.00	60.00	60.00	65.00	70.00
Apixaban	-	-	-	9.00	16.25	24.50
Rivaroxaban	37.50	41.25	45.00	38.25	36.56	34.13
LMWH-dabigatran	12.50	13.75	15.00	12.75	12.19	11.37

Table 5.1. Distribution of patients in the *status quo* and alternative scenario [Bellone, 2016].

LMWH = Low Molecular Weight Heparin ; NOAC = Novel Oral Anticoagulants; VKA = Vitamin K Antagonists

- **Unit costs** were calculated from the perspective of the National Health System. The costs considered were:
  - **Drugs' acquisition**: The prices were taken by the Italian Official Gazette, considering **ex-factory price** for the drugs distributed through the direct distribution channel (apixaban, rivaroxaban, dabigatran, and LMWH) and **retail price** for the drug distributed through the territorial channel (warfarin). Dosages were considered as reported in the relevant Summary of Product Characteristics (SPC) and the treatment periods were estimated as follows: 40% of patient in treatment for 3 months, 30% for 6 months, 20% for 12 months, and 10% for 18 months.
  - **Drugs' monitoring**: INR monitoring was taken into account only for warfarin, as it is recommended by the Task Force on Pulmonary Embolism [Task Force sull'Embolia Polmonare, 2001]. The frequency and the cost for check-up visits was based on the literature (14 in the first 3 months and 1/month thereafter, considering €23.75 per visit [Mennini, 2012; Pengo, 2011]).
  - **Management of events**: The events considered were recurrent VTE and bleeding episodes. The rates of occurrence of the events for apixaban were retrieved by AMPLIFY [Agnelli, 2013a] and AMPLIFY-EXT [Agnelli, 2013b] pivotal trials, while for comparators reference was made to two network metanalyses [Cohen, 2015; Cohen, 2016]. Hospitalization rates after acute episodes of VTE were gathered by a prospective study using data from MASTER registry.
    - The cost for the management of episodes of recurrent VTE on inpatient basis was calculated using the price list for hospital services for acute patients by using DRG 78 (PE) and 128 (DVT).

        - The cost for the management of episodes on outpatient basis was estimated as €530.80 and €318.89 for PD and DVT, respectively.
        - The cost for the management of bleeding events came from the price list for hospital care for acute patients.
- Further scenario analyses were performed to test the robustness of the results obtained. In particular:
    - 2 alternative scenarios hypothesized different distribution of patients under treatment (a. all the patients for 6 months; b. 30% for 3 months, 30% for 6 months, 30% for 12 months, and 10% for 18 months);
    - 2 further scenarios considered that apixaban was the only NOAC available (c.) and that the only treatment available were NOACs (d.), respectively.

The resulting **cost of illness** over the 3-year time frame considered is equal to €159,625,170 in the *status quo* scenario (without apixaban) vs. €155,686,505 in the alternative scenario, with apixaban. The difference between the current and the hypothetical total cost represents the **budget impact,** equal to a saving of €3,938,665. This saving is mainly due to the reduction in VTE events and bleedings resulting from the increased recourse to apixaban. In particular, if apixaban were to acquire 15%, 25%, and 35% of the market shares of the NOACs, the saving for the NHS would amount to €821,748, €1,250,454, and €1,866,466 in the first, second, and third year following its introduction, respectively (Table 5.2). The other scenarios also showed savings for NHS, accounting for €3,704,810, €4,047,074, €12,954,207, and €6,040,150 in scenarios a., b., c., and d., respectively.

	Costs (€)					
	Year 1		Year 2		Year 3	
	Status quo scenario	Alternative scenario	*Status quo* scenario	Alternative scenario	*Status quo* scenario	Alternative scenario
Pharmaceutical	8,988,034	10,599,151	10,503,633	12,335,721	11,381,600	13,310,314
INR monitoring	8,746,631	6,997,305	8,198,914	6,383,498	7,320,371	5,497,694
Recurrent VTE events	7,946,260	7,924,638	16,077,039	16,044,535	24,501,867	24,453,720
Bleeding events	14,668,311	14,006,394	18,946,554	17,711,932	22,345,958	20,421,602
Total	40,349,236	39,527,488	53,726,140	52,475,686	65,549,796	63,683,330
Budget Impact	**- 821,748**		**- 1,250,454**		**- 1,866,466**	

Table 5.2 Budget Impact Analysis in the 3-year period after apixaban introduction [Bellone, 2016].

INR = International Normalized Ratio; VTE = Venous Thromboembolism

Questions

1. **The evaluation of the financial viability of a new healthcare intervention should be performed by means of:**
   A. Cost-effectiveness analysis
   B. Cost-utility analysis
   C. Budget impact analysis
   D. All the analyses above

2. **Tick the correct sentence**
   A. Target population always corresponds to the entire sick population
   B. Target population defines patients eligible to receive the treatment whose budget impact is to be estimated
   C. Sick population defines patients eligible to receive the treatment whose budget impact is to be estimated
   D. None of the abovementioned options are correct

3. **Budget impact analyses may be used to:**
   A. Compare a new healthcare intervention with current treatments or change in usage of current health technology
   B. Estimate the financial consequences of a guideline
   C. Synthesizing the available knowledge at a particular point in time and providing a specific range of predictions based on realistic estimates of the input parameters
   D. All of the abovementioned options are correct

4. **Tick the correct sentence/s (more than one may apply)**
   A. The difference between the current and the hypothetical total cost represents the budget impact
   B. A good budget impact model must be flexible
   C. Data about efficacy and safety generally come from cross-sectional studies
   D. Some budget impact analyses delineate a unique scenario

Answers

1. **C**
2. **B**
3. **D**
4. **A, B**

References

- Agnelli G, Buller HR, Cohen A, et al.; AMPLIFY Investigators. Oral apixaban for the treatment of acute venous thromboembolism. *N Engl J Med* 2013; 369: 799-808. https://doi.org/10.1056/NEJMoa1302507 [a]
- Agnelli G, Buller HR, Cohen A, et al.; AMPLIFY-EXT Investigators. Apixaban for extended treatment of venous thromboembolism. *N Engl J Med* 2013; 368: 699-708. https://doi.org/10.1056/NEJMoa1207541 [b]
- Bellone M, Di Vigilio R, Di Rienzo P. Budget impact analysis of apixaban to treat and prevent venous thromboembolism in Italy. *Farmeconomia. Health economics and therapeutic pathways* 2016; 17: 127-36. https://doi.org/10.7175/fe.v17i3.1280
- Cohen AT, Hamilton M, Bird A, et al. Comparison of the Non-VKA Oral Anticoagulants Apixaban, Dabigatran, and Rivaroxaban in the Extended Treatment and Prevention of Venous Thromboembolism: Systematic Review and Network Meta-Analysis. *PLoS One* 2016; 11: e0160064. https://doi.org/10.1371/journal.pone.0160064
- Cohen AT, Hamilton M, Mitchell SA, et al. Comparison of the Novel Oral Anticoagulants Apixaban, Dabigatran, Edoxaban, and Rivaroxaban in the Initial and Long-Term Treatment and Prevention of Venous Thromboembolism: Systematic Review and Network Meta-Analysis. *PLoS One* 2015; 10: e0144856. https://doi.org/10.1371/journal.pone.0144856
- Mauskopf JA, Sullivan SD, Annemans L, et al. Principles of Good Practice for Budget Impact Analysis: Report of the ISPOR Task Force on Good Research Practices-Budget Impact Analysis. *Value Health* 2007; 10: 336-47
- Mennini F, Russo S, Marcellusi A. Budget impact analysis resulting from the use of dabigatran etexilate in preventing stroke in patients with non-valvular atrial fibrillation in Italy. *Farmeconomia. Health economics and therapeutic pathways* 2012;13: 121-31. https://doi.org/10.7175/fe.v13i3.268
- Pengo V, Crippa L, Falanga A, et al. Questions and answers on the use of dabigatran and perspectives on the use of other new oral anticoagulants in patients with atrial fibrillation. A consensus document of the Italian Federation of Thrombosis Centers (FCSA). *Thromb Haemost* 2011; 106: 868-7. https://doi.org/10.1160/TH11-05-0358
- Task Force sull'Embolia Polmonare. Linee guida per la diagnosi ed il trattamento dell'embolia polmonare acuta. *Ital Heart J Suppl* 2001; 2: 161-99