Түйін. Денсаулық халықтың жағдайын анықтайтын фактор ретінде елдің жоғарғы көрсеткіштерін ғана емес, оның әл-ауқатын да көрсетеді. Ал халықтың денсаулығын сақтау мен қамтамасыз етуге байланысты шығындар мемлекет міндеттерінің бірі болып табылады. Салым мен шығынның тиімділігі денсаулықты жоғалтудан келтірілген экономикалық зиянмен анықталады. Экономикалық залалды бағалау экономика, қаржы және тәуекелдерді басқару саласында жоспарлау мен шешім қабылдаудың маңызды құрылғысы болып табылады. Өзінің географиялық орналасу жағдайына байланысты Қазақстанда аса қауіпті инфекциялардың эндемиялық табиғаттары бар. Үлкен қаржылық шығындарды және аса қауіпті инфекциялар салдарынан өтініш әсерін ескере отырып, эндемиялық аурулардан болатын экономикалық зиянды есептеу ендемиялық зиянды есептеу әдістемесін әзірлеу маңызды бағыт болып табылады.

Әдістеме тікелей және жанама әдістермен жасалды. Экономикалық залалды бағалаудың тікелей әдісі пациенттерді емдеуге және күтуге байланысты шығындарды, соның ішінде медициналық қызметке, дәрі-дәрмекке, құрал-жабдыққа, тасымалдауға және т.б. шығындарды тікелей қосуға негізделген. Жанама әдіс инфекциямен байланысты, халықтың өнімділігін жоғалту және мемлекеттік кірісті жоғалту шығындарды бағалау үшін қолданылады. Әзірленген әдістеме бюджет қаражатын жұмсаудың ұтымдылығы мен мақсаттылығын арттыруға мүмкіндік береді.

Түйніді сөзден: эндемиялық ауру, аса қауіпті инфекциялар, әдістеме, экономикалық зиян, экономика, денсаулық сақтау.


К.М. Ахметова1, З.Б. Жумадилова1, Ж.И. Шайдуллина1, М.Б. Жумадилова2
1 «QazBioPharm» Улттық холдинг, Астана, Қазақстан,
2 Казпейский университет технологий и инжиниринга им. Есенова, Актау, Қазақстан

DEVELOPMENT OF A METHODOLOGY FOR ASSESSING THE ECONOMIC DAMAGE FROM ENDEMIC DISEASES

Resume. Health as a factor in the well-being of the population determines not only the performance of the country, but also its well-being. And the expenditure associated with maintaining and providing a healthy population is one of the tasks of the state. The efficacy of the expenditure directed for prevention and restoration of the health of population is determined by the correlation of economic damage inflicted in case of disease, with the expenditure caused this result. Economic damage assessment is an important tool for planning and decision-making in the field of economics, finance and risk management. Due to its geographical position, Kazakhstan has endemic natural foci of extremely dangerous infections. Taking into account the large financial costs and the impact of the consequences of extremely dangerous infections on the country's economy, the deve-
Introduction. In the conditions of modern development of the country's economy, social indicators are important, including health as a factor in the well-being of the population. The health of a population can be represented by epidemiological parameters such as prevalence, morbidity or mortality. Also, additional health-related indicators can be measured, such as disability-adjusted life years and the socioeconomic costs of illness [1]. Cost of illness studies can give a quantity estimation of the socioeconomic costs associated with illness and indicate the maximum costs that could potentially be reduced if the illness were prevented [2]. Thus, such studies serve as the important purpose of providing evidences for the logical allocation of scarce resources during various decision-making processes in the health sector, especially in the direction of high-risk infections.

In the Republic of Kazakhstan, due to its geographical location, there are endemic natural foci of especially dangerous infections of plague, tularemia, hemorrhagic fevers (Crimean-Congo hemorrhagic fever, hemorrhagic fever with renal syndrome), anthrax and other zoonotic infections. In Kazakhstan, natural foci of especially dangerous infections occupy significant areas. For example, The area of natural plague foci in Kazakhstan exceeds 1,117,000 km2, which is equal to approximately 41% of the country's territory and this is 50.7% of the entire enzootic territory of the Commonwealth of Independent States. Endemic for Crimean-Congo hemorrhagic fever, the territory occupies the southern part of Kazakhstan with a tendency of being increased annually [3].

Methods for calculating the economic burden of different diseases vary greatly between studies. Some studies include only medical indicators in the methodology, while other methods use a human resources approach to calculate indirect costs. Thus, estimates of the economic burden of disease can vary between studies by a factor of 2-10 in cost. Because of these differences in methodology, it is difficult to directly compare the economic burden of outcomes for each disease across studies [4]. Therefore, it is necessary to develop a methodology for calculating the economic damage to assess the socioeconomic burden of diseases in Kazakhstan of diseases caused by especially dangerous infections. Such standardized approach is needed to unify the calculation and analysis of the burden of endemic diseases.

Materials and methods. Considering international experience, as well as a number of existing methods for assessing the economic damage from diseases of especially dangerous infections, the model is built on the basis of direct and indirect methods using the example of Crimean-Congo hemorrhagic fever and anthrax. The direct method of assessing economic damage is based on the direct summation of losses and costs associated with the treatment and care of patients, including the cost of medical services, medicines, equipment, transportation, etc. The indirect method is used to estimate the costs associated with infection, such as possible loss of population productivity and loss of government revenue. The developed methodology will allow to assess the rationality and expediency of spending the budget.

Keywords: endemic disease, extremely dangerous infections, methodology, economic damage, economics, healthcare.
Figure 1 - Algorithm for building a model for assessing economic damage

stan dated October 30, 2020 No. ҚР ДСМ-170/2020 «On approval of tariffs for medical services provided within the guaranteed volume of free medical care and in the system of compulsory social health insurance». The costs of treating a patient in healthcare entities providing specialized medical care in inpatient and inpatient-substituting conditions within the guaranteed volume of free medical care or the mandatory social health insurance system are determined by the established rate for one treated case for clinical and cost groups, which includes the costs of treating a patient in a hospital (outpatient), the costs of medicines, medical devices, etc. medical services, salaries of the main medical workers involved in the treatment of one case, expenses for taxes and other manda-
tory payments to the budget for one case, expenses for
the patient’s meals in the hospital.
In the indirect method, the main indicator is disability and
the average salary of the population. Due to the large
spread of indicators, the size of the average salary is
made by region.
Based on the recommendations of the World Health Or-
ganization [5], as well as the experience of other coun-
tries in assessing the economic damage from diseases,
mathematical approaches were used aimed at isolating
and integrating values, summing and correlating of the
data to determine the level of their impact.
Official statistical data on the economic and epidemi-
ological situation in the country for the period from 2018 to
2022 were taken as initial indicators. Along with this, the
legislative framework was considered, which defines the
basic principles of building a model and which has relat-
ied regulatory norms.
These factors determined the approaches and principles
of constructing a model for assessing economic dam-
age from extremely dangerous infections in Kazakhstan.
Results. As a result of integration, as well as analysis of
available methods for calculating statistical and other in-
formation necessary to obtain relevant data, the econom-
ic damage assessment model is presented in the form of
the following formulas:

\[ ED = C_{dm} + C_{im} \]  \hspace{1cm} (1)

Where, ED – economic damage;
C_{dm} – direct method calculation;
C_{im} – calculation by indirect method.

\[ C_{dm} = PC + AC + LC \]  \hspace{1cm} (2)

Where, PC – personal expenses;
AC – related costs;
LC – costs of localization and prevention of proliferation
and its consequences.

Personal expenses (PC) are calculated according to the
formula:

\[ PC = \sum i (K_i \cdot C_{hi} + C_{di}) \]  \hspace{1cm} (3)

Where, Ki – the number of days of treatment according to
the protocol depending on the type of disease and severity
(based on the conclusion of a medical organization);
Chi – the cost of treatment per day depending on the type
of disease and severity (according to approved rates);
Cdi – the cost of medicines depending on the type of dis-
ease and severity;
i – a certain type of disease;
\[ \sum i \] – the sum of cases of infection of a certain type of
infection.

The associated costs (AC) are calculated according to the
formula:

\[ AC = \sum i (T + R_i \cdot A_i) \]  \hspace{1cm} (4)

Where, T – the costs associated with the transportation
of patients according to tariffs, including emergency am-
bulance;
Ri – the costs of tests per person or diagnostic object (ac-
ccording to the approved tariffs and the procedure for con-
ducting diagnostics);
Ai – the number of environments or samples.

The costs of localization and prevention of proliferation
and its consequences (LC) are calculated using the for-
mula:

\[ LC = \sum i ((S_d \cdot C_{d}) + C_q + L) \]  \hspace{1cm} (5)

Where, L – the costs of destroying the sources of infec-
tion (according to the approved procedure for sanitary and
preventive measures);
Sd – disinfection area depending on the spread and types
of disinfection object (according to sanitary and epidemi-
ological rules);
Cd – the cost of disinfection per square meter (according
to approved tariffs);
Cq - costs of quarantine measures depending on the ar-
aea and structure of the spread of infection.

The calculation by the indirect method (Cim) is present-
ed in the form of the following formula:

\[ C_{im} = C_{to} + C_d + LP \]  \hspace{1cm} (6)

Where, Cto – costs for the time of disability (disability);
Cd – damage due to mortality;
LP – lost profit.

The costs for the time of disability (Cto) are calculated ac-
cording to the formula:

\[ C_{to} = \sum i ((K_i \cdot P_{i}d) + (K_i \cdot B_{i}) + (D_2 - D_0) \cdot B_s) \]  \hspace{1cm} (7)

Where, Ki – the number of days of treatment according to
the protocol, depending on the type of disease and severity;
Pid is the average salary per day in the region, calculat-
ed based on the average number of working days per
year – 246 days;
Bd – payments to the budget per day (tax and other pay-
ments to the budget);
Ds – date of establishment of disability or recognition of
disability;
Dn – average age of life expectancy;
Damage due to mortality ($Cd$) is calculated by the formula:

$$Cd = \sum i \left( (D_d - D_n) \cdot P_{iy} + (D_d - D_n) \cdot B_y \right)$$  \hspace{1cm} (8)$$

Where, $D_d$ – date of death;
$D_n$ – average age of life expectancy;
$P_{iy}$ – average salary in the region per year;
$B_y$ – payments from the state due to disability or invalid.

The calculation of the lost profit ($LP$) is carried out on the formula:

$$LP = \sum i \left( (K_i + K_{qi}) \cdot U_e \right) + L$$  \hspace{1cm} (9)$$

Where, $K_i$ – the number of days of treatment according to the protocol depending on the type of disease and severity;
$K_{qi}$ – the number of days of quarantine measures depending on the type of disease;
$U_e$ – productivity per day;
$L$ – loss of life, including forced slaughter, alienation and destruction of animals.

Discussion. As part of the ongoing research, a methodology for assessing economic damage has been developed that meets the initially set conditions and has practical application.

The WHO recommendations and world experience in the field of assessing not only economic damage, but also calculating indicators adopted in healthcare [6, 7], including indicators such as DALY [8], disease assessment and others, were considered.

Along with this, the accepted models for assessing economic damage in other countries were considered [9-11].

On the basis of which it can be noted that to a greater extent, the accepted models comply with WHO recommendations and have the same structure. The difference is the indicators used in the calculation.

As a result, the basic principles of the methodology development were formed that meet the current legislation of the Republic of Kazakhstan, as well as the current sanitary and epidemiological situation and the adopted regulations on particularly dangerous infections. The models developed and proposed for implementation also comply with WHO recommendations and internationally accepted approaches.

The methodology is a dynamic formula, adaptive to specific situations and cases of endemic especially dangerous infectious diseases in Kazakhstan. Along with this, the proposed model has a risk indicator, which is the coefficient of influence of the previous period on the calculated assessment of economic damage.

In the proposed model, the risk is presented in the form of a coefficient and is formed depending on the severity of the disease and the amount of measures taken for its diagnosis and treatment. Previously, this approach to assessing economic damage has not been applied either in Kazakhstan or in international practice.

As a result, the accepted results have wider opportunities for further application in the development of programs for both the healthcare system and other related industries. However, for a full-fledged calculation, additional work is required to obtain statistical data that allows you to get a more accurate result and increase the efficiency of the model.

So, for the calculation, indicators of lost profits are taken, which form a forecast of damage for a long-term period. This indicator is based on the productivity of the sectors of the economy and specifically the current economic entity. Currently, due to the lack of a single standard within the country for the output of finished agricultural products, as well as productivity indicators for the industry and for a specific market, the calculation results have a relative error, or require high detail when considering each case. To ensure this indicator, it is necessary to conduct research on accounting and monitoring of relevant indicators in the field of agriculture and animal husbandry, using digital and innovative solutions.

When considering the data forming economic damage, the use of a billing system and statistical extrapolation of data is noted, which does not allow for variability with different degrees of severity of the disease, the timing of identification and the additional treatment methods used in case of complications.

Along with this, when establishing disability, there is no diagnosis of particularly dangerous infections as the root causes of disability, since in some cases the outcome of the disease depends on the state of the body at the time of infection (the presence of concomitant diseases, age, immune status, etc.). As a result, statistical information for assessing economic damage is incomplete and does not reflect the details of the picture of damage (consequences) to public health.

It should be noted that there is no legislative framework for taking into account the risk of particularly dangerous infections and assessing their impact on the country’s economy. In this connection, within the framework of ensuring biological safety, as well as in connection with the dependence of economic indicators on cases of particularly dangerous infections, it is necessary to adopt a number of regulatory documents in this area.

Based on the problems identified during the study, in order to increase the usefulness of the calculation of economic damage, it is recommended:

1. Adopt at the legal level the proposed methodology for assessing economic damage from particularly dangerous diseases endemic to Kazakhstan;
2. To improve the efficiency of accounting for statistical data, it is necessary to develop and implement a system for monitoring the cost of agricultural products (by region), taking into account the changing market situation;
3. In order to increase efficiency, it is necessary to develop a dynamic accounting methodology;
4. Introduction of a system of additional diagnostics for particularly dangerous infections when making a decision on disability and determining the causes of death. In general, the developed methodology for assessing economic damage is integrated, has an applied nature, is relevant and ready for implementation.

Conclusion. Thus, the proposed model provides:

- Unification of calculations of economic damage from particular dangerous infections (by excluding certain groups of indicators that do not depend on the methodology and are of exceptional importance);
- The calculation of economic damage varies depending on regional indicators (average salary), which makes it possible to assess the amount of economic damage in different regions;
- The construction of the model is based on direct and indirect methods, but differs from the accepted calculation methods in greater detail, which significantly increases its accuracy and efficiency.
- The indicators used and the result obtained correspond to the accepted country data and the system of macroeconomic calculation, and can also be used both to adjust and calculate forecasts, and to assess the effectiveness of budgeting preventive measures.

As a result, the model can be used and adapted, both in Kazakhstan and in other countries, if appropriate statistical data and methods for calculating macroeconomic indicators are available.

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