ORIGINAL STUDY

Выгодно ли государству обеспечивать больных сахарным диабетом, находящихся на инсулинотерапии, средствами для проведения самоконтроля уровня глюкозы крови по нормативным потребностям?

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Обоснование. *Распространенность сахарного диабета (СД) в РФ продолжает расти, и, прежде всего за счет больных СД 2 типа (СД2). В последние годы изменяется парадигма лечения СД, все в большей степени больной становится равноправным участником процесса лечения, постоянно возрастает роль самоконтроля гликемии. Накоплен целый ряд клинических доказательств, свидетельствующих о наличии положительной связи уровня проведения самоконтроля со снижением эпидемиологического и, соответственно, экономического бремени СД. Однако в настоящее время в России уровень обеспеченности инструментарием для проведения самоконтроля, закупаемым за счет государственных средств, значительно ниже нормативного уровня.*

Цель. *Создание доказательной базы, позволяющей принимать решения о распределении государственных ресурсов системы здравоохранения на основе анализа затрат государства и получаемых им макроэкономических выгод от планируемых расходов. В рамках исследования экономические выгоды определялись от реализации двух мероприятий: обеспечения в рамках государственно финансируемых программ закупок инструментария для проведения самоконтроля уровня глюкозы крови у больных СД в соответствии с нормативами и от использования глюкометров повышенной точности.*

Методы. *Исследуемая когорта – больные СД, получающие инсулинотерапию. Эпидемиологическое бремя этой когорты определялось по следующим показателям: численность рассматриваемого контингента, число случаев осложнений по классам болезней, возникающих в результате развития СД в этой группе больных, инвалидизация и смертность по половозрастным группам. При оценке экономического бремени эпидемиологическое бремя транслируется в монетарные термины, используя метод стоимости болезни. Выгоды определялись в терминах сокращения экономического бремени.*

Результаты. *Экономическая выгода от государственного обеспечения тест-полосками больных СД, находящихся на инсулинотерапии, в соответствии с нормативными показателями превышает необходимые дополнительные вложения в их закупку в 1,5 раза. Значительное снижение степени погрешности используемых при самоконтроле глюкометров (снижение погрешности с 20% до 10%) может привести к сокращению экономического бремени на 9,36 млрд руб. Совокупные выгоды государства от реализации обоих рассматриваемых мероприятий позволили бы сократить экономическое бремя, наносимое государству распространением этого заболевания, снизив его на 29,2 млрд руб.*

Заключение. *Повышение уровня государственных закупок инструментария для проведения самоконтроля уровня глюкозы крови до уровня нормативной обеспеченности больных СД, получающих инсулинотерапию, приносит государству экономические выгоды, значительно превышающие требуемые вложения.*

Ключевые слова: *бремя сахарного диабета; самоконтроль; экономическая выгода*

Is it beneficial to the state to provide insulin-treated diabetic patients with public funds for self-monitoring blood glucose?

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Background. *In Russia, the prevalence of diabetes continues to increase with the growing diabetes epidemic. In recent years, the paradigm of diabetes treatment has been changing, with patients increasingly becoming equal participants in the treatment process, through the introduction of self-monitoring blood glucose (SMBG). Several clinical studies have demonstrated a positive relationship between SMBG and the decline of the epidemiological and economic burden of diabetes. At present, the procurement of public funds for SMBG is below the specified level in Russia.*

Aims. *To investigate the potential macroeconomic benefits of public health resource allocation and the use of planned state investments to fund SMBG in insulin-treated diabetic patients.*

Materials and methods. *This study was conducted with data from insulin-treated diabetic patients. The epidemiological burden of this cohort was determined by the following indicators: the number of patients and the incidence of complications resulting from diabetes, disability, mortality, age and sex. The economic benefits were evaluated by the implementation of two measures: (1) procurement of public funds for the purchase of means for SMBG in patients with insulin-treated diabetes and (2) the use of highly accurate blood glucose metres. To evaluate economic burden, the epidemiological burden was translated into monetary terms using cost-of-illness. Economic benefits were defined as reductions in economic burden.*

Results. *The economic benefits of public-funded blood glucose test strips for insulin-treated diabetic patients exceeded the required additional investments for their purchase by 1.5 fold. A significant reduction in the inaccuracy of blood glucose metres from 20% to 10% may reduce the economic burden by 9.36 billion RUB. The combined state benefits from the implementation of both measures would significantly decrease the economic burden of diabetes to 29.2 billion RUB.*

Conclusions. Increased procurement of public funds for SMBG in insulin-treated diabetic patients would bring economic benefits that far exceed the required investments.

Keywords: *the burden of diabetes; self-control; economic benefits*

According to data from the World Health Organization, diabetes mellitus (DM) is one of the leading causes of death and disability worldwide [1]. Diabetic patients are 2–3 times more likely to die due to cardiovascular diseases and strokes, and they become blind 10 times more frequently than the rest of the population. Without appropriate treatment, patients with DM often develop severe complications that lead to reduced working capacity with subsequent disability and premature death due to the long-term complications of DM. Thus, DM poses a significant economic burden to any country.

The prevalence of DM in the Russian Federation continues to increase, mainly due to an increase in the number of patients with type 2 DM (T2DM). According to epidemiological studies, the actual prevalence of DM is at least 3–4 times higher than is officially declared [2].

During the last few years, the treatment paradigm for DM has significantly changed. The new approach entails greater involvement by the patient, who is considered an equal participant in the treatment process. As a result, self-monitoring of blood glucose (SMBG) has become increasingly important. Appropriate frequency of testing and subsequent correction of insulin dosage are key components in the effective management of DM in patients receiving insulin. The minimum frequency of SMBG is dependent on the type of insulin therapy (IT), and it is clearly regulated by the algorithms of specialized medical care provided to patients with DM and approved by the Russian Association of Endocrinologists. However, patients with DM often neglect regular testing. This is largely attributed to the reduced public procurement of test strips. This decreasing trend in the procurement of the tools for SMBG can be explained by the reduction of funds allocated for this purpose as well as by the legal collision present in this area. On the one hand, Government Resolution No. 890 dated 30 July 1994 stipulates that patients with DM should be provided with medicines, insulin syringes, disinfectants and diagnostic tools (i.e. test strips). On the other hand, the number of test strips that can be provided to a patient is regulated by the Orders of the Russian Ministry of Health dedicated to the standards of medical care. New standards of primary medical care for patients with DM were approved in 2012. Unlike the previous standards, these contain no information regarding the number of test strips allotted to each patient.

Currently, there is a large amount of clinical evidence showing a positive correlation between the quality of self-monitoring and the decreased frequency of complications, disability and other parameters that reflect the epidemiological burden of DM.

Existing policies regarding the provision of diagnostic tools for patients with DM in combination with reduced healthcare funding in Russia necessitate a comprehensive economic assessment of public spending efficiency in terms of DM treatment.

Aim

In the present study, we aimed to establish an evidence-based strategy to adequately allocate public healthcare resources based on an analysis of both government expenditures and the possible macro-economic benefits associated with these expenditures. In our study, we evaluated the possible economic benefits of 2 measures: 1) providing patients with DM with tools for SMBG within state-funded procurement programs; and 2) the use of highly accurate glucometers.

The objectives of the present study were to:

- assess the epidemiological burden of patients with DM receiving IT;
- assess the economic burden of patients with DM receiving IT;

- estimate the possible economic benefits of effective self-monitoring in patients with DM, with particular attention to adequate frequency of SMBG; and
- estimate the possible economic benefits of the use of highly accurate SMBG tools.

Methods

The medical and social consequences of the disease are reflected in the epidemiological burden, measured by such factors as incidence and prevalence rates, mortality, permanent and temporary disability and amount of healthcare resources, among others.

Within our study, we analysed a cohort of patients with DM receiving IT (patients with both T1DM and T2DM). The epidemiological burden of this cohort was determined by assessing the number of patients in the cohort, the frequency of DM-associated complications and the disability and mortality rates, by age and gender.

The assessment of economic burden involved the conversion of the epidemiological burden into monetary terms using various methods and approaches. The economic effects of DM were evaluated using a cost-of-illness analysis. We estimated material costs that determined the level of economic effect. These costs included both real resources and their use and real economic losses to society associated with the spread of the disease. Intangible costs such as pain, suffering, value of life lost were not analysed.

Material expenditure included both direct and indirect costs. Direct costs consisted of medical and non-medical costs. Public healthcare costs for providing medical care to the DM cohort comprised the medical costs. Non-medical costs included social payments for patients with physical disabilities that developed as a result of DM. Indirect costs included the expenditures associated with temporary or persistent disability as well as with premature death.

We used a prevalence-based approach that allowed evaluation of the disease consequences in both newly and previously diagnosed patients.

We performed a top-down analysis to estimate the amount of medical costs.

The amount of indirect costs was evaluated using the human-capital method that allows measurement of the loss of future productivity based on the current wealth via discounting. Current wealth was assessed in terms of foregone income.

Economic benefits associated with effective self-monitoring for the treatment of DM were assessed in terms of the possible reduction of economic burden achieved by providing study patients with test strips for SMBG. To determine the degree to which economic burden could be reduced, the existing SMBG coverage situation, in which test strips for patients with DM are purchased by the government, was compared to a hypothetical situation that involved complete coverage of test strips for patients with DM. Data on the actual treatment results achieved were associated with the existing coverage situation, and improved treatment results were associated with the hypothetical situation.

The data for the study was retrieved from:

- Statistical reports of the Russian Ministry of Health
- The National Register of Diabetic Patients of the Russian Federation
- Reports of the Federal State Statistics Service
- Russian and foreign epidemiological studies

Results

Evaluation of the epidemiological burden included several stages of analysis. In the first stage we determined the number of patients with T1DM and T2DM receiving IT. Calculations were based on the actual prevalence of DM stated in the statistical reports of the Russian Ministry of Health [3] and the proportion of patients with T2DM receiving IT from the National Register of Diabetic Patients of the Russian Federation [4]. As of 2014, the estimated number of patients in the study cohort was 1,034,754, composed of 310,177 individuals with T1DM and 724,577 individuals with T2DM, all of whom received IT.

In the next stage of the study, we estimated the number of patients with DM on IT who received medical care for DM or its complications. The calculations were based on the previously estimated number of patients in the cohort and on information regarding the frequency of different complications (according to the International Statistical Classification of Diseases) retrieved from the National Register of Diabetic Patients. The most frequent complications included diseases of the circulatory system, diseases of the eye and adnexa and diseases of the genitourinary system (Figure 1).

In the third stage of the study we evaluated the rates of DM-associated disability and mortality based on age and gender. The estimated number of deaths and disabled people were calculated using data on the rates of mortality and disability, respectively, provided by the National Register of Diabetic Patients. In 2014, the estimated number of disabled patients with DM receiving IT was 526,686 (27,820 children and 498,866 adults). Approximately one-third of all disabled people in the cohort were of working age (Figure 2). The estimated number of unemployed disabled people of working age was calculated to be 128,557 using the average employment rate of disabled people.

The estimated number of deaths in the study cohort was 27,392. The rate of premature death (in working age individuals) was almost 20% (Figure 3).

The results of the epidemiological burden assessment were used for evaluation of the economic burden of DM.

An assessment of direct medical costs was performed by top-down analysis to allow for evaluation of medical care costs by the disease class. The calculations were based on the total amount of public healthcare expenditures [5] and the estimated coefficients of providing medical care for each disease class [6]. The average cost of treating a patient was calculated by dividing the total amount of

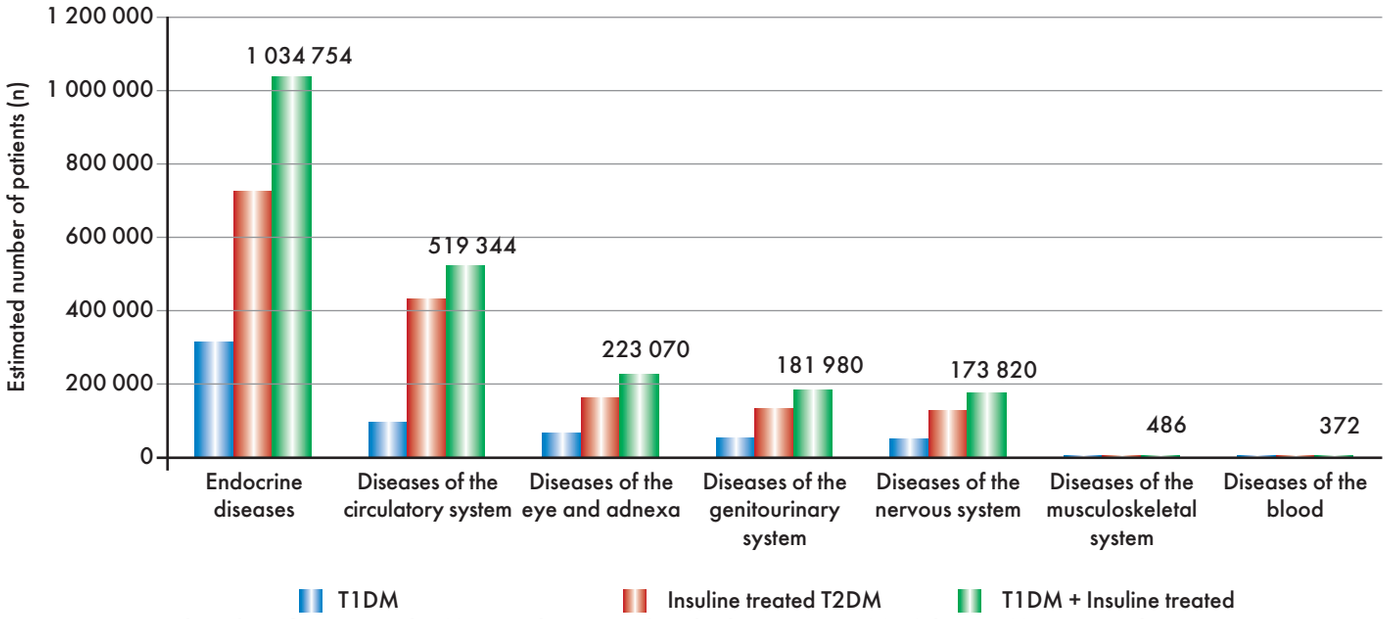

Figure 1. Estimated number of patients with DM on IT who received medical assistance in 2014 due to DM or its complications.

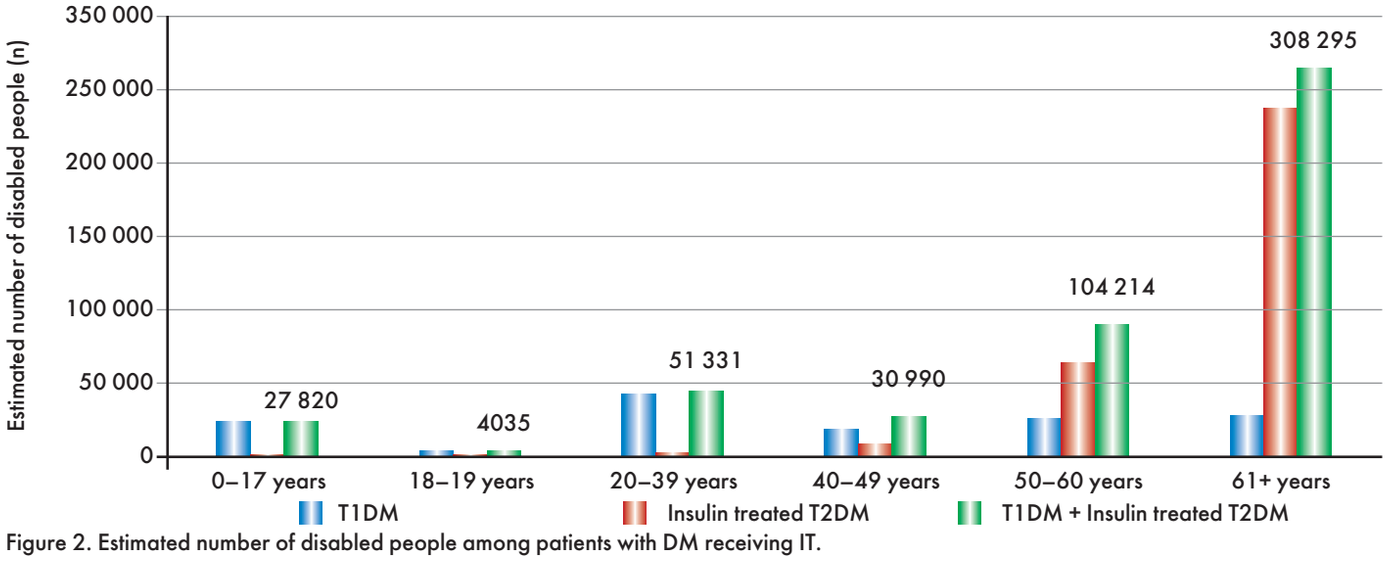

Figure 2. Estimated number of disabled people among patients with DM receiving IT.

funding used for treatment by the number of patients [7]. Direct medical costs were calculated as the number of patients with DM on IT who received medical care for DM or its complications multiplied by the average cost of treating a patient. We took into account special coefficients that reflected the differences between T1DM and T2DM treatment costs, based on results from other studies [8]. Corrective cost coefficients reflected the ratio of treatment costs per a patient with T1DM or T2DM to the cost of treating a DM patient.

In 2014, the direct medical costs were 15 billion rubles. The majority of the money was spent on the treatment of DM-related complications, whereas approximately one-third of it was spent on the treatment of DM itself (Figure 4).

The estimation of direct non-medical costs was based on the number of disabled people in the study cohort and data on average social transfers to a disabled person. Social transfers included disability pensions, monthly payments and lump sum payments. Due to the lack of detailed data on the distribution of patients in different disability groups, we calculated the amount of social transfers in accordance with the average amounts of transfer to 2 main categories of disabled people: children and adults. We used information from the Federal State Statistics Service to determine the average annual amount of social transfers to all disabled people. The average amount of annual social transfers was defined as the quotient obtained by dividing the total amount of payments by the total number of disabled people. As of 2014, the direct non-medical costs were 80.9 billion rubles.

The assessment of indirect costs (reflecting work losses) was based on the following parameters:

- Temporary disability
- Persistent disability
- Premature death

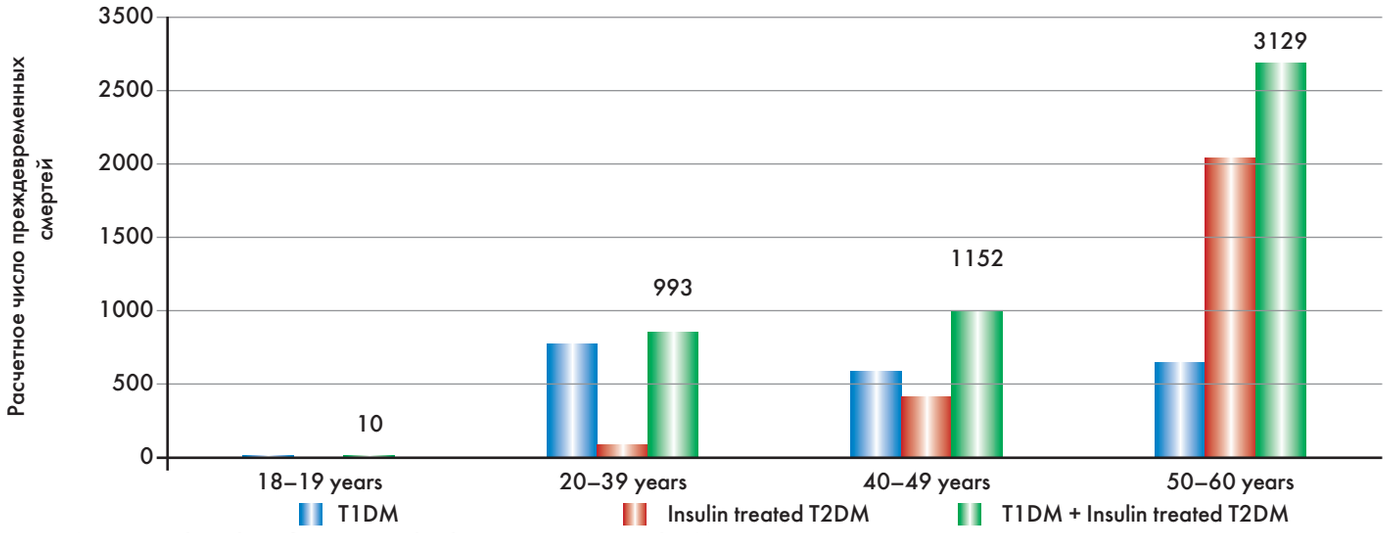

Figure 3. Estimated number of premature deaths among patients with DM receiving IT.

We used the human-capital method to evaluate productivity losses. The which human-capital method reflects future productivity losses in current prices by applying discounting. In accordance with WHO recommendations, we used salary as an indicator of productivity [9]. We applied a 5% discounting rate. f.

The assessment of productivity losses associated with temporary disability due to concomitant diseases in patients with DM on IT was based on the comparison of the average duration of sick leave in the study cohort to the average duration of sick leave in the general population. This comparison allowed us to determine additional working days lost by patients with DM. Production losses were calculated by multiplying the additional lost working days by the number of sick leaves and the average daily salary. In 2014, the estimated production losses were 0.2 billion rubles.

Productivity losses due to persistent disability or disability retirement were estimated in terms of the years of potentially lost working activity, calculated as the difference between the average age of disability retirement and the usual retirement age.

In 2014, the production losses associated with disability in patients with DM receiving IT accounted for 420.1 billion rubles.

The estimation of production losses associated with premature death was based on the number of potentially lost years of life, calculated as the difference between the average age of death (dependent on age and gender) and the retirement age (60 years for men and 55 years for women) and the average salary (dependent on age and gender) at a 5% discounting rate. As of 2014, the productivity losses associated with premature death comprised 14.9 billion rubles.

The total indirect costs were 435.2 billion rubles.

In 2014, the economic burden of patients with DM receiving IT comprised 531.7 billion rubles. This burden was mainly associated with indirect cost. Indirect cost accounted for 82% of the total economic burden. Direct medical costs comprised only 3% of the overall economic burden of patients with DM on IT (Figure 5). The main public health expenditures were for the treatment of DM complications. Approximately 65% of all direct medical costs were spent on the treatment of DM-related complications.

Economic benefits associated with effective self-monitoring during the treatment of DM receiving IT were assessed in terms of possible reduction of the economic burden achieved by providing study patients with test strips for SMBG in accordance with recommended norms. The economic burden reduction was determined by comparing the existing situation with provision of test strips for insulin treated diabetes patients purchased under public funded program, with a hypothetical situation that entailed higher up to recommended level of state provision of test strips for these patients.

According to the algorithms of specialized medical care to patients with DM, the frequency of SMBG testing should be:

- At least 4 times per day for patients with T1DM and T2DM receiving intensive IT
- On average, 2.29 times per day for patients with T2DM receiving mixed insulin
- On average, 1.43 times per day for patients with T2DM receiving one injection per day [10]

According to the data from the National Register of Diabetic Patients, approximately 50% of patients with T2DM on IT received intensive therapy, 15% received mixed insulin and 35% received only one insulin injection per day.

The estimated average number of test strips needed for SMBG was 3.2 strips per patient per day. This estimation was based on the number of patients receiving IT, required frequency of glucose measurement and the type of IT (Table 1).

The existing policy of providing test strips for SMBG to patients with DM does not ensure complete coverage and adequate frequency of testing. As of 2014, the estimated number of test strips purchased by public funds was 0.1 strips per patient per day. We assumed that within

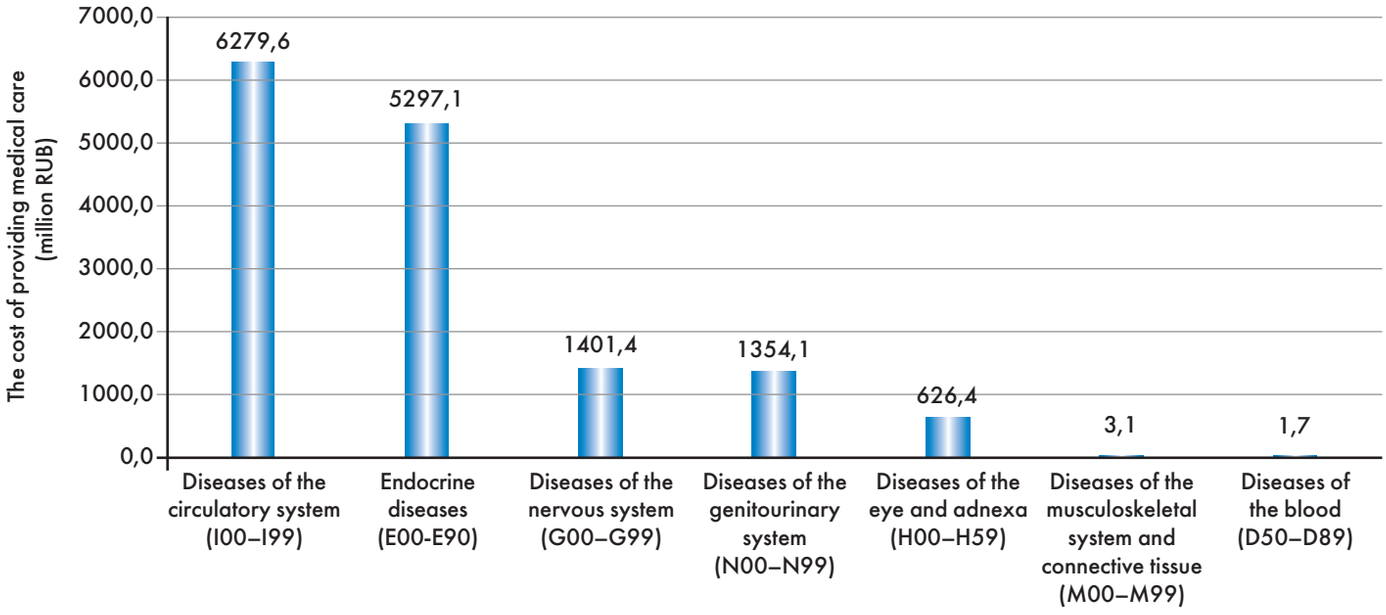

Figure 4. The cost of providing medical care for patients with DM receiving IT (million rubles).

the existing policy, patients from the study cohort were provided with test strips at least twice as frequently as the other patients. We used this assumption to calculate the amount of additional purchases required for patients with DM receiving IT.

As of 2014, the amount of additional public funding required for adequate SMBG in patients with DM receiving insulin would have been 13.7 billion rubles.

We also assumed that all patients in the study cohort were well trained and completely adherent to the recommendations in terms of the diet, work regimen and so on. We based our calculations on the evidence that increased treatment efficiency is associated with good glucose control.

1. The frequency of SMBG is tightly associated with better metabolic control, ensuring a 0.2% reduction of the HbA1c level with each additional glucose test per day [11].
2. A 1% decrease in the HbA1c level has been shown to reduce the number of complications and DM-related deaths by 21% in a population of patients with T2DM [12]. We assumed that other evaluated parameters such as development of complications, disability and the average duration of sick leave would, therefore, also decrease by 21%. A 1% decrease in the HbA1c level has also been shown to decrease the frequency of nephropathy by 25% and the frequency of retinopathy by 39% [13].

Our results suggest that improved coverage of test strips for patients with DM on IT can potentially decrease the level of HbA1c by 0.6%.

Taking into account the measures described, we propose that the epidemiologic burden may be reduced via the following changes: a 13% decrease in the frequency of all complications, mortality and disability among patients with T2DM; a 15% decrease in the frequency of nephropathy; and a 23% decrease in the frequency of retinopathy among patients with T1DM.

The possible decrease in the epidemiological burden was converted into a decreased economic burden for each type of cost. Economic benefits associated with improved coverage of test strips for patients with DM could have totalled almost 20 billion rubles in 2014. The greatest reduction of losses is observed in the indirect costs. Their proportion reaches 60% of all economic benefits. The greatest benefits from the proposed strategy can be obtained by reducing the level of disability. The proportion of direct non-medical costs (social transfers to disabled people) and indirect costs associated with disability account for more than 90% of the total reduction of economic burden (Figure 6).

The economic benefit from the improved coverage of test strips for patients with DM on IT exceeds the additional costs of purchasing the strips by 1.5 times. In other words, the additional investments associated with procurement of the test strips are not only paid off, but also bring significant economic benefit due to the recovery of labour potential. Comparison of the economic benefits to the additional expenditures associated with improved coverage of test strips for patients with DM on IT allows for the conclusion that additional costs for the purchase of tests strips can be economically justified since they ensure decreased productivity losses and the restoration of working potential.

As mentioned above, maintaining the target blood glucose level is crucial for effective treatment of DM. Self-monitoring of the blood glucose level using glucometers and test strips is one of the main components of the therapy that significantly affects its effectiveness.

Detailed analysis of the potential economic benefits associated with the use of specific SMBG equipment/consumables should be conducted prior to its purchase. The accuracy of SMBG testing should be considered as one of the key factors ensuring adequate monitoring of the

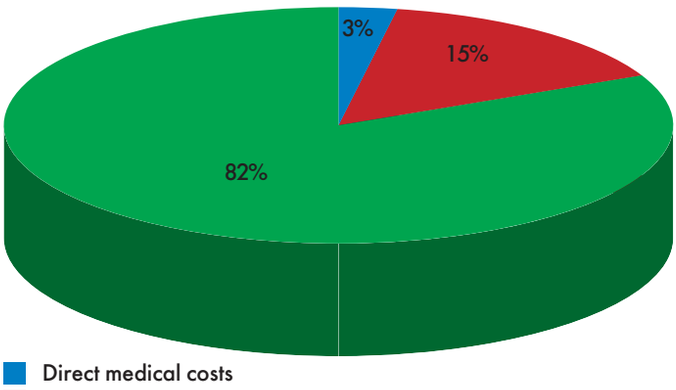

Figure 5. Types and proportions of costs comprising the economic burden in 2014.

disease. Increased accuracy of glucose testing is important for timely adjustment of treatment, which is crucial for prevention of late DM complications.

The accuracy of the measurements is especially important in determining the doses of insulin and their timely correction. Inaccurate glucose level measurements lead to incorrect results and subsequent incorrect decisions as to the required dose of insulin.

Several attempts have been made to assess the impact of glucometer accuracy on the clinical parameters of DM. In one of these studies, the authors demonstrated that increased accuracy of the equipment used for SMBG resulted in improved levels of glycated haemoglobin. According to Schnell et al., the reduction of the glucometer and test strip error from 20% to 15%, from 20% to 10% and from 20% to 5% resulted in 0.14%, 0.28% and 0.39% reduction in HbA1c, respectively [14, 15]. We used this data for estimation of potential economic benefits associated with the procurement of highly accurate SMBG equipment for patients with DM. According to our calculations, the use of highly accurate glucometers in our country can potentially provide substantial economic benefits, significantly decreasing the economic burden of DM. Most of the benefits can be obtained by reducing production losses.

Significant reduction of SMBG equipment errors (from 20% to 10%) can ensure a decrease in healthcare expenditures of 9.36 billion rubles. The amount of cost savings increases with the accuracy of glucometers (Figure 7).

The total benefits associated with the implementation of the 2 proposed strategies (ensuring adequate coverage of test strips for patients with DM on IT and the use of highly accurate glucometers) amount to 29.2 billion rubles, which implies significant reduction of the economic burden of the disease.

Discussion

Our results regarding the economic burden of patients with DM on IT correlates with the estimations obtained in foreign studies. Most studies show that the economic burden of DM consists mainly of indirect costs that often account for more than half of all expenditures. For instance, summarized results from 25 Latin American

Table 1

Estimation of the average need for test strips for a DM patient receiving IT in 2014

Parameter	T1DM	T2DM
Number of registered patients (*)	310 177	3 836 493
Proportion of patients receiving IT, % (**)	100	18,886
Number of registered patients receiving IT	310 177	724 577
Proportion of patients receiving different types of IT, % (**)		
Intensive therapy	100	50
One injection per day		35
Mixed insulin		15
Number of registered patients receiving different types of IT		
Intensive therapy	310177	362 288
One injection per day		253 602
Mixed insulin		108 687
Average number of test strips per patient per day depending on the type of IT (***)		
Intensive therapy	4	4
Mixed insulin		2,29
One injection per day		1,43
Annual need for test strips (entire cohort)		
Intensive therapy	452858420	528 941 053
Mixed insulin		90 675 609
One injection per day		132 235 263
Total need for test strips for all patients with DM receiving IT	1 204 710 345	
Total number of registered patients with DM receiving IT	1 034 754	
Estimated number of test strips per day per 1 DM patient receiving IT	3.2	

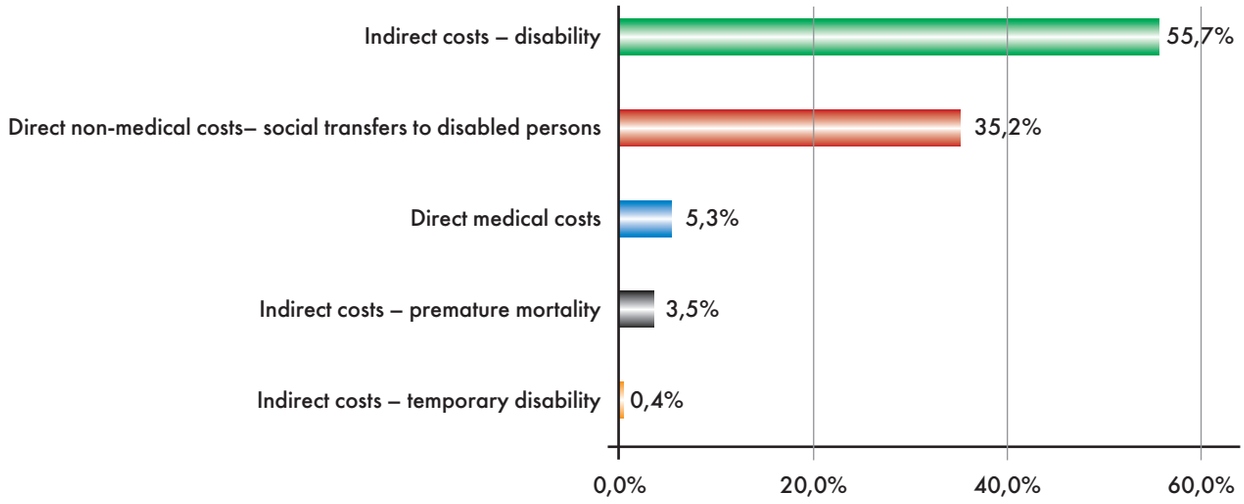

Figure 6. The structure of the economic benefits associated with improved coverage test strips for patients with DM depending on the type of costs.

countries indicate that DM-related production losses can exceed treatment costs by nearly 5 times [18].

In Russia, like in the most foreign countries [19], medical costs are primarily used for medical care of DM complications, not for DM itself. Our results suggest that more than 40% of all public healthcare expenditures allocated for the treatment of patients with DM were used for the treatment of diseases of the circulatory system.

The estimations of the economic benefits associated with adequate SMBG depend on the existing clinical evidence of the influence of measurement frequency on the severity of diabetes. These estimations will probably change with the improvement of the evidence base. However, it is already clear that the improvement of glucose monitoring is an appropriate measure for ensuring significant economic benefits.

Our estimation of the potential economic benefits associated with the use of highly accurate glucometers is generally logical: better equipment provides better results. Additional studies may change the approach to the evaluation of economic benefits. So far, our data may be considered as an argument for the implementation of highly accurate glucometers into routine clinical practise. This equipment may be more expensive, but will be able to provide additional economic benefits both for patients and society.

Conclusion

As of 2014, the economic burden of patients with DM receiving IT was 531.1 billion rubles. The burden mainly included indirect costs that accounted for approximately 82% of the total. Direct medical costs comprised only around 3% of the total costs forming the economic burden. The main direct medical costs were associated with the treatment of DM complications. The proportion of direct medical costs spent on the treatment of DM complications accounted for approximately 65% of the total direct medical costs.

The analysis of public procurement of test strips for SMBG revealed extremely low coverage of these important consumables for patients with DM for effective DM control. As of 2014, the estimated number of test strips purchased out of public funds was 0.1 strips per patient per day.

Our calculations suggest that additional costs required for adequate coverage of patients with DM receiving IT with test strips would have comprised 13.7 billion rubles in 2014.

Achievement of adequate coverage with test strips within the study cohort could have decreased both the epidemiological and economic burden of the disease. The economic benefits associated with improved coverage of patients with DM with SMBG consumables ensured by the system of public procurement should have comprised 19.9 billion rubles. Thus, the benefits from the proposed strategy (reflected in a decreased economic burden) could have exceeded 1.5 times the funds invested in the procurement of additional test strips. In other words, substantial investments in the improvement of the coverage of DM patients with the SMBG consumables are not only paid off, but also bring significant economic benefits due to the recovery of the labour potential.

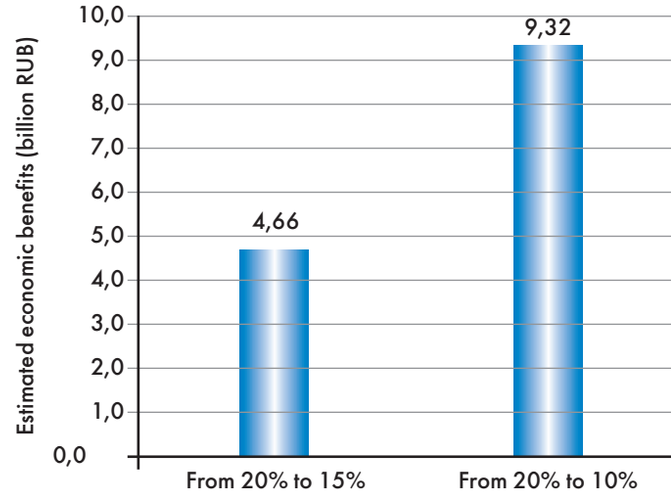

Figure 7. Economic benefits associated with the use of highly accurate glucometers, 2014 (billion rubles).

We demonstrated that the use of more accurate glucometers for SMBG in patients with DM on IT provides additional economic benefits up to 9.32 billion rubles.

Our results suggest that increased public procurement of SMBG consumables for patients with DM on IT can be repaid through a decreased economic burden achieved by an improvement of health of patients with DM.

Additional information

Conflict of interest

The authors declare no conflict of interest related to current manuscript.

Authors contribution

Shestakova M.V.—development of a research concept and study design for the assessment of economic burden of DM and evaluation of medical effectiveness of 2 measures: adequate coverage of patients with DM on IT with SMBG consumables and the use of highly accurate glucometers; Popovich L.D.—development of a research concept and study design for the assessment of economic burden of DM and evaluation of medical effectiveness of 2 measures described in the article; Potapchik E.G.—collection, processing and analysis of the data required for calculation of economic burden and benefits, calculation of economic parameters, drafting the manuscript; Mayorov A.Yu.—analysis of the data required for calculation of economic burden, editing the manuscript; Vikulova O.K.—collection and processing of the data from the National register of diabetes mellitus in the Russian Federation.

Список литературы | References

1. Murray CJL, Vos T, Lozano R, et al. Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet*.380(9859):2197-2223. doi: 10.1016/S0140-6736(12)61689-4
2. Дедов И.И. Инновационные технологии в лечении и профилактике сахарного диабета и его осложнений // Сахарный диабет. – 2013. – Т. 16. – №3. – С. 4-10. [Dedov II. Novel technologies for the treatment and prevention of diabetes mellitus and its complications. *Diabetes mellitus*. 2013;16(3):4-10. (in Russ)]. doi: 10.14341/2072-0351-811
3. Заболеваемость всего населения России в 2014 году. Статистические материалы. ФГБУ «Центральный научно-исследовательский институт организации и информатизации здравоохранения» Минздрава. Москва; 2015 [Zabolevaemost' vsego naseleniya Rossii v 2014 godu. Statisticheskie materialy. FGBU «Tsentral'nyy nauchno-issledovatel'skiy institut organizatsii i informatizatsii zdravookhraneniya» Minzdrava. Moscow; 2015 (in Russ)].
4. Данные Государственного регистра сахарного диабета в РФ за 2014 г. [Dannye Gosudarstvennogo registra sakharnogo diabeta v RF za 2014 g (in Russ)].
5. Государственный доклад о реализации государственной политики в сфере здоровья за 2014 год. Министерство здравоохранения Российской Федерации. Москва; 2014. [Gosudarstvennyy doklad o realizatsii gosudarstvennoy politiki v sfere zdorov'ya za 2014 god. Ministerstvo zdravookhraneniya Rossiyskoy Federatsii. Moscow; 2014 (in Russ)].
6. Dying Too Young. Europe and Central Asia, Human Development Department; 2005. Available from: http://siteresources.worldbank.org/INTECA/Resources/Dying_too_Young_Summary_UPDATED_Oct_19.pdf
7. Заболеваемость всего населения России в 2014 году. Статистические материалы. ФГБУ «Центральный научно-исследовательский институт организации и информатизации здравоохранения» Минздрава. Москва; 2015 [Zabolevaemost' vsego naseleniya Rossii v 2014 godu. Statisticheskie materialy. FGBU «Tsentral'nyy nauchno-issledovatel'skiy institut organizatsii i informatizatsii zdravookhraneniya» Minzdrava. Moscow; 2015 (in Russ)].
8. Дедов И.И., Шестакова М.В., Сунцов Ю.И., и др. Результаты реализации подпрограммы "Сахарный диабет" Федеральной целевой программы "Предупреждение и борьба с социально значимыми заболеваниями 2007–2012 годы" // Сахарный диабет. – 2013. – Т. 16. – №2S. – С. 1-48. [Dedov II, Shestakova MV, Suntsov YI, Peterkova VA, Galstyan GR, Mayorov AY, et al. Federal targeted programme 'Prevention and Management of Socially Significant Diseases (2007-2012)': results of the 'Diabetes mellitus' sub-programme. *Diabetes mellitus*. 2013;16(2S):1-48 (in Russ)] doi: 10.14341/2072-0351-3879
9. Guide to Identifying the Economic Consequences of Disease and Injury, World Health Organization 2009, Appendix B Critical overview of the cost of illness methodology. Available from: http://www.who.int/choice/publications/d_economic_impact_guide.pdf
10. Дедов И.И., Шестакова М.В., Галстян Г.Р., и др. Алгоритмы специализированной медицинской помощи больным сахарным диабетом. Под редакцией И.И. Дедова, М.В. Шестаковой (7-й выпуск) // Сахарный диабет. – 2015. – Т. 18. – №1S – С. 1-112. [Dedov II, Shestakova MV, Galstyan GR, et al. Standards of specialized diabetes care. Edited by Dedov I.I., Shestakova M.V. (7th edition). *Diabetes mellitus*. 2015;18(1S):1-112.] doi: 10.14341/DM20151S1-112
11. Ziegler R, Heidtmann B, Hilgard D, et al. Frequency of SMBG correlates with HbA1c and acute complications in children and adolescents with type 1 diabetes. *Pediatr Diabetes*. 2011;12(1):11-17. doi: 10.1111/j.1399-5448.2010.00650.x
12. Stratton IM, Adler AI, Neil HAW, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ*. 2000;321(7258):405-412.
13. Czupryniak L, Barkai L, Bolgarska S, et al. Self-monitoring of blood glucose in diabetes: from evidence to clinical reality in Central and Eastern Europe--recommendations from the international Central-Eastern European expert group. *Diabetes Technol Ther*. 2014;16(7):460-475. doi: 10.1089/dia.2013.0302
14. Schnell O, Erbach M, Wintergerst E. Higher accuracy of self-monitoring of blood glucose in insulin-treated patients in Germany: clinical and economical aspects. *J Diabetes Sci Technol*. 2013;7(4):904-912. doi: 10.1177/193229681300700413
15. Schnell O, Erbach M. Impact of a reduced error range of SMBG in insulin-treated patients in Germany. *J Diabetes Sci Technol*. 2014;8(3):479-482. doi: 10.1177/1932296813516206
16. Stratton IM, Adler AI, Neil HAW, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *BMJ*. 2000;321(7258):405-412.
17. Czupryniak L, Barkai L, Bolgarska S, et al. Self-Monitoring of Blood Glucose in Diabetes: From Evidence to Clinical Reality in Central and Eastern Europe—Recommendations from the International Central-Eastern European Expert Group. *Diabetes Technology & Therapeutics*. 2014;16(7):460-475. doi: 10.1089/dia.2013.0302
18. Barceló A, Aedo C, Rajpathak S, Robles S. The cost of diabetes in Latin America and the Caribbean. *Bulletin of the World Health Organization*. 2003;81(1):19-27.
19. Ray JA, Valentine WJ, Secnik K, et al. Review of the cost of diabetes complications in Australia, Canada, France, Germany, Italy and Spain. *Curr Med Res Opin*. 2005;21(10):1617-1629. doi: 10.1185/030079905X65349

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