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## MODELLING OF EXPENSES FOR LIQUIDATION OF CONSEQUENCES OF MEDICINES' ADVERSE REACTIONS

*The method of calculation of direct expenses for liquidation of consequences of medicines' adverse reactions has been developed and is mathematically justified. The offered algorithm of calculations allows to optimize or to reduce costs for treatment of patients, to prevent emergence or to minimize losses from a number of specific risks connected with occurrence of medicines' adverse reactions.*

**Key words:** medicines, adverse reactions, expenses, safe use, rational therapy.

### PROBLEM DEFINITION

Due to a large number of medicines on the market and increase their level of consumption, special attention is paid to pharmacological control, medicines safety problems and optimize health care needs. The relevance of this issue stems from the fact that the use of medicines is accompanied by a large number of adverse effects and is a source of serious financial losses associated with the aftermath of an ineffective therapy.

### ANALYSIS OF PREVIOUS STUDIES AND PUBLICATIONS

Analysis of literature shows that the increase in side effects of used medicines depends on many factors, including lack of information about the new capabilities of effective pharmacotherapy, polypharmacy, low use of the achievements of evidence-based medicine, unethical promotion, self-healing problems, inadequate monitoring of drugs adverse effects.

According to various sources 2 to 6% of the human population suffer from adverse reactions, while 6-15% of patients having serious adverse reactions required adjustments. Mortality from drugs adverse reactions (AR) came in the 4th place in the world, give place to only the cardiovascular diseases (including stroke) and oncology [1, 3 - 9].

### IDENTIFICATION OF UNRESOLVED ISSUES OF THE GENERAL PROBLEM

All the above suggests that there is a need to develop a mechanism for costs calculation of adverse

effects manifestation which allows, on the one hand, to optimize the costs on medical care, and on the other – to achieve the most effective results of treatment.

### FORMULATION OF THE PURPOSES OF THE ARTICLE

In connection with the above the purpose of the study was to conduct research complex aimed at studying the risks associated with the occurrence of AR and methodological approaches to their assessment.

### THE MAIN MATERIAL OF RESEARCH

Investigation of the specific risks associated with the AR development allowed to classify risks into separate groups according to the objects to which they apply.

Thus, the following risks can occur in a person receiving medical agents:

- development of adverse reactions;
- adverse outcome (disability, the emergence of new disease, invalidity, death);
- moral damage;
- prolongation of treatment duration;
- increased cost of treatment.

For employing organizations arise:

- labor expenses;
- increase payments for sick –lists (list of disability);
- shortfall in revenue.

For health care settings is a threat to these risks:

- increase in financial expenses in the event of changing the drug that caused the AR;
- increase in financial costs for treatment of AR;

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- increase in the financial costs of emergency medical manipulation in case of AR;
- reduced confidence in medical staff and clinic in general;
- increase in bed-days and annual average bed occupancy rate;
- pecuniary penalties and litigation;
- irrational list of drugs recommended for the procurement budget.

For manufacturers in this situation there are risks:

- identify the negative drugs consequences;
- return of the batch of goods;
- prohibition of the sale of the drug;
- pecuniary penalties;
- risk of legal costs;
- deterioration of the company's image.

Economic and social expenses associated with the above listed risks are significant enough. Estimation of these expenses provides an understanding of risk in case of AR and improves, in particular, the rationality of budgetary and extra budgetary funds to purchase medicines.

Usually, the expenses for removing the effects of AR are divided into direct and indirect. Direct

expenses includes the cost of medical and pharmaceutical care patient (cost of services provided and the cost of medicines, materials used, equipment, etc.) [2]. Also there is the impact of indirect expenses that appears after a period of time and is quite significant in its social and economic structure. The structure of indirect expenses are those associated with temporary disability in case of AR, non-produced product by patient as a result of his disability, associated with disability or death, increase of payments for sick-lists, an increasing number of bed-days and annual average bed occupancy rate, with an ineffective formation of drugs assortment, which are purchased by medical institutions.

The algorithm for calculation of a direct expense on elimination of consequences of adverse reactions is given in Fig. 1. Calculations should be carried out using data on dosage, basic diagnosis, duration of drug therapy, the number of cases of AR, information about cancellation of a particular drug. Next, the calculations take into account the costs on diagnosing the symptoms of the AR manifestation, the average cost of AR symptoms pharmacotherapy, duration of treatment, cost per bed-day.

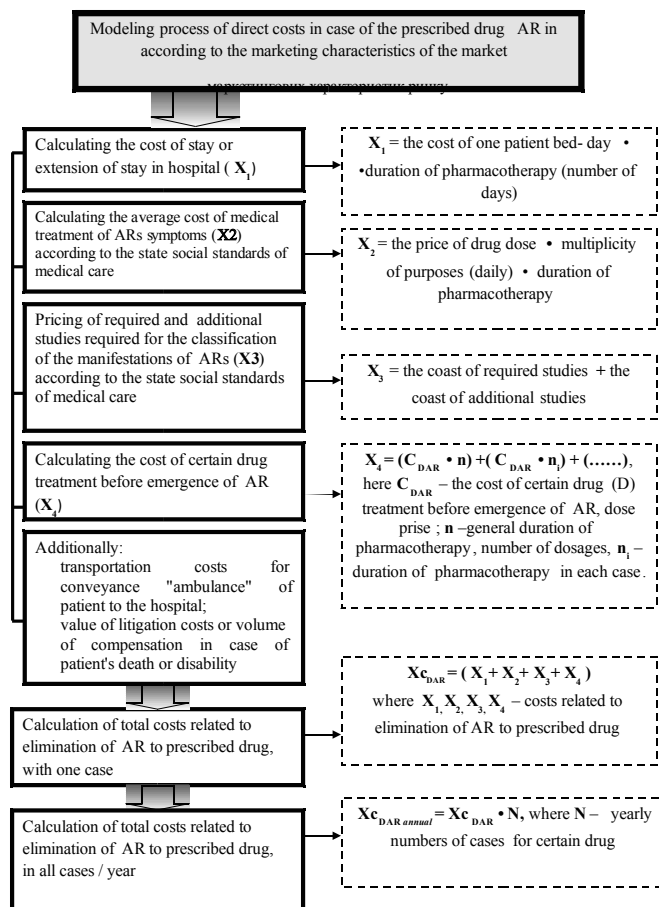


Fig. 1. The process of direct costs modeling in case of drugs AR according to marketing characteristics of the market

Using this algorithm we have calculated the direct expenses to remedy the effects of PR through the use of antibacterial agents. Calculations were carried out using a database of cases of AR in the Kharkiv region, when were fixed 1933 cases of adverse effects. Expenses measures of care was evaluated based on the minimum purchase prices for drugs (at the time of research) and minimum rates for medical manipulations which were on the health insurance market.

The amount of medicines therapy was calculated according to standards of medical care for adult population in Ukraine (Ministry of Healthcare of Ukraine № 507 from 28.12.2002 "On the approval of medical care and quality of medical care standards").

The analysis shows the need for careful selection of medicines in terms of "quality - safety," because amounts received as costs to eliminate the effects of AR in some cases can be reduced to zero rationality and optimization of pharmacotherapy, significantly increase the duration and cost of treatment.

The proposed analysis algorithm allows to assess the level of costs for elimination of AR, promotes cost-effective methods of drug use, improve the quality of medical and pharmaceutical care, rational use of available resources, including budgetary and extra-budgetary funds allocated for drugs purchasing.

#### CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

1. It is shown that importance of safe consumption of medicines and rational pharmacotherapy causes the need for the mechanism of cost calculation of the adverse events manifestation and choice of medical product development, that allow, on the one hand, to optimize the cost of medical care, and on the other - to achieve the most effective treatment results.

2. Investigation of the specific risks associated with the occurrence of adverse reactions when using drugs, allowed to classify risks into the following groups: for the person receiving medical product, for company-employer, for health care setting; for drug manufacturer.

3. The expediency of conducting pharmacoeconomic analysis considering direct costs in case of AR drugs. The method for calculating the direct costs to determine more effective (safe) and less

expensive drugs for rational therapy and expediency of the inclusion of appropriate drugs in the forms of any level was developed and scientifically proved.

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**МОДЕЛИРОВАНИЕ ЗАТРАТ НА ЛИКВИДАЦИЮ ПОСЛЕДСТВИЙ  
ПОБОЧНЫХ РЕАЦИЙ НА ЛЕКАРСТВЕННЫЕ СРЕДСТВА**

Разработан и математически обоснован метод подсчета прямых затрат на ликвидацию последствий побочных реакций при использовании лекарственных средств. Предложенный алгоритм расчетов позволит оптимизировать или сократить затраты на лечение больных, предупредить возникновение или минимизировать убытки от ряда специфических рисков, связанных с проявлением побочного действия лекарственных средств.

**Ключевые слова:** лекарственное средство, побочная реакция, затраты, безопасное использование, рациональная терапия.

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**МОДЕЛЮВАННЯ ВИТРАТ НА ЛІКВІДАЦІЮ НАСЛІДКІВ  
ПОБІЧНИХ РЕАКЦІЙ НА ЛІКАРСЬКІ ЗАСОБИ**

Розроблено та математично обґрунтовано метод обчислення витрат на ліквідацію наслідків побічних реакцій при використанні лікарських засобів. Запропонований алгоритм підрахунків дозволить визначити адекватну терапію, оптимізувати або скоротити витрати на лікування хворого, попередити виникнення або мінімізувати втрати від низки специфічних ризиків, пов'язаних з проявом побічної дії лікарських засобів.

**Ключові слова:** лікарський засіб, побічна реакція, витрати, безпека застосування, раціональна терапія.

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