

The use of environmental aspects in health economics on the example of the valuation of human life

**Ewa BANDURSKA, Małgorzata WOJNAROWSKA, Agnieszka WOJTECKA,
Marzena ZARZECZNA – BARAN**
Public Health and Social Medicine Department, Medical University of Gdansk, Poland

Abstract: The aspects of environment's protection play double role in determining human's health- direct which was illustrated, by among others, Lalonde in his concept called the fields of health and indirect by being part of a methodology used in health economics. Improving quality of air, reducing its' pollution was the base of introducing the first study carried out in Poland in order to determine the value of non-market good, which is human's life. These calculations allowed to proceed the most universal pharmacoeconomic analysis – Cost Benefit Analysis (CBA). On the basis of Willingness To Pay (WPT) method, the VOLY indicator has been estimated within a range 40-70.000 PLN (the differences resulted from various assumptions in the methodology). Presently proceeded pharmacoeconomic methods do not use the aspects of environments' protection so commonly to assess the value of non-market goods, but it's important to remember that they were the most important elements of studies initiating the use of analysis of economic efficiency in Poland.

Keywords: environment's protection, pharmacoeconomics, value of life, CBA analysis

1. Introduction

Human's health is determined by many different factors, that all together shape health status of society. In 1974, the Canadian minister of health – Marc Lalonde presented in the report called A New Perspective on the Health of Canadians, the concept of so called fields of health, meaning the groups of determinants influencing human's health. As the most important have been recognized: lifestyle (50%), medicine (20%), biology (15%) and environment (15%)

Correspondence Address: Ewa Bandurska, Małgorzata Wojnarowska, Agnieszka Wojtecka, Marzena Zarzeczna – Baran, Public Health and Social Medicine Department, Medical University of Gdansk, Poland. Tel. +48583491540, e-mail: ebandurska@gumed.edu.pl.

(Nowak-Starz et al., 2013: 10). Although it's been found that human's health is determined mostly by the people's lifestyle (if they abuse alcohol, eat unhealthy) a relevant meaning was noticed in relation to environmental factors. These are among others (Kolarzyk, 2008: 180):

- Psychological factors, such as: stress;
- Physical factors, such as: microclimate;
- Biological factors, such as: viruses, bacteria;
- Chemical factors, such as: chemical substances;
- Emergency situations, such as: chemical disasters.

In many other studies, besides Lalonde's, it has been proved that factors associated with state of environment significantly affect health of society (Getzen, 2013: 71-74; Jakubczyk et al., 2010: 163). Apart from them, it is useful to focus on demographic changes, that are currently much more severe, than it was few decades ago (Kalinowski, 2002: 55).

The aim of the article is to present the usefulness of environment's protection aspects in the beginning phase of introducing pharmacoeconomic analysis in Poland and their influence on methodology used presently.

2. Justification for conducting comparative analysis in health economics

Demand for health services increases. It is caused among others by factors such as: improvement in medical knowledge, changes in health needs presented by society, improvement in diagnostic possibilities. Every budget of health system is limited though and cannot be exceeded. Therefore arises the need to make choices which diseases should be treated in the first place and how (Skrzypczak, 2007: 2). For many years now studies have been carried out to determine the level of funds that can be spent on the treatment of the disease in a specified period of time, so that on the one hand- to provide the optimal standard of care for patients and on the other- diversify the expenses of the health system and does not allow for a situation in which a significant part of the budget is dedicated only for the chosen field of medicine. The idea of saving human's life by any means and costs has face the limits in financial resources and growing number of patients, who require medical help. Because of this fact, the economists began working on finding economic method which after evaluation of medical effectiveness would

provide a tool useful in determination the economical effectiveness and impact on health system budget.

3. Methodology of pharmacoeconomic analysis and the usefulness of environment's protection aspects

In the economic evaluation of medical interventions three analyses are most commonly used. These are as follows:

- Cost Effectiveness Analysis (CEA) - in which the value of costs is expressed in monetary units and is compared to the achieved effects, which are expressed in natural units meaning in the same units that they were measured, for example kilograms in assessing body mass). This analysis can be used only in comparison of two similar interventions, in which the effects can be expressed in the same units (for example two health programs dealing with obesity).
- Cost- Utility Analysis (CUA) - in which costs of the intervention are expressed with monetary units and are compared with effects of the intervention, which are expressed with special units, dedicated for this analysis, meaning QALYs (Quality Adjusted Life Years). QALY can be explained as one year of life spent in perfect health. Usage of this method allows for evaluation not only the length of life but also its' quality and important parameters like: pain, dyspnoea, ability to play social roles, ability to move.
- Cost-Benefit Analysis (CBA) - in which both- the costs and the effects are expressed in monetary units. The result of the analysis is expressed as the values of CBR rate (Cost Benefit Ratio). CBR is a quotient of costs to benefits and to be considered as the effective intervention must take a value greater than 1. This analysis is widely used because it can be applied even in relation to the intervention of various themes, with different effects, because all the parameters are brought in their values to a common denominator, i.e. monetary units. Because of that, CBA analysis is commonly used and valued for reasons of its versatility. The problem is, however, related to the necessity to convert the effects into monetary units, which often is not easy and creates many problems in methodology, especially when appears a need to convert into monetary units the value of goods, which are usually not expressed in

money values, like health, wellbeing and many others. Elements of environment's protection played an important role in expression of non-market goods in monetary units, for example in the valuation of human's being life (Nizankowski, 2002: 12-13).

4. Application of environmental protection elements in pharmacoeconomics

It is known that there are goods that do not operate in normally understood market, there is no demand for that goods. These goods are usually determined as priceless, however it doesn't mean these goods are worthless or have no price, on the contrary, are of great value for the society. The fact, that the market doesn't include these good in the basic definitional meaning, doesn't indicate that there are no important, at least potential reasons for which these goods shouldn't be valued and expressed in monetary units. One of such reasons was the necessity of implementation pharmacoeconomic analysis into health systems to make reasonable choices in selecting the most effective procedures and dealing with rising health needs of societies (Żylicz, 2008: 8-12). In the valuation of the non-market goods, based on elements of environment's protection, two basic methods are used (Czajkowski, 2008):

1. Revealed preference method (RPM)

It allows for the economic evaluation of the benefits, which are gained thanks to the improvement of the natural environment. The examples of the RPM are: Hedonic Prices Method (HPM) and Contingent Valuation Method (CVM).

2. Indirect Valuation Method (IVM)

This methodology doesn't allow for direct evaluation of preferences, that is why it also called a declared preferences method. Market prices or financial expenditures that are needed for environmental renewal are the grounds of this method. The examples of the IVM are: opportunity costs, preventive method.

From the year 2000 intensive works have been started in Poland, leading to valuation of human life. At that time some US studies, in which the valuation of life was done based conditional choice methodology, were well known.

In the first study, the researchers analyzed willingness to pay a sum of money in order to avoid risk of death in fire after installing a smoke detector at home. The study was based on changes in society decisions as the price of detectors was changing.

Another US study was based on the hedonic prices method. In this study people who took risk and crossed the highway to spare some time instead of using a footbridge were observed. Time was considered as a factor that can be expressed in monetary units for example with use of the average salary per month to value this (Getzen, 2013: 71-74).

The first attempt to value human's life based on environment's protection aspects was done in Poland between 2006-2008. This study was an element of a bigger study carried out within an EU project called NEEDS (New Energy Externalities Developments for Sustainability). In this study CVM (Contingent Valuation Method) was used. The obtained values are used (after discounting) in CBA analysis.

CVM method, as mentioned before, belongs to the group of direct methods (meaning Revealed preference method (RPM), is basing on opinions presented by respondents, which are supposed to show the preferences of the society and its' willingness to pay for improvement in environment's quality and preventing changes that might harm the natural environment. This method is determined as contingent because the fact of conducting the study doesn't mean that the discussed intervention will be implemented in the real life.

This method is though, widely used and accepted (it's been officially accepted in 1979 in USA as optima for studies dealing with valuation of foods in environment's protection subject).

In the study realized within NEEDS project, the VOLY (Value of Life Year) was estimated with use of Contingent Valuation Method in Poland for the first time. It was basing on willingness to pay for the reduction in air pollution. The group of 150 Warsaw's citizens, representative for the general group in terms of age, gender and level of education) was asked how much money they are ready to pay to make their life longer for 3 and 6 months, thanks to the decrease of air pollution. The estimated WTP indicator (Willingness To Pay) for one additional year of life was at the level between 40-70.000 PLN. The methodology used in the study allowed for the direct estimation of VOLY according to the following formulas:

- For additional 3 months of life: $VOLY_1^3 = (WTP^3 * 12) * 4 * (LE - A)$
- For additional 6 months of life: $VOLY_1^6 = (WTP^6 * 12) * 2 * (LE - A)$

Where:

- *WPT3 and WPT6 – estimated average values of Willingness to Pay for making life longer for 3 and 6 months;*
- *LE –life expectancy;*
- *A- average age of the study group (counted separately for males and females).*

An alternative methodology was also used. It was based on individual remaining life expectancy. The VOLY indicators were calculated with use of following formulas:

- *For additional 3 months of life: $VOLY_{II}^3 = \frac{(WTP_i^3 * 12) * 4 * (LE - A)}{n}$*
- *For additional 6 months of life: $VOLY_{II}^6 = \frac{(WTP_i^6 * 12) * 2 * (LE - A)}{n}$*

Where:

- *WPT6 and WPT3- individual Willingness to Pay for making life longer for 3 and 6 months;*
- *(LE-A)- difference between the individual expected length of life of the respondent and the present age of the respondent (meaning RLE - Remaining Life Expectancy).*

The estimated values of VOLY, obtained through determined Willingness To Pay for less polluted air, resulting in longer life, were high for WPT for 3 additional months. This indicator was decided to be official for the whole Polish study (as mentioned before, the Polish study was a part of a bigger, European study NEEDS) (Markowska, 2007: 19). After implementation of the same methodology, the higher estimations of VOLY were observed in Switzerland, Czech Republic and Denmark, and the lowest in Poland and Hungary (Desaigues, 2006).

Besides historic meaning in methodology of pharmacoeconomics, WTP method (the same used in NEEDS study) is presently used in calculation of indirect costs. WTP method is basing on survey studies in which respondent are asked to determine the amounts of money they are ready to pay for- decrease of risk of occupational disease by reducing hazardous factor or how much money they would accept for working or living in hazardous conditions (among other that considers environemntal factors) (E&Y, 2013).

5. Conclusion

Methods of valuation of human's life have a significant meaning in health economics, enabling conduction of a universal pharmacoeconomic analysis, which is CBA. This analysis would never become so significant without usage of environment's protection aspects. Nowadays the methods of valuation of human's life, using WPT and VOLY are not so commonly used. They have been replaced by newer but still not ideal methods, like for example method based on HCA (Human Capital Approach). In HCA method value for human's life is calculated based on the labor productivity and GDP (Gross Domestic Product) creation. This method is easy to proceed, but doesn't include non-economic aspects, present in every person's life (Jakubczyk, 2010: 28).

Environment's protection, beside direct influence on human's health, described for example in Lalonde's fields of health, has its' indirect influence. This indirect influence is for example being a part in health economics methodology and as a result- a part of decision making in health systems.

Literature

- Desaigues, B.; Ami, D.; Hutchison, M.; Rabl, A.; Chilton, S.; Metcalf, H.; Hunt, A.; Ortiz, R.; Navrud, S.; Kaderjak, P.; Szántó, R.; Seested Nielsen, J.; Jeanrenaud, C.; Pellegrini, S.; Braun Kohlová, M.; Scasny, M.; Máca, V.; Urban, J.; Stoeckel, M.-E.; Bartczak, A.; Markiewicz, O.; Riera, P.; Farreras, V. (2006). *Final Report on the monetary valuation of mortality and morbidity risks from air pollution*. UParis. Available at: http://www.needs-project.org/RS1b/NEEDS_RS1b_D6.7.pdf. Accessed 23 July 2014.
- Ernst&Young (2013). *Metodyka pomiaru kosztów pośrednich w Polskim systemie ochrony zdrowia*. Available at: [http://www.ey.com/Publication/vwLUAssets/Raport_Metodyka_pomiaru_kosztow_posrednich_17.09/\\$FILE/Raport_Metodyka%20pomiaru%20kosztow%20posrednich_17.09.pdf](http://www.ey.com/Publication/vwLUAssets/Raport_Metodyka_pomiaru_kosztow_posrednich_17.09/$FILE/Raport_Metodyka%20pomiaru%20kosztow%20posrednich_17.09.pdf). Accessed 5 December 2014.
- Getzen, T. (2013). *Ekonomika zdrowia*. Warszawa. Polskie Wydawnictwo Naukowe.
- Helbin, J. (2008). *Środowiskowe czynniki fizyczne wpływające na organizm człowieka*. Available at: <http://www.e-nujag.cm-uj.krakow.pl/materialy/higiena/Skrypt-tekst.pdf>. Accessed 23 July 2014.
- Jakubczyk, M.; Wrona, W.; Macioch, T.; Golicki, D.; Niewada, M.; Hermanowski, T. (2010). Indirect costs in health technology assessment. *Polski merkuriusz lekarski: organ Polskiego Towarzystwa Lekarskiego* 28(163): 42-45.
- Kalinowski, P. (2002). Aging of the Polish population and its effect on the health care system in Poland. *Wiadomości Lekarskie* 55 Suppl. 1: 196-200.
- Kolarzyk, E. (ed.) (2008). *Wybrane problemy higieny i ekologii człowieka*. Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego.

- Markiewicz, O.; Bartczak, A.; Czajkowski, M.; Markowska, A. (2007). Wartość Dodatkowego Roku Przeżycia w Polsce. Wyniki i Wnioski z Badań Wyceny w Kontekście Poprawy Jakości Powietrza. *Ekonomia* 19: 194–208.
- Nizankowski, R. (2002). *Analiza opłacalności*. Kraków: Uniwersyteckie Wydawnictwo Medyczne Vealius.
- Nowak-Starz, G. et al. (2013). Medyczne koncepcje struktury zdrowia jego ochrony i promocji. *Zdrowie i Dobrostan*, 1: 149–162.
- Skrzypczak, Z. (2007). Possible use of economic analysis in healthcare. *Studia i Materiały - Wydział Zarządzania UW* 2: 32–39.
- Stanković, A.; Nikolić, M.; Arandjelović, M. (2012). Effects of Air Pollution on Blood Pressure of Pregnant Women. *Polish Journal of Environmental Studies* 21(2): 465–469.
- Wysocki, M.; Miller, M. (2003). Paradigm of Lalonde, the World Health Organization and new public health. *Przegląd Epidemiologiczny* 57: 1505–1512.
- Żylicz, A. (2008). *Wycena dóbr nierynkowych*. XLI Szkoła Matematyki Poglądowej *Konkret i abstrakcja*. Available at: <http://www.msn.ap.siedlce.pl/smp/msn/42/08-12.pdf>. Accessed 23 July 2014.

***Wykorzystanie aspektów ochrony środowiska w naukach ekonomicznych
na przykładzie wyceny wartości ludzkiego życia***

Streszczenie

Aspekty ochrony środowiska, poza bezpośrednim wpływem na zdrowie społeczeństwa, zobrazowanym w koncepcji pól zdrowia Lalonde’a, odgrywają również rolę pośrednią, poprzez stanowienie jednej z głównych elementów metodologii w ekonomice zdrowia. poprawa jakości powietrza stanowiła bazę do wykonania w Polsce pierwszego badania wyceniającego dobro nierynkowe, jakim jest ludzkie życie i tym samym umożliwiającą przeprowadzenie najbardziej uniwersalnej analizy farmakoekonomicznej CBA. Na podstawie metody WTP oszacowano wartość wskaźnika VOLY w zakresie 40-70 tys. zł. (równice wynikały z różnych założeń alternatywnych ramion badania). Aktualnie metody farmakoekonomiczne rzadziej wykorzystują aspekty ochrony środowiska do wyceny dóbr nierynkowych, ale stanowiły one jeden z najważniejszych elementów prac, inicjujących wykorzystywanie analiz efektywności ekonomicznej w Polsce.

Słowa kluczowe: ochrona środowiska, farmakoekonomika, wartość życia, analiza CBA