ECONOMIC ASPECTS OF MEDICAL ERRORS

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ABSTRACT
The critical problem of medical errors and the associated costs has recently been increasingly in the focus of attention of a number of world renowned experts.
In the present article we review in detail and analyze the economic aspects of this problem. A methodology to assess the cost of medical errors and an algorithm for their prevention are presented. The cost of a medical error and the expenses required to avoid and prevent it are compared using graphical analysis of the prevention cost curve and the medical error compensation damages cost curve.

Key words: medical error, cost, prevention, economic evaluation

INTRODUCTION
By their nature medical services are complex, rather specific and sometimes unpredictable. That is why medicine is considered to be a symbiotic combination of science and art of human knowledge where it is quite possible for an adverse event to happen or be experienced by a patient despite the high qualification of physicians and other medical specialists involved in the diagnostic and therapeutic process, despite the rigorous observance of medical standards, organizational regulations and rules.1,2

As healthcare costs at present keep rising worldwide any additional expenses required by the people to pay should be given an economic assessment and justification. Without regard for the moral and ethical aspects of medical errors, the limited resources require that the benefits expected from certain measures to be undertaken be analyzed and compared with the associated costs, i.e. an economic analysis should be conducted.

The aim of this study was to make a detailed review and critical analysis of the issue of the “economic aspects of medical errors” in specialized publications and to propose an evaluation methodology and a prevention algorithm for medical errors.

For years experts from around the world have recognized that “medical errors” exist, yet what brought them to the forefront of public attention was the release of Institute Of Medicine (IOM) report “To Err is Human: Building a Safer Health System” in 1999. It showed that medical errors are significant national public health problem resulting in substantial morbidity, disability and mortality.3 In 2001 the second report of IOM “Crossing the Quality Chasm: A New Health System for the 21st Century”, was released extending the findings of the first one to other important dimensions of health care quality. It states that in spite of the accumulated immense experience and empiric evidence provided by a number of international studies there is still a considerable risk to patient safety.4 As a result of the published findings, medical errors have become subject of worldwide research aiming at identifying and classifying errors and developing monitoring and reporting systems as well as methods and rules for preventing them.

When referring to “medical errors” attention is usually focused on health system “flaws” or weaknesses not only on medical but also on legal, ethical and economic sides. In some countries medical errors are an indicator of the quality of medical services provided.5 According to WHO patient safety is a global public priority. The research in this respect shows that between 4% and 16% of all hospitalized patients have suffered medical errors that could have been prevented in most of the cases.6,7

Despite the efforts of a number of researchers in this area scientific terminology in this field is still unclear; there is no consensus on what medical errors are: are they physician’s errors, or incidents, or medical malpractice, negligence etc.
In most countries (USA, Great Britain, Australia, France etc.) these concepts are synonymous. One reason accounting for this is the variety, complexity, variability and uncertainty of medical activities and procedures and because treatment outcome or effect are not always determined by proper medical processes or structure.\textsuperscript{8,9} In 2000 the experts in The Quality Interagency Coordinating Task Force (QuIC) gave a broader definition of a medical error, expanding the 1999 IOM definition.\textsuperscript{10} They defined medical errors as “failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. Errors can include problems in practice, products, procedures, and systems”. Other authors such as J. Reason (1990), B. Strauch (2002), de Vries et al. (2008) have also tried to provide definitions.\textsuperscript{11-13} JCAHO defines medical error as “unexpected occurrence involving death or serious physical or psychological injury”.\textsuperscript{14}

The problem for precise definitions of concepts relating to patient safety, ensuring their adequate interpretation in practice has been raised in Bulgaria as well.\textsuperscript{8,9} The Provision in the Law for blood, blood donation and blood transfusion is that “Serious incident” shall mean any adverse event associated with collection, testing, processing, storage, and distribution of blood and blood components that might lead to death, life-threatening condition, disability or disease that result in prolongation of recipient’s hospitalisation.\textsuperscript{15} According to the Bulgarian Executive Agency for medical Audit (EAMA) medical error is a failure to perform and/ or incorrect performance of planned actions and/ or normative requirements, or execution of wrong plan to achieve an aim.\textsuperscript{9}

It is other authors’ views that in defining “medical errors” certain degrees of guilt should be taken into consideration.\textsuperscript{16} In our opinion there is substantial difference between “medical” and “physician” error. When discussing medical errors we consider incorrect medical actions plans or correct plans executed the wrong way under optimal work circumstances. “Medical error” is a broader concept than “physician error”: it incorporates different degree of guilt and responsibility, if proven, not only physician’s but also of other specialists taking part in planning and provision of medical care. Unlike that the guilt in the “physician errors” is born by those directly involved in medical process, i.e. in type I errors there is a management problem and in type II – it is personal.

Many authors such as Ibrahim Adham Taib, L. Leape and J. Lazarou use various taxonomies of medical errors depending on the criteria used for classification.\textsuperscript{17-19} Liochkova et al. categorize medical errors as:\textsuperscript{20}

- Errors resulting from objective factors – imperfection of medical science; lack of time or work conditions.
- Errors resulting from subjective factors – lack of knowledge, negligence, not using available medical technology.

Experience has shown that there are many possible ways to categorize medical errors, but no universally accepted taxonomy.\textsuperscript{17}

The acknowledgment, identification, definition and categorization of medical errors raised a number of questions and studies also in other areas such as law, ethics and economics. In legal terms medical errors are considered reasons or grounds for certain legal actions on behalf of the affected persons against the medical service provider.\textsuperscript{16} Such legal actions may lead to administrative penalties (prohibition of practicing, fines etc.) or initiation of criminal prosecution (e.g. detention) depending on the laws and regulations in different countries. Emphasis is placed on defining the difference between inadvertent errors and those arising from negligence, incompetence or poor training of the physician or because of weaknesses and gaps in the health system.

The ethical approach to medical errors is in the context of moral duty and humanity as stipulated in the Hippocratic oath, the Code of professional ethics, good medical practice guidelines in this country, etc.\textsuperscript{21-23} These papers include analysis of the effects and harm done not only to the patient but also to the psyche of the health specialist who committed the error.

In this paper we will also discuss the economic aspects of medical errors.

Using economic evaluation of costs and benefits of different measures for prevention and avoiding medical errors allows making the best choice for a more efficient allocation of limited public resources. At present, despite the efforts of a number of researchers, economic evaluations of medical errors have limited application. Unfortunately, we could not find Bulgarian empiric studies in this area. The most research of this kind has been conducted in the USA and Canada, although none of these studies describe the actual methodology applied in the assessment of the medical errors.\textsuperscript{24-28}

In the Board on Health Care Services (HCS) report „Preventing Medication Errors: Quality Chasm Series” there is an estimate that the extra
health care costs resulting from treatment errors in USA in 2006 amount to more than $3.5 billion, associated with harm, not counting the personal costs for the patients (lost household earnings, costs of medication etc). Medical errors cost the U.S. economy $19.5 billion for additional medical services in 2008, which is 0.1357% of GDP. This is a drastic increase over a two-year period. The published reports indicate that although USA has one of the most advanced health care systems providing some of the highest quality services, the number of health care errors is unacceptably high costing increasingly more to the regular taxpayer. Table 1 shows the findings of different studies on the costs incurred on people as a result of the complications occurring in medical interventions.

Europe lacks accurate statistic data on medical errors and the extra costs resulting from them because there is no official body engaged in identification and registration, unlike the USA. Yet there has been evidence that clearly suggests that the cases of incorrect treatment increase. The UK Department of Health has estimated that adverse events affect around 850 000 people and cost at least £2 billion each year for the extra hospital services. The data in Table 1 (for the USA and UK) show not only the extra costs for the hospital treatment as a result of adverse events. They show, however, the high price paid by society in cases of medical errors. All developed countries have channelled recently their efforts towards development of methods and systems to reduce their number. The emphasis is put mainly on the economic benefits of these measures.

It has been estimated that 8.3% of Bulgarians identify themselves as victims of a medical error over the last 5 years (the project on “Ameliorating the judicial system effectiveness in cases concerning medical errors or negligence and enhancing the protection of patients’ rights in Bulgaria”).

**How to calculate the social cost of a medical error paid by the people**

Although market pricing methods could hardly be applied to health care the calculation method is more or less successfully applied in this specific area. Therefore, applying the calculation approach, we propose the following mathematic model for estimating the costs of medical errors:

\[
C_{ME} = C_{AMS} + PPC_{HUD} + LI_{DIS} + LI_{FM} + C_{Other}
\]

where:

- \(C_{ME}\) – costs of medical error;
- \(C_{AMS}\) - expenses for extra medical (outpatient and hospital) services;
- \(PPC_{HUD}\) – expenses covered by the patient for outpatient treatment and medication;
- \(LI_{DIS}\) - lost income because of disability. This coefficient can be calculated by the method used by Osterhaus to calculate in currency the lost labour cost due to disability;
- \(LI_{FM}\) – lost income by another family member taking care of a person with disability;

**Table 1.** Estimated annual mortality and economic cost of medical intervention in USA*

<table>
<thead>
<tr>
<th>Type of medical errors</th>
<th>Deaths</th>
<th>Cost</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication error</td>
<td>106 000</td>
<td>$12 billion</td>
<td>(Lazarou et al.)</td>
</tr>
<tr>
<td>Physician error</td>
<td>98 000</td>
<td>$2 billion</td>
<td>(IOM, 1999)</td>
</tr>
<tr>
<td>Errors due to incompliance and misprescription, incl.:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedsores</td>
<td>115 000</td>
<td>$55 billion</td>
<td>Xakellis, Frantz, Lewis (1995), Barczak et al. (1997)</td>
</tr>
<tr>
<td>Unnecessary procedures</td>
<td>37 136</td>
<td>$122 billion</td>
<td>HCUP (2003)</td>
</tr>
<tr>
<td>Surgery-related errors</td>
<td>32 000</td>
<td>$9 billion</td>
<td>Tunis and Gelband (1994)</td>
</tr>
<tr>
<td>Outpatients</td>
<td>199 000</td>
<td>$77 billion</td>
<td>Starfield (2000a)</td>
</tr>
</tbody>
</table>

The other costs include the pain-and-suffering related cost that is difficult to quantify, calculated by means of various quality of life questionnaires (SF-36, SF-12, EuroQul etc.). They provide a general subjective evaluation of the patient’s psychological and emotional status. Their price can be calculated by the contingent method applied to subjective concepts that are difficult to measure such as ending or relieving the discomfort resulting from a medical error. Attempts at pricing these parameters are mainly made by USA legal and insurance scholars to establish the amount of damages due in cases of a confirmed medical error.35

We suggest that the mathematical model presented for estimating the total costs of medical errors (as a sum of the costs of all medical errors over a period of time, for example a year) be used in reference to the country’s GDP. The purpose is to establish the relative share spent on covering total costs of medical errors and the undertaking of specific actions by the state for improving quality of medical services, based on this analysis. According to the American economist RA Postner, on the grounds of Learned Hand formula rule in cases of negligence, effective allocation and utilization of resources for prevention and avoidance of medical errors only exists when the difference of $1 spent preventing the adverse event saves $1 spent on compensating for it.36,37 In our opinion this statement could be presented by the inequality:

\[ C_{\text{Prevention}} < P \times C_{\text{ME}} \]

where:
- \( C_{\text{Prevention}} \) - costs of preventing adverse events (medical error),
- \( P \) - probability of an adverse event;
- \( C_{\text{ME}} \) - costs of medical error.

Although Philips Crosby’s “zero defects” concept is widely applied in management, especially in aviation and defence industries, it is unfortunate that the reduction of medical errors to zero is impossible.38

From the economic perspective increase in measures for prevention of adverse events including medical errors requires substantial financing. What is meant is direct costs related to safety measures as well as some hidden costs – in the form of delays or new errors, lost of missed opportunities for effective treatment etc.

In Fig. 1 we present the prevention and compensation of medical errors costs curves for different levels of safety in a particular health care system. If we consider the medical errors damage compensation costs curve alone it is obvious that raising the level of safety decreases the total social costs. In this case the aim we could set is to achieve the highest possible level of safety. If we consider the prevention of medical errors costs curve we see that the higher the level of safety the higher the increase of prevention costs society has to cover.

The curve displaying the total costs of preventing medical errors is presented by a U-shaped dotted curve. It is a sum of the two curves. From the economic perspective the most effective level of safety is achieved in point A where the public expenses are the lowest. Improving safety beyond that point, to the right of the graph, would lead to additional costs exceeding the additional social benefits, due to insufficient reduction of adverse events after a certain point. Although medical effectiveness and efficiency, consistent with the major social role and functions of health care, should be the main determinants, the expenses beyond this point are not always justifiable. However, in order to make the economic assessment an electronic medical errors registration system is required. The algorithm of prevention, based on the Deming cycle is shown on Fig. 2.

The first step in this model is developing and introducing a national electronic register of medical errors.40-45 It is recognised that there are major barriers to medical reporting, such as the ‘culture of blame’.46,47 To promote participation of health services providers it must be made clear in advance that the person reporting shall remain anonymous, that no charges will be pressed and he or she will not be prosecuted. That would enable gathering, processing and analyzing data form different sources. The next step is setting up quality medical service clubs in workplaces where health professionals voluntarily discuss registered data. Quality control tools such as Fish-bone diagram and Pareto charts

Figure 1. Total public expenditures.
could be used to differentiate main areas and reasons for medical errors, to draw lessons how to avoid them in the future. The last stage of the algorithm aims to change organizational culture of medical professionals from culture of blame to culture of self assessment, analysis and open discussion.

The social benefits from this algorithm may be summarized in several aspects:

- Raised awareness on issues related to medical errors.
- Promoted exchange of successful solutions and good practices among health care providers.
- Culture of open debate. The aim is not to blame measures for preventing medical errors will enable us to properly identify priority areas and to make the best social choice possible.

**REFERENCES**


**Figure 2.** Model of medical errors prevention.

but to promote registration of medical errors so that initiatives could be developed to prevent errors.

- Development of best practices aiming at reducing medical errors.
- Lowering medical care expenses through eliminating errors and their repeated occurrence.

**CONCLUSIONS**

In conclusion, ignoring the cost-effectiveness analysis in health care may lead to significant increase in costs of adverse events prevention, i.e. taking costly and inefficient measures would only lead to wasting limited resources. Empirical findings established that the focus in medicine is shifted mainly towards quality improvement aiming at reducing medical errors and not taking adequate actions to control expenditures thus increasing public costs. The global economic crisis and the increasing costs of medical errors force a focus shift to another aspect - the economic evaluation. The use of economic methods for the assessment of costs and effects (both expected and unexpected) of planned measures for preventing medical errors will enable us to properly identify priority areas and to make the best social choice possible.
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ЭКОНОМИЧЕСКИЕ АСПЕКТЫ МЕДИЦИНСКИХ ОШИБОК

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РЕЗЮМЕ

В последние годы все большее число мировых экспертов изучает и анализирует медицинские ошибки и нововозникшие расходы, сопровождающие их.

В настоящей работе делаются подробный обзор и критический анализ состояния проблемы "экономические аспекты медицинских ошибок". Представляются методика определения стоимостей и алгоритм превенции медицинских ошибок. Делается также попытка сопоставить стоимость медицинской ошибки с расходами, необходимыми для ее предотвращения и превенции посредством графического анализа кривой расходов для превентии и кривой расходов для компенсирования убытков вследствие медицинских ошибок.