HEALTH ECONOMIC VALUE GENERATION IN THE AZERBAIJAN REPUBLIC: SIMULATEDRESULTS FOR A INTEGRATED TELECARDIOLOGY CARE PROGRAM

Christian Elsner
CEO at University ClinicUniversitätsklinikum Schleswig-Holstein,Campus Lübeck,
RatzeburgerAllee 160 (MFC 5, 3. OG) in 23538 Lübeck,
Email christian.elsner@uksh.de

Dennis Häckl
WIG Wissenschaftliches Institut, Nikolaistraße 6-10, 04109 Leipzig

Received January 6 2014; accepted 15 Mayl 2014; published online 15 July 2014

Abstract

Economic feasibility studies for Health-Technology Assessment (HTA) become more and more important over time. While the data situation is quite good in industrialized countries, it is quite hard to predict health economic values in countries with a developing healthcare system. In the Azerbaijan Republic (AR) thereis a problematicdatasituation on theexactepidemiology oft he Congestive Heart Failure (CHF) and a not tooprecisedatasituation on healthcarecost. Thiasworktriestointerpolatethe worth of a disease management program for cardiac diseases in the AR system and understands itself as a "best guess" and methodology to recalculate the effects with a better and growing data situation.Additionally a risk sharing approach implementing better incentive mechanisms was discussed.The entities taken into account by the simulation model were the impacts on heart attack, stroke and heart failure. The Simulation took place atthe simulated AR population with specific morbidity criteria.According to the simulation a per patient gross saving of 323,53 US$ per year was reached over all entities. The real cost saving without a QALY saving effect would be at a 111,33 US$ per year. Taking also the new technology implementation cost into account, a positive return would only be generated over the additional QALY effect. Overall the technology could produce a QALY effect of 8889 QALYs per year in the AR.

Keywords: Azerbaijan Republic,Economic feasibility, Health Economics, Reinsurance, Disease Management, Simulation, Modelling, Cardiac monitoring

JEL Classification codes: I 15

I. INTRODUCTION

Economic feasibility studies for Health-Technology Assessment (HTA) become more and more important over time. While the data situation is quite good in industrialized countries, it is quite hard to predict health economic values in countries with a developing healthcare system. For a fast and efficient approach simulations may help to predict economic feasibility effects. This way providers and payors may be enabled better in establishing new therapeutic options for patients and predicting the effects for the different parameters.

To evaluate the approach of a "predictive" simulation including "missing data" from a certain healthcare system, a german simulation model for "chronic heart failure" (CHF) was adapted and "feeded" with the available data from the Azerbaijan Republic (AR) healthcare system. The model and the generated data may helpto develop the CHF approach and product development related considerations in the AR.

The simulation for CHF care taken into account is a plain simple telemedical care program – not very technical sophisticated and not expensive at all. The mechanism behind it is a weight and bloodpressure tele-measurement system combined with a two-weekly call.

II. THE AZERBAIJAN REPUBLIC HEALTHCARE SYSTEM AND CHF CARE

In the Azerbaijan Republic (AR) the role of voluntary health insurance and donor funding is small and the main sources of funding for health care are out of pocket payments (61.5%) and general government expenditure (31.5%) [World Health Organization. Azerbaijan. National Health Accounts Series 2009. Geneva: WHO, 2009. http://www.who.int/nha/country/aze.pdf]. In the year

2012 only 1,2 percent of the gross domestic product (GDP) was spent on healthcare expenditures – very low below the world average of 6.1 percent [The World Bank Health Indicators, Website http://data.worldbank.org/ Health Indicator public health expenditure in % of GDP of Azerbajan vs. World Index]. The public health expenditure in percentage of the total healthcare expenditure ranked at 22,8% - compared to a world spending of 59,8% in 2012[The World Bank Health Indicators, Website http://data.worldbank.org/ Health Indicator public health expenditure in % of total health expenditure of Azerbajan vs. World Index]. The 2012 per capita spending for healthcare expenditures is at very low 398,2 US$ (world average 1.030,40 US$ and Germany 4.683,20 US$) while life expectancy is in the AR at a world average level of 70,6 years (2012, male and female mix) compared to a 2012 life expectancy in Germany of 80,9 years [The World Bank Health Indicators, Website http://data.worldbank.org/ Health Indicator per captita spending and life expectancy].

The share of the small budgetary allocations for health in the AR is controlled by 60% by the Ministry of Health and the remaining 40% go to the 65 local government administrations which fund primary and secondary state facilities within their district boundaries [Ibrahimov F et al: Health system review. Health Systems in Transition 2010;12(3). http://www.euro. who.int/__ data/assets/ pdf_file/0004/118156/E94132.pdf].As there is no mechanism for the redistribution of funds between districts, the funds allocated for the local government administrations act as 65 separate pools. Fragmentation of pooling is an issue in terms of efficiency, but also equity as funding for services is not linked to health needs of the population. Shortfalls in state funding for services mean therefore a steady growth in out-of-pocket payments which hinder equity and access for poorer households [Lewis M. Informal health payments in central and eastern Europe and the former Soviet Union: issues, trends and policy implications. In: Mossialos E et al (eds). Funding Health Care: Options for Europe. Buckingham: Open University Press, 2002, pp.184–205].

Overall the AR health care system acts as an integrated model where the providers are owned by the payors. The public health providers, as state institutions, have limited financial and managerial autonomy: Public health care facilities receive input-based payments based on the number of beds or staff through prospective fixed line-item budgets. That means, that a hospital will get paid regardless of whether it has no patients or is fully occupied. Underspending is penalised over reductions in allocations because the next year budgeting process is based on last years expenditures. The installed payment mechanism does not provide any incentives for hospital administrators to reduce costs to improve efficiency or to reward better performing facilities.

In the field of congestive heart failure it is hard to get exact data for the incidence and prevalence in the AR. For the simulation model an extrapolation from Healthgrades© was used [http://www.rightdiagnosis.com/c/congestive_heart_failure/stats-country.htm]. Due to a shifted age-structure compared to the US and Germany, where roughly 2% of the 40-59 aged, 5% of the 60-69 aged and 10% of the over 70 aged population suffer from CHF, the rate in the AR may be slightly lower per se – an effect, which may be compensated due to a poorer treatment regime. According to Healthgrades© an overall rate of 1.764 % CHF patients in the AR can be estimated. Taking into account, that the AR has 9.49 MIO inhabitants [http://en.wikipedia. org/wiki/Azerbaijan], this represents a number of 167.551 people relevant for an innovative CHF therapy.

To the knowledge of the authors there are no special telemedical care programs for CHF underway in the AR. A first medical Internet and telemedicine station in the Azerbaijan Republic was establishedin June 1997. In the consequent years consultations were carried out with international clinics in specialties such as cardiology, ophthalmology, endocrinology and surgery – but up to date there is no systematic approach to care for CHF patients systematically over a telemedical approach.A telemedical approach with patient-morbidity oriented budgeting and a

pay-per-performance way with the single providers may be an adequate way to overcome this shortfall in the care and incentive mechanism. Idea of this paper was to adapt a simulation for an approximation on the health economic effects of such a technology in the AR.

III. METHODOLOGY OF BUILDING THE MODEL

Simulations and Modelling are defined as a "... replicable sequence of computations used for generating estimates of quantities of concern [...] based on data from primary and/or secondary sources…" [National Reasearch Council. Improving Information for Social Policy Decisisions: the Uses of Microsimulation Modeling. Vol 1. Review and Recommandations. National Academy Press, Washington DC, 1991] and are recommended in the modernization Act of the Food and Drug Administration (FDA) end of the 80´s[Compare: www.fda.gov/cdrh/modact97.pdf] as valueable tool to help in healthcare and social policy decisions. According to the FDA simulations it can also be some kind of "Evidence based Medicine" (EBM) – which names the conscientious, explicit and judicious use of current best external evidence in makingdecisionsin the care of individual patients [Sackett DL, Rosenberg WMC et al.: Evidence-based medicine: What it is and what it isn't. BMJ, 1996, 312, 71-72]. This Definition includes, that EBM is not limited to studies and meta-analyzes. Also the general concept of the expected value of information (VOI) from decision theory [http://en.wikipedia.org/wiki/Value_of_information] is transferable to EBM:The VOI is defined as the difference between the expected consequences (benefits) of a decision to be made under consideration of specific information and the expected consequences (benefits) if that decision is made without that information [Raiffa H.: Decision Analysis; Introductory Lectures on Choices under Uncertainty. Reading, MA.Addison Wesley, 1968]. Due to this high expectation several standards for testing and validating a healthcare simulation had to be kept [Weinstein MC; O'Brian B et al.: Principles of Good Practice for Decision Analytic Modeling in Health-Care Evaluation: Report

of the ISPOR Task Force on Good Research Practices-Modeling Studies. Value Health 2003, 6(1), 9-17]. Figure 1 shows these accepted standards for the 4 dimensions of simulation model testing.

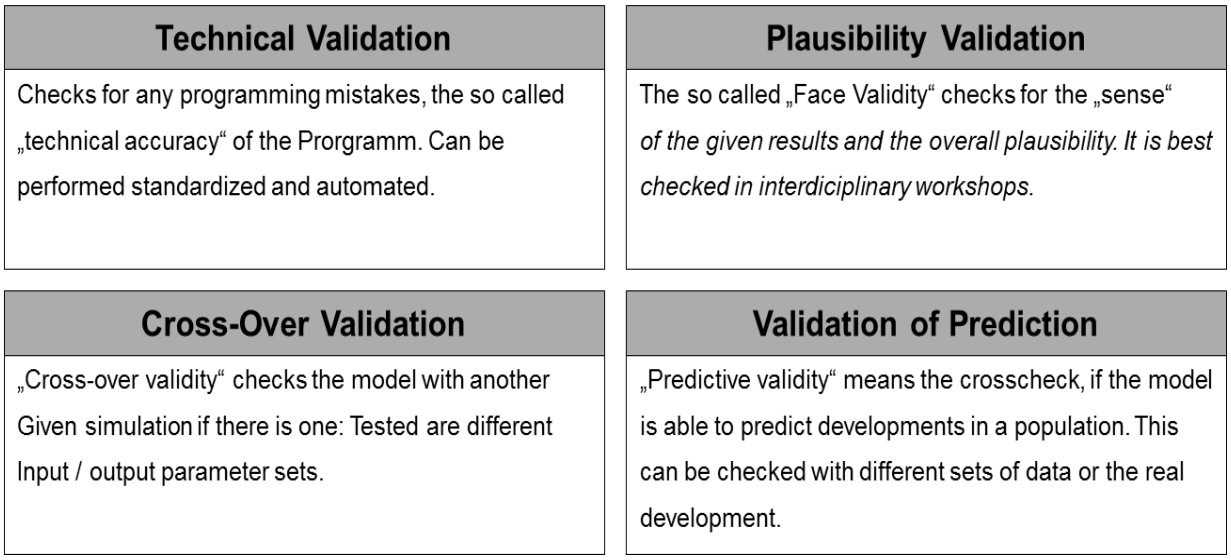


Fig. 1 The four dimensions of simulation validation

The approach to build the simulation itself is also a 4 step way. Figure 2 shows this schematic process in an overview and states out resources used and results after each step.

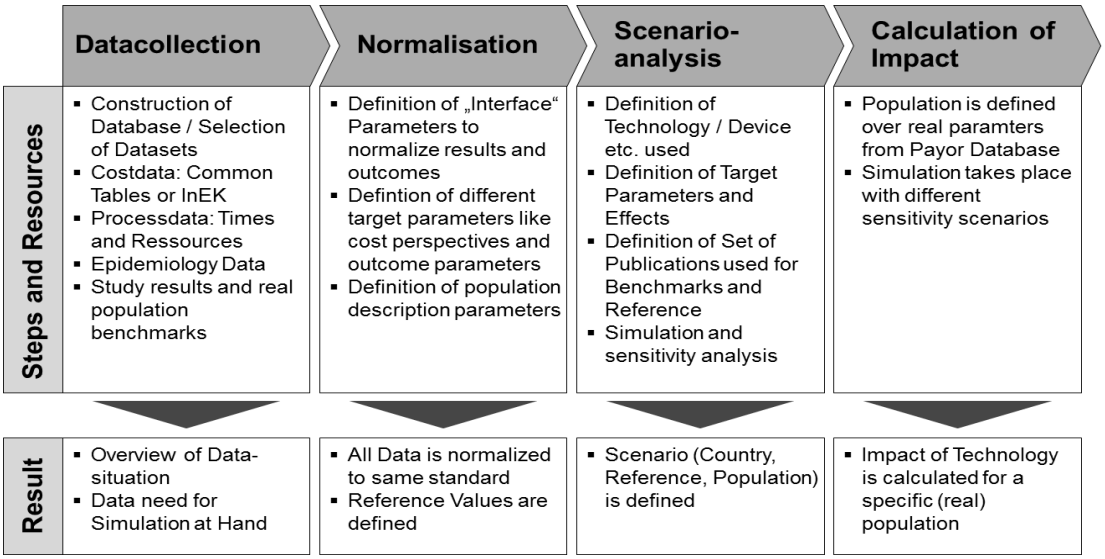


Fig. 2 Approach to build the simulation

In a first step the different data sources were identified and structured in a central repository. Normally – as in this case - there are 5 different kinds of data being integrated in the dataset:

(1) Costdata from common cost tables on wages, (2) treatmentcost and cost of equipment, (3) Data on Process Work-flows mostly from specific studies (e.g. How long does it take to perform an ECG?), (4) Data on population epidemiology like incidence and prevalence rates for targeted illnesses, and last (5) Data on specific effects of the Technology to be investigated in the simulation.In a second step the data is “normalized”: All input and outcome values are projected to a similar “normalized” set of parameters. This normalisation process would for example project different studies comparing the impact of a HF-Monitoring system to the two parameters “Number of Hospitalisations” and “Length of Stay” with and without the technology and would make it compareable to other studies dealing with a compareable technology.

The data is then extracted in Extensible-Media-Language (XML) Format and stored to the database of the simulation, where different sets can be selected and correlations are stored and connected in the core model of the software tool. Figure 3 gives a coding example for that.

<Define_Value>XYZ Study</Define_Value>

<Content_Type>LOS without Monitoring<Content_Type>

<Value_MID>11</Value_MID>

<Value_MAX>17</Value_MAX>

<Value_MIN>7</Value_MIN>

</Content_Type>

<RefPopulation>Post Infarction MADIT II</RefPopulation>

<Evidence>I b</Evidence>

Fig. 3 Coding example in XML Format

In a third step the Scenario-Analysis takes place, which can be different for different adaptions of the simulation. In this step, the technology used or compared is specified, the reference and benchmark publications are chosen and the simulation is run with a different set of minimum and maximum parameters from the chosen publications.

In the fourth and last step the simulation is custom-tailored to a specific population-mix according to the parameters delivered e.g. from the payor and the impact on the whole population and single patients is calculated.

IV. THE SELECTION OF SPECIFIC MODEL DATA

For the simulation model a simulated AR population mix of 167.551 people was designed: The population had a spread of heart failure according to New York Health Association (NYHA) (= I: 20%, II: 35%, III: 22%, IV: 23%), a male and female mix of 50:50, a median age of 65 with a standard deviation of 12. This mix was estimated from the Healthgrades © approximation [http://www.rightdiagnosis.com/c/congestive_heart_failure/stats-country.htm]. The population was postulated an Atrial Flutter (AF) prevalence of 6% and a 6% yearly risk of a myocardial infarction (MI).The model implemented 3 dimensions of effects shown in Figure 4.

	Topic	Method of Intervention and no. of Patients
1	Risk Reduction in the field of myocardial infarction (MI)	More effective monitoring and selection of high risk patients to reduce costs and myocardial infarctions in the patients.
2	Risk Reduction in the field of stroke	More effective selection of AF patients – reducing the burden / side effect of anticoagulation and reduction of stroke in the patients.
3	More efficient care in the field of chronic heart failure (CHF)	More effective monitoring of the patient and thus targeted reduction in intensive days and treatment costs at 50% of the patients.

Fig. 4The 4 effects on effectiveness of care and corresponding patients in the population

Overall 35 references and publication outcomes were integrated in the simulation model and connected according to the illustrated methodology in figure 2. For the results of this simulation the original source data of the german simulation - where original data was missing – was interpolated: over source data context like cost of hospital days or where nothing else was available over the per capita spending Germany vs. AR [Implementing Health Sector Reform in Central Asia: Papers from a Health Policy Seminar Held in Ashgabat, Turkmenistan in June, 1996 Zuzana Feachem, Martin Hensher, Laura Rose, World Bank Publications, 1999]. The main data used can be seen in table 1.

Description and Reference for financial data (selected work)	Value per Patient
Value for a quality-adjusted life (cost / QALY), mean, interpolated [H. Dakin et al. „The influence of cost-effectiveness and other factors on NICE decisions" in HERC Research Paper 05/14]	4.000 US$ p. QALY
Cost for a day in a hospital (non-intensiv care), WHO [Data from the WHO http://www.who.]	37.38 US$ p.d.
Cost for a day in a hospital (intensive care), rounded average WHO[Data from the WHO http://www.who.int/choice/country/aze/cost/en/]	66.61 US$ p.d
Savings overCHF monitoring, interpolated from German simulation [Kielblock, B., et al. "Einfluss einer telemedizinisch unterstützten Betreuung auf Gesamtbehandlungskosten und Mortalität bei chronischer Herzinsuffizienz." Dtsch Med Wochenschr 132.9 (2007): 417-22.]	416,63 US$ p.a.
Adverse events due to Anticoagulation [Hamby *L, Weeks WB, Malikowski C Complications of warfarin therapy*: *causes,costs, and the role of the anticoagulation clinic*. *Eff Clin Pract . 2000*;*3:179–184*]	19.81 US$ p.a.
Cost of a single "mean" stroke (lifetime costs, discounted) [Kolominsky-Rabas, Peter L., et al. "Lifetime cost of ischemic stroke in germany: Results and national projections from a population-based stroke registry the erlangen stroke project." *Stroke* 37.5 (2006): 1179-1183.]	3.667 US$ p. Stroke
Cost of a single "mean" myocardial infarction (MI) [Gandjour, A., F. Kleinschmit, and K. W. Lauterbach. "European comparison of costs and quality in the treatment of acute myocardial infarction (2000–2001)."*European heart journal* 23.11 (2002): 858-868.]	1.641 US$ p. MI

Table 1: Used Cost Parameter

The researched technology included a “simple” setting of a daily monitoring of Blood-Pressure and Weight-Measurement in the patients. Cost for this treatment was not calculated in this simulation.

V. RESULTS FROM THE SIMULATION

Entity p.a. in TSD US$	Hospital Treatment	Medication	Reha-bilitation	Transport Cost	QALYs	Overall
Myocardial Infarction	$ 1.912	$ 1.445	$ 79	$ 113	$ 1.045	**$ 4.593**
Stroke	$ 212	$ 863	$ 105	$ 7	$ 920	**$ 2.107**
Heart Failure	$ 2.025	$ 445	$ 1.325	$ 123	$ 3.589	**$ 7.507**
	$ 4.149	**$ 2.753**	**$ 1.508**	**$ 243**	**$ 5.554**	

Table 2:Distribution of p.a. savings over the complete model for all entities in TSD US$

Entity p.Pt.p.a.	Hospital Treatment	Medication	Reha-bilitation	Transport Cost	QALYs	Overall
Myocardial Infarction	$ 11,41	$ 8,63	$ 0,47	$ 0,67	$ 5,92	**$ 7,10**
Stroke	$ 1,27	$ 5,15	$ 0,63	$ 0,04	$ 5,49	**$ 2,58**
Heart Failure	$ 71,77	$ 2,66	$ 7,91	$ 0,73	$ 40,79	**$ 23,86**
	$ 4,45	**$ 6,43**	**$ 9,00**	**$ 1,45**	**$ 12,20**	

Table 3: Distribution of p.a. savings for all entities in US$ per patient

Table 2 and 3 show the results in two different notations: an AR wide saving per year (table 2) and a per Patient saving in the AR (table 3). The simulation was performed according to the described modelling approach over a simple monte-carlo-treeage and Microsoft Excel Simulation for the 3 dimensions. Output parameters were 4 simplified cost dimension parameters “Hospital Treatment Cost”, “Medication Cost”, “Cost for Rehabilitation” and “Transport Cost”. These were chosen for the pure projection of savings and a 5thdimension “QALYs” (at the given cost of 4.000 US$) was also projected in an US$ equivalent.

VI. DISCUSSION OF THE RESULTS

Looking at the specific results of the simulated population and the value generation through a “simple” telemonitoring over external devices, one can say, that the technology has an

overall saving of 323,53 US$ per patient per year over all entities. The real cost saving without a QALY saving effect would be at a 111,33 US$ per year. Taking into account, that no cost for the telemedical measures were calculated and the service would include a 2-3 week phone call and a telemedical care system worth a monthly fee of 15 US$ production cost, it turns out, that the technology may not be able to save "real" cost in the system. A positive return would only be generated over the additional QALY effect. Overall the technology could produce a QALY effect of 8889 QALYs per year in the AR.

With the tool and methodology itself a custom-tailored health economic feasibility study e.g. in terms of a specific population mix of the investigation and/or targeted outcome parameters (e.g. saved cost at Provider, saved transportation cost, etc.) was produced. Additionally the possibility of the implementation of a reinsurance model allows selective "risk adjustment" or a nearly complete "buy out" of the risk of the new technology over an external reinsurance provider. The designed reinsurance model is based exactly on the simulation model described in this work and calculates the premium on an individually selectable risk algorithm basing on the calculated underlying risks.

The whole simulation can only give a very rough overview on the potential savings and effects of the technology – a big problem to get precise effects from the simulation is the fact of the missing data: As there was only some cost data available and some epidemiology data was completely missing for the specific distribution of CHF, the value simulated must been seen as a "rough range" value. Positively speaking the tool and methodology can be used and integrated in the development cycle of a new AR care program – as soon there is more evidence available, the tool can simulate more precise results. New scientific evidence and market-related needs can be

integrated fast and easy in a very early stage and products can be marketed more targeted e.g. to a specific population-mix of a single healthcare provider.

Specially for the AR healthcare system there could also be a good chance to combine a new technology approach with theredesign of the incentive mechanism in the AR healthcare system.The simulation model would be ideal for a calculation of a premium for better outcomes in the AR health system for the new care program in CHF.

Literature

1. World Health Organization. Azerbaijan. National Health Accounts Series 2009. Geneva: WHO, 2009. http://www.who.int/nha/country/aze.pdf
2. The World Bank Health Indicators, Website http://data.worldbank.org/ Health Indicator public health expenditure in % of GDP of Azerbajan vs. World Index
3. The World Bank Health Indicators, Website http://data.worldbank.org/ Health Indicator public health expenditure in % of total health expenditure of Azerbajan vs. World Index
4. Ibrahimov F et al: Health system review. Health Systems in Transition 2010;12(3). http://www.euro.who.int/__data/assets/ pdf_file/0004/118156/E94132.pdf
5. National Reasearch Council. Improving Information for Social Policy Decisisions: the Uses of Microsimulation Modeling. Vol 1. Review and Recommandations. National Academy Press, Washington DC, 1991
6. Compare: www.fda.gov/cdrh/modact97.pdf
7. Sackett DL, Rosenberg WMC et al.: Evidence-based medicine: What it is and what it isn't. BMJ, 1996, 312, 71-72
8. http://en.wikipedia.org/wiki/Value_of_information
9. Raiffa H.: Decision Analysis; Introductory Lectures on Choices under Uncertainty. Reading, MA.Addison Wesley, 1968
10. Weinstein MC; O'Brian B et al.: Principles of Good Practice for Decision Analytic Modeling in Health-Care Evaluation: Report of the ISPOR Task Force on Good Research Practices-Modeling Studies. Value Health 2003, 6(1), 9-17
11. http://www.rightdiagnosis.com/c/congestive_heart_failure/stats-country.htm

12. Implementing Health Sector Reform in Central Asia: Papers from a Health Policy Seminar Held in Ashgabat, Turkmenistan in June, 1996. Zuzana Feachem, Martin Hensher, Laura Rose, World Bank Publications, 1999
13. H. Dakin et al. „The influence of cost-effectiveness and other factors on NICE decisions" in HERC Research Paper 05/14
14. Data from the WHO http://www.who.
15. Data from the WHO http://www.who.int/choice/country/aze/cost/en/
16. Kielblock, B., et al. "Einfluss einer telemedizinisch unterstützten Betreuung auf Gesamtbehandlungskosten und Mortalität bei chronischer Herzinsuffizienz." Dtsch Med Wochenschr 132.9 (2007): 417-22.
17. Hamby *L, Weeks WB, Malikowski C Complications of warfarin therapy*: *causes,costs, and the role of the anticoagulation clinic*. *Eff Clin Pract . 2000;3:179–184*
18. Gandjour, A., F. Kleinschmit, and K. W. Lauterbach. "European comparison of costs and quality in the treatment of acute myocardial infarction (2000–2001)."*European heart journal* 23.11 (2002): 858-868.