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Original research article

The impact of full reimbursement of flash glucose monitoring on Czech patients – experience of one diabetes center

Kateřina Štechová [1], Radek Kovács [2] *, Martina Tuháčková [1], Martina Salátová [1], Šárka Malá [1], Pavlína Piťhová [1], Dita Pichlerová [1]

[1] *Charles University and Motol University Hospital, 2nd Faculty of Medicine, Department of Internal Medicine, Prague, Czech Republic*
[2] *Charles University, Faculty of Social Sciences, Department of Public and Social Policy, Prague, Czech Republic*

Abstract

The introduction of glucose sensors has been a major shift in glycemic self-monitoring. The aim of the study was to analyze the medical effect of Flash Glucose Monitoring (FGM) in type 1 diabetes patients at our clinic, in the context of the introduction of full reimbursement of FGM technology from public health insurance. We studied 64 women and 51 men (median age 42 years). All patients were treated with an intensified insulin regimen. No previous experience with any glucose sensors was reported by 61 patients (43%). Data on diabetes control prior to the introduction of the full FGM reimbursement (2019) and 12 months later (2020) were compared. Additionally, cost-effectiveness analysis was done.

Diabetes control improved significantly ($p = 0.001$ for HbA1c interannual decrease). Results were influenced mainly by the number of applied sensors; surprisingly only 30 patients (29.6%) used all covered sensors.

If we consider, for example, a decrease of the risk of the progression of diabetic kidney disease to the end stage of chronic renal failure by 1/3 (due to diabetes control improvement which is achieved by using glucose sensors), there will also be an economic benefit as the cost-effectiveness ratio was calculated for this model situation 6 and the net cost of USD 7,281.

The financial barrier is clearly not the only barrier to the widespread use of modern technologies. The results of the study led to the implementation of long-term nudge strategies targeted at both patients and health professionals in our center to improve patients' prognosis.

Keywords: Cost Effectiveness Analysis; Flash Glucose Monitoring; Full Reimbursement; Health Insurance; Type 1 Diabetes Mellitus

Introduction

The goal of achieving optimal compensation of diabetes mellitus (DM) is to minimize the occurrence of acute as well as chronic complications of diabetes mellitus, and thereby significantly improve the patient's quality of life. However, the prevention of DM complications is also of socio-economic importance because their treatment represents a significant economic burden (Anjana et al., 2017; Dover et al., 2017).

Regular blood glucose self-monitoring is a basic condition to achieve optimal control in patients with diabetes mellitus (DM) treated with insulin. Monitored results are necessary to assess the effectiveness of therapy, to change therapy strategy, to adjust dietary habits, and to provide efficient physical activity management. In everyday practice, it is important to strike a balance between achieving good blood glucose control and the patient's quality of life. Glucose self-monitoring using a glucometer is burdened by several complications for daily life (it is time consuming, requires manual dexterity, etc.), and important glycemic fluctuations may be missed. A major shift in glycemic self-monitoring has been the introduction of glucose sensors (Anjana et al., 2017; Dover et al., 2017. The most used glucose sensors are constructed as a platinum electrode covered with an enzyme (usually glucose oxidase) and are placed into the subcutaneous tissue. The enzyme enables the concentration of glucose in the vicinity of the sensor to be converted into an electrical signal, which is transferred using a transmitter to the receiving device (mobile phone or separate receiver). A fundamental advantage of this approach is that the signal is registered at short time intervals (minutes) and thus allows assessing the dynamics of the glucose concentration value over time (Chart 1). Thanks to this, the patient can react flexibly to the change of glycemia. The disadvantage of this method is that the concentration of glucose is registered in the intercellular fluid in the subcutaneous tissue and not directly in the blood stream, so it is not de facto "true" glycemia. With more rapid changes in blood glucose (glycemia), the blood

* **Corresponding author:** Radek Kovács, Charles University, Faculty of Social Sciences, Department of Public and Social Policy, Smetanovo nábř. 6, 110 00 Prague 1, Czech Republic; e-mail: radek.kovacs@fsv.cuni.cz
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glucose readings and the readings from the sensor may differ because it takes time for the glucose concentrations between the compartments to equalize. However, patients are specifically warned about this. The values from the glucose sensors are either displayed in real time mode (RT-CGM, Continuous Glucose Monitoring) or at the moment of the scan by the receiver, when current and retrospective values are obtained, and it is therefore possible to assess the glycemia change (so-called Flash Glucose Monitoring – FGM). Unlike the second generation, the first generation of FGM sensors did not allow the setting of hypo- and hyperglycemic alarms (Galindo and Aleppo, 2020). The first commercially available glucose sensor appeared in 1999 (Mastrototaro, 1999). Since then, the development of glucose sensors has focused on improving their accuracy, reducing their size, and extending their lifetime. In addition, modern sensors are calibration-free (Galindo and Aleppo, 2020).

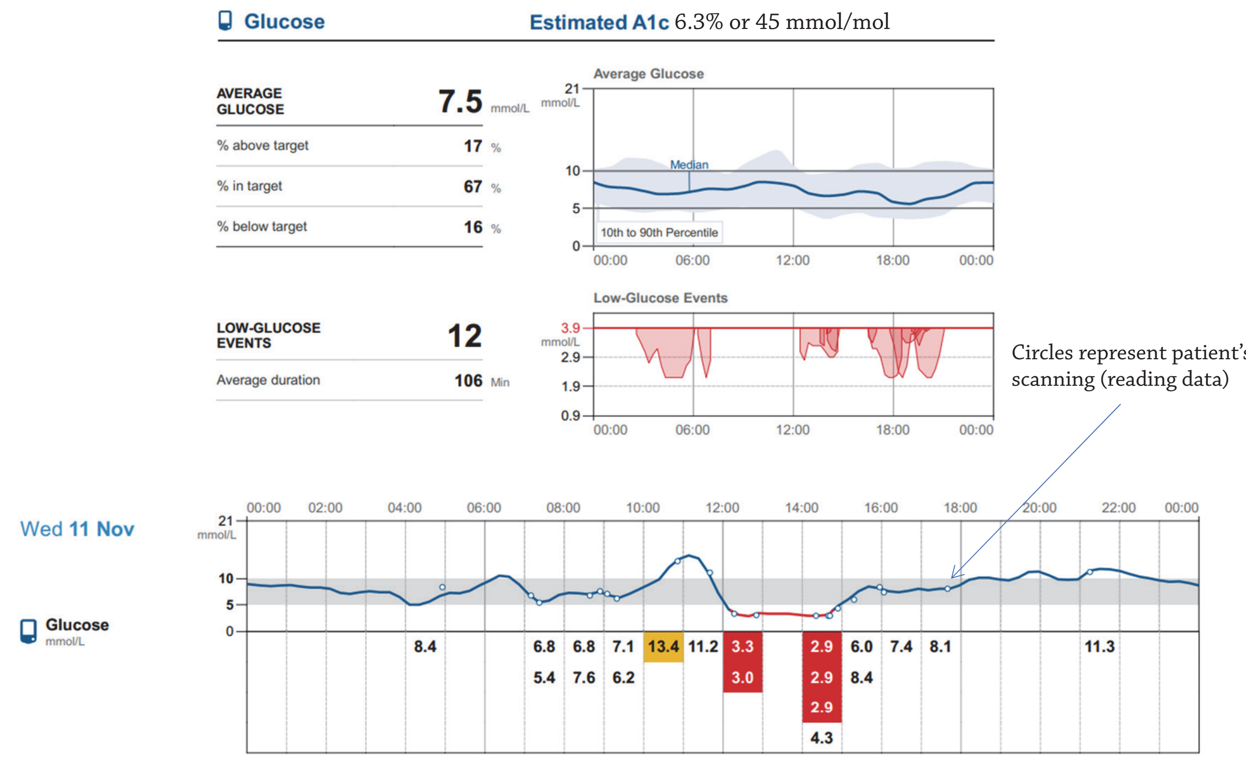


Chart 1. Glucose sensor data (14 days summary and example of one particular day; example of data from one patient from the study)

In our retrospective study, we focused on the FGM system (FreeStyle Libre sensor). It was specifically the first generation of this type of sensor, which some patients preferred precisely because they were not bothered by alarms. In addition, patients appreciated its small size and easy operation with sufficient accuracy.

DM1 patients require intensified insulin regime (multiple daily insulin injections or treatment by insulin pump) and precise glucose monitoring is crucial for them to adjust insulin doses accordingly. The immediate impetus for our study was the fact that in 2020, there was a significant improvement in self-monitoring opportunities for adult patients with type 1 diabetes mellitus (DM1) in the Czech Republic, as since 2020, health insurance companies fully pay for glucose sensors (RT-CGM or FGM) for adults with DM1 when it is medically justified. A receiver can be prescribed free for a patient once every 4 years. Prior to this change, reimbursement of sensors from public health funds in the Czech Republic was partial and it was a major obstacle for some patients to make full use of this technology. In many other countries, patients still have to pay for glucose sensors themselves.

After the financial barrier fell, we managed to convince many patients who did not want to use the system with alarms to start using FGM. We therefore decided to focus on our patients who are using FGM. The aim of the study was to analyze the use and medical effect of FGM in patients with DM1 at our clinic, in the context of the introduction of full payment of 26 FGM sensors and a reader per patient and calendar year from public health insurance. We supplemented the analysis of clinical data with a wider economic reflection (by modeling it's economic effect). Clinical studies on diabetes treatment in the Czech Republic rarely focus on the economic side of the problem. Regarding glucose sensor reimbursement, only one piece of work has been published on its impact on patients' diabetes control (Šumník et al., 2021), and this study only focused on pediatric patients who achieved full sensor reimbursement earlier than adults. There are already many studies (international and national) that demonstrate the clinical benefit of using glucose sensors even in patients with other types of diabetes (Radovnická et al., 2022; Seidu et al., 2024).

Materials and methods

Characteristics of the study population

General characteristics

The study was designed as a retrospective one and included a total of 115 adult patients treated with type 1 diabetes (DM1) at the Department of Internal Medicine, University Hospital Motol in Prague who used FGM (FreeStyle Libre, Abbott

Diabetes Care, Alameda, CA, U.S.A.) in 2020, and from whom complete data on diabetes control in 2019 were available.

Patients signed an approved informed consent to the collection and processing of their data, which were completely anonymous for the purposes of the study.

In the study group, there were 64 women and 51 men. Median age of participants was 42 years (range 22–75 years). The median duration of diabetes was 21 years (range 0–48 years). All patients were treated with an intensified insulin regimen using insulin analogues, of which 33 patients were treated with an insulin pump (CSII – Continuous Subcutaneous Insulin Infusion).

No previous experience with glucose sensors (either RT-CGM or FGM) was reported by 61 patients (43%).

Detailed further characteristics of the study group are given in Suppl. Table 1.

Control of diabetes in the monitored cohort before and after the introduction of full FGM reimbursement

Diabetes control was primarily evaluated by the value of glycosylated haemoglobin (HbA1c), which reflects glycemia in the last 3 months and is recommended in most patients to be below 53 mmol/mol (7.0% DCCT; Holt et al., 2021). The median of HbA1c values of our patients in 2019 was 63 mmol/mol (7.9% DCCT), range 29–120 mmol/mol (4.8–13.1% DCCT). Further clinical data on patients from the year 2019 are summarized in Suppl. Table 2.

After the introduction of full FGM reimbursement diabetes control was also evaluated by HbA1c levels and by TIR (Time In Range) which is specific parameter derived from glucose sensor data. Range was set by the manufacturer (in agreement with experts' opinions) to be 5–10 mmol/l, which is not fully physiological, but it is medically acceptable (Holt et al., 2021). Occurrence of hypoglycemia (specifically a serious one which requires the help of another person) and diabetic ketoacidosis were also recorded. Several individual characteristics with possible impact on diabetes control were analyzed (patient's age, education, etc.).

Statistical analysis

IBM SPSS Statistics v.26 software (Armonk, New York, U.S.A.) was used for statistical analysis. First, the normality of the data was verified, and non-parametric tests were chosen within the correlation analysis and comparison between groups and subgroups, using specifically the Mann–Whitney, Kruskall–Wallis and Wilcoxon tests. The significance level was determined by default as $p = 0.05$.

Economic analysis and modelling

We employed cost-effectiveness analysis (CEA), comparing costs and outcomes of FGM (FreeStyle Libre).

We used publicly available data from the Institute of Health Information and Statistics of the Czech Republic (IHIS CR) database, and data from the two largest Czech health insurance companies (VZP – General Public Health Insurance Fund, and ZP MV – Ministry of the Interior Public Health Insurance Fund), and finally the data presented by the Diabetic Association of the Czech Republic (DACR) – Table 1a.

In addition, we performed a cost calculation directly for our patients, separately for patients treated with CSII and with the MDI (Multiple Daily Injections) regimen respectively. From the data provided by our economic department, we also derived the average costs of hospitalization for diabetic ketoacidosis and for severe hypoglycemia (details are presented in Table 1b).

The used monetary unit is USD (the rate of exchange of CZK/USD = 22.20, March 2023).

Cost-effectiveness

To analyze the cost-effectiveness of FGM (FreeStyle Libre) in terms of public health expenditures in present value, we summarize the entry characteristics which are described in Table 1a, b and in further detail in the supplementary material. Briefly, when calculating the possible economic impact on chronic diabetic complications (microvascular and macrovascular), we employed the conclusions of several studies (DCCT/EDIC Study Research Group, 2016; Nathan and DCCT/EDIC Research Group, 2014). We modeled the possible benefit of diabetes control improvement (due to glucose sensors using) for 33%, respectively for 50% reduction in the development of chronic complications. We used the average costs for all chronic complications obtained from public sources, but we also adapted the analysis for one concrete complication. Specifically, we chose the final stage of diabetic kidney disease (DKD) requiring hemodialysis, and we calculated with the annual price provided by VZP for dialysis per one patient.

In the case of acute complications (severe hypoglycemia, diabetic ketoacidosis requiring hospitalization), we used economic data provided from our hospital's economic department

Table 1a. Input data from authorities for *cost-effectiveness* analysis

Number of DM1 patients (in thousands)	61
Number of DM2 patients (in thousands)	786
The proportion of patients treated with insulin (15% IIT, 8% conventional IT, 1% CSII)	24% (225,000)
COSTS expressed per patient per year (rounded to whole numbers)	
Annual costs of FGM (thousand USD)	1.8
Annual diabetes complication costs per patient, 60 per cent of total costs (USD)	626
Annual direct social costs associated with diabetes per patient (USD)	535
A decrease in GDP due to reduced labor productivity per patient (USD, 2019)	298
Annual costs of dialysis (thousand USD)	26.4

Diabetic Association of the Czech Republic (2014); General Health Insurance Company of the Czech Republic (2019); Institute of Health Intormation and Statistics of the Czech Republic (2007–2016); Medical Information Service (2018); Office of the Associate Director for Policy and Strategy (2021)

Table 1b. Our input data for *cost-effectiveness* analysis (average costs)

	USD/year
CSII treatment plus FGM	3,902
CSII treatment, self-monitoring by glucometer only	2,451
MDI treatment plus FGM	2,672
MDI treatment, self-monitoring by glucometer only	1,221
	USD/1 hospitalisation
Hospitalisation for DKA	1,000
Hospitalisation for severe hypoglycaemia	500

and adapted the calculation to the hypothesis that FGM may possibly mean the annual avoidance of one serious acute complication per patient.

Cost-effectiveness (ratio approach resp. net benefit approach) of an FGM sensor per 1 patient in present value were calculated according to the following formulas (Office of the Associate Director for Policy and Strategy, 2021):

$$\text{CE Ratio} = \frac{\text{Effect (FGM)}}{\text{Cost}_{\text{(FGM)}} - \text{Cost}_{\text{(without FGM)}}}$$

$$\text{CE net} = \text{Effect}_{\text{(FGM)}} - [\text{Cost}_{\text{(FGM)}} - \text{Cost}_{\text{(without FGM)}}]$$

Results

In 2020, 30 patients (29.6%) used all covered sensors (26 sensors). Approximately the same number of patients used 13 or fewer sensors, i.e., half, or less than reimbursed. Specifically, in this subgroup there were 28 people, which represents 24.3% of the whole studied population. Other patients (57 people) applied more than 13 sensors in 2020 but were not prescribed the full number of paid sensors.

Diabetes control in the monitored cohort after the introduction of full FGM reimbursement

Here we can compare several parameters of diabetes control, from the first and last visit in a given calendar year (2020). The median HbA1c was initially 62 mmol/mol (30–118 mmol/mol) which is 7.8% DCCT (4.9–12.9% DCCT) and was even slightly lower at the last control (61 mmol/mol, 30–121 mmol/mol, i.e., 7.7 % DCCT, 4.9–13.2% DCCT). The decrease in the value of HbA1c compared to 2019 was significant in both cases (for comparison with the first value in 2020 it was $p = 0.006$, for comparison with the last value for the given year 2020 it was $p = 0.001$ – Chart 2).

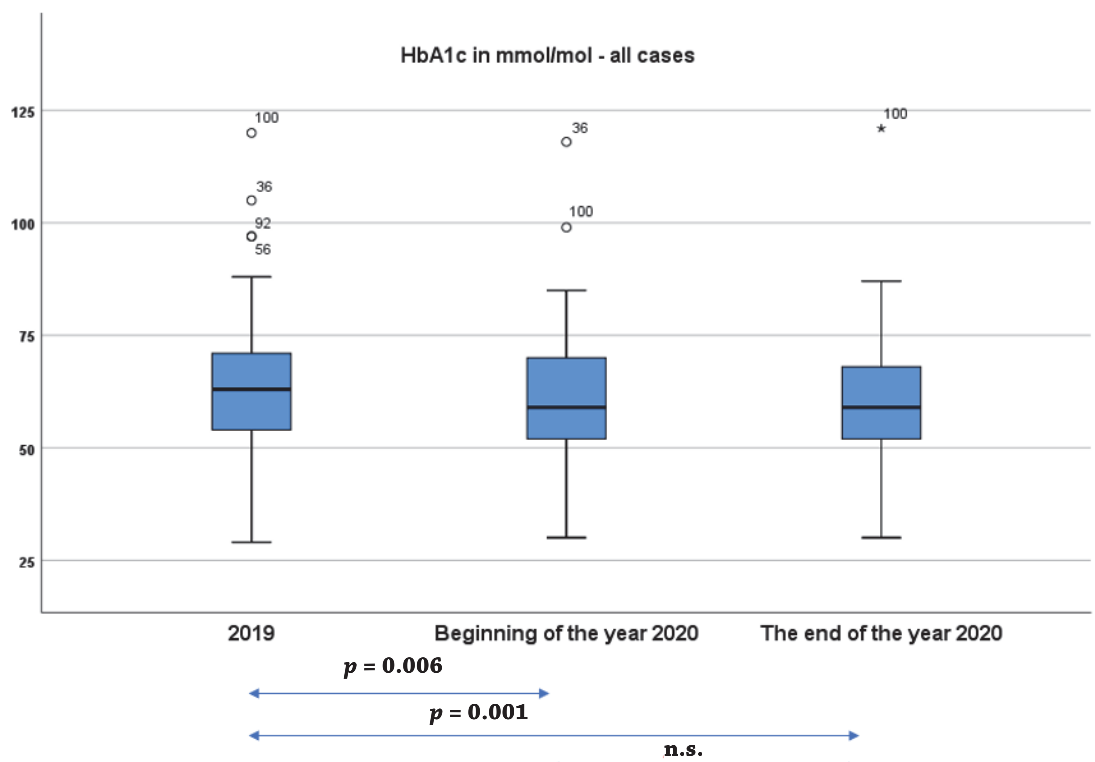


Chart 2. Year-on-year comparison of HbA1c values – whole study population

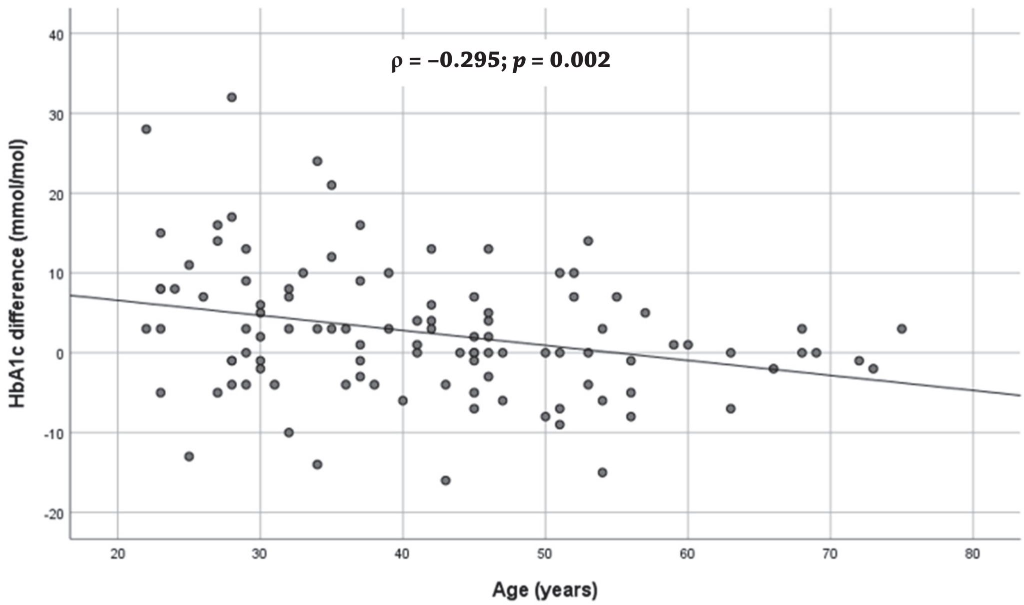
Data on time in the target range (TIR) are available for 2020 only. The median TIR values from the first and second measurements in 2020 are 49.5% (0–84%) and 47% (9–88%) respectively. There is no statistically significant difference between these two measurements.

None of all 115 patients experienced severe hypoglycaemia in 2020, nor was diabetic ketoacidosis requiring hospitalization reported.

Factors influencing diabetes control

The first of the studied factors was the patient's age. Elderly patients did not achieve as much improvement in HbA1c as younger subjects ($\rho = -0.295$, $p = 0.002$ for correlation of age with year-on-year change in HbA1c, Chart 3). We also observed that patients with higher educational attainment were able to achieve a more significant improvement in HbA1c in this year-on-year comparison ($p = 0.029$). Neither significant correlation of HbA1c nor of TIR was found with the other monitored general parameters (gender, place of residence).

Regarding the monitored clinical parameters (LDL cholesterol, glomerular filtration rate eGF, microalbuminuria), the change in these clinical parameters very closely reflected the change in HbA1 ($p < 0.001$ for all of them). An important (although not surprising) parameter was the number of applied sensors, as illustrated in Chart 4a, b, c, when the greatest improvement was achieved in the group of those who did use all 26 sensors. On the other hand, no effect was observed in sporadic users (patients who used 13 or less sensors in 2020).



(*Elderly patients did not achieve as much improvement in year-on-year change in HbA1c*)

Chart 3. Patient's age and year-on-year change in HbA1c

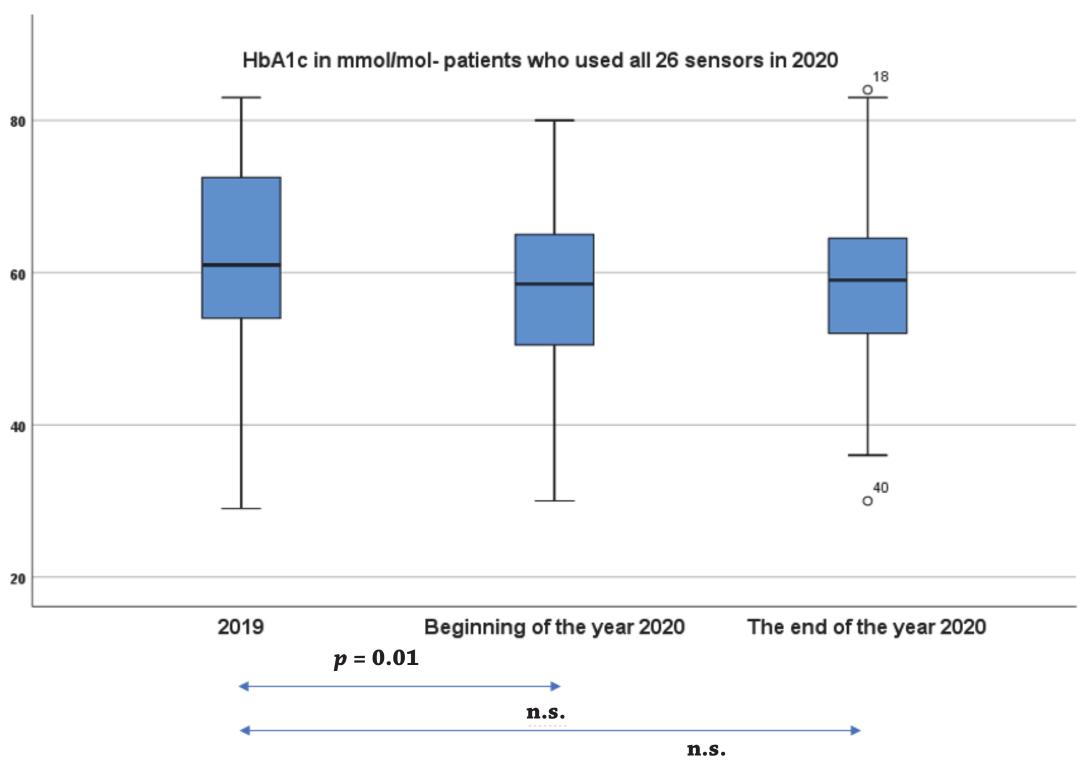


Chart 4a. Change of glycosylated haemoglobin in patients who used all available sensors

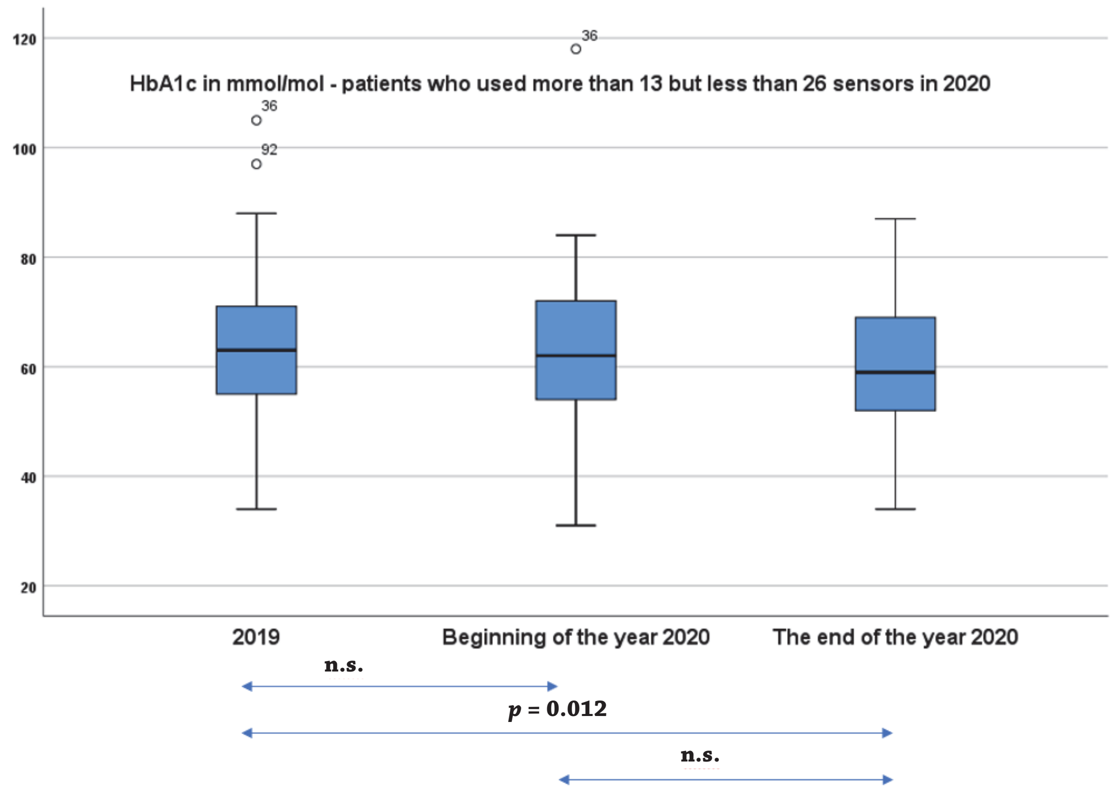


Chart 4b. Change of glycosylated haemoglobin in patients who used most, but not all, available sensors

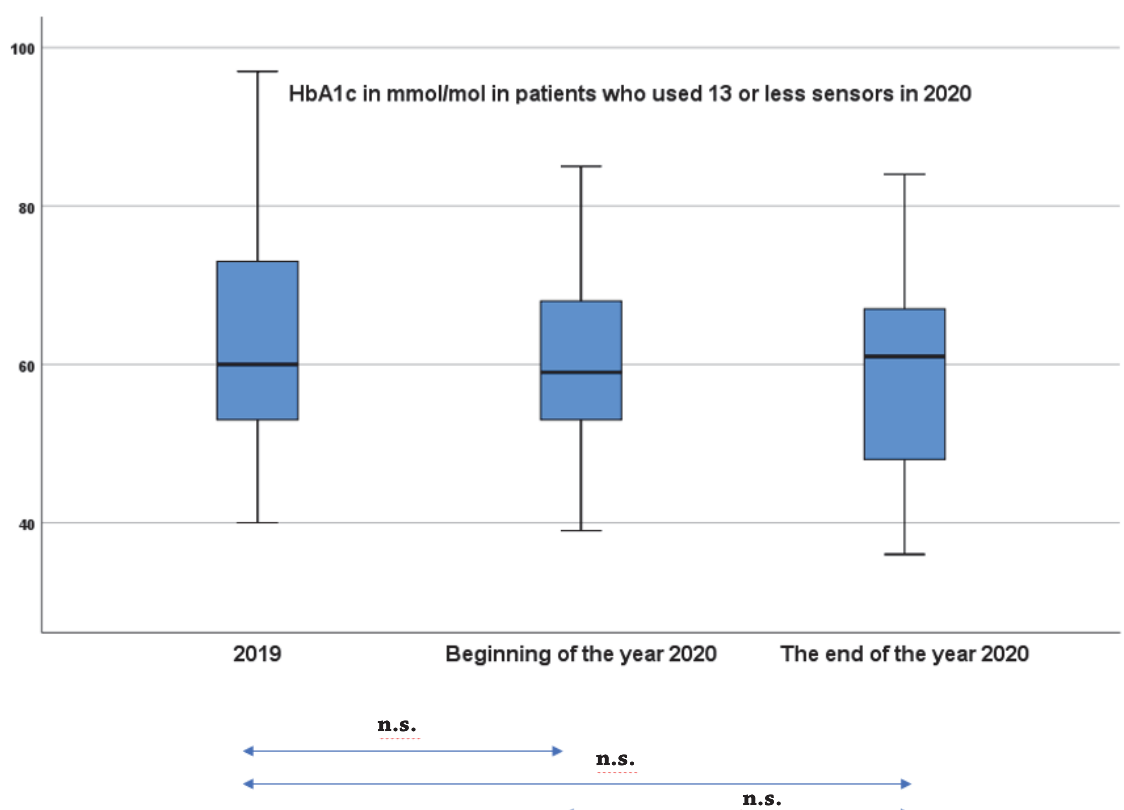


Chart 4c. Change in glycosylated haemoglobin in patients who used half or less of the sensors available to them

Patients treated with an insulin pump had better HbA1c values than others, but only at baseline. In addition, this difference was only marginally significant ($p = 0.055$). Previous experience with glucose sensors was reflected in the difference between the final and initial HbA1c values, when this difference was more pronounced in those who had no previous experience ($p = 0.013$, Chart 5). We did not observe any effect of the duration of diabetes on any other monitored parameter.

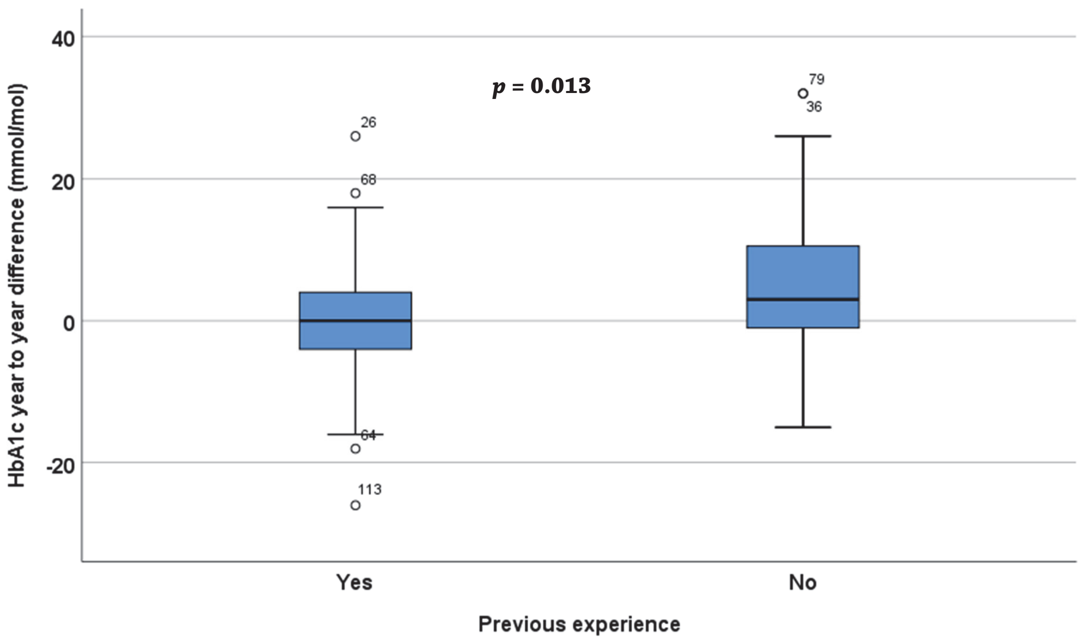


Chart 5. The effect of the previous experience with glucose sensors

Economic analysis

We started retrospective economic analysis from these data and presumptions (Diabetic Association of the Czech Republic, 2014; General Health Insurance Company of the Czech Republic, 2019, 2020; Institute of Health Information and Statistics of the Czech Republic, 2007–2016; Medical Information Service, 2018; Office of the Associate Director for Policy and Strategy, 2021):

1. The health insurance companies fully reimburse DM1 patients for 26 pieces of FGM sensors per year (12 consecutive months), and a reader once every 4 years. Patients treated for other forms of diabetes can purchase the reader and sensors as self-payers. The price of a reader is USD 63.8 and a sensor costs USD 70.2. *The annual cost of the whole set accounts for USD 1,889 per patient.* Notice – As Suppl. Table 3 shows, the number of users has significantly increased in the past years.
2. The incidence of new cases of DM shows an upward trend over time, with the number of new cases increasing by approximately 5,200 patients per year. A similar trend is also seen in the prevalence of patients with DM increasing to an average of 14,000 patients per year. The proportion of patients treated with insulin remains relatively stable at approximately 24%.
3. Studies on the costs of diabetes concluded that the cost of treating complications accounts for the majority of the total cost of diabetes treatment (Brodszky et al, 2019). In 2016, 106,682 patients with diabetic nephropathy were registered in the Czech Republic (of which 40,229 were in the stage of chronic renal insufficiency), 95,100 patients with retinopathy (of which 2,267 were blind), and 41,441 patients with diabetic foot (of which more than 9,969 were after lower limb amputation). Chronic complication reports do not specify the type of diabetes.
4. In the Czech Republic, the costs of diabetes treatment reach over USD 980 million per year (2014). Of this amount, more than 60% of the costs are for the treatment of diabetes complications requiring hospitalization. Only 5% is the cost of outpatient care, up to 20% is the cost of pharmacotherapy of diabetes, insulin contributes 75% and oral antidiabetics 25%. The cost of treating diseases associated with diabetes, such as hypertension, accounts for up to 15% of the cost. We have more recent data on financial costs from individual health insurance companies. In 2018, the biggest national health company e.g., General Health Insurance Company (VZP) had 557,157 insured persons with a diagnosis of diabetes mellitus registered (representing 65% of all DM patients). In the last five years, the cost of this disease for VZP has increased significantly, although the number of registered patients has increased only slightly (by 4.2%). Specifically, VZP expenditure on diabetes treatment has risen by USD 57.9 million in 2015 to USD 356.3 million in 2019, which represents increase from 104 USD per patient per year to 639/patient/year. ZP MV, the second largest insurance company in the Czech Republic, reported that the average cost of treating a DM patient in 2013 was USD 1,005. Five years later it already accounted for USD 1,446/patient/year. Due to the significant difference between the data from the two largest national health care payers, we decided to use the average of both values for our calculations, e.g., USD 1,043/patient/year.
5. Besides, the Czech Ministry of Health estimated social care costs (i.e., those associated with social benefits and disability pensions) at USD 713 million. According to statistics from the Czech Social Security Administration, direct social care costs in connection with diabetes are around USD 445–490 million per year for social care and social benefits.

Indirect costs, including a decrease in GDP (Gross Domestic Product) due to reduced labor productivity, are estimated at approximately USD 267.3 million.

Cost-effectiveness

If we calculated only with general data provided by insurance companies, which are obtained as an average from all policyholders, the result would show considerable inefficiency – as demonstrated in Table 2a, b. The same is true for hypothetical annual reduction of one serious acute complication per patient. However, the situation will change fundamentally if we substitute the general price of chronic complications treatment for the costs of the treatment of one particular complication, namely for the costs of treatment of the terminal phase of kidney failure requiring hemodialysis. If we consider a 50% effect to prevent this complication, the cost-effectiveness ratio will be 9.0 and the net cost will be USD 11,779 (values are the same for MDI as well as for CSII therapy). If we expect a lesser effect of 33% to prevent this complication, the cost-effectiveness ratio will be 6 and the net cost will be USD 7,281 which is still highly effective.

Table 2a. CAE output for acute complications

Complication	DKA	Hypoglycaemia
	Minus 1 episode/ year	Minus 1 episode/ year
	CE Ratio/CE net	CE Ratio/CE net
CSII treatment plus FGM	0.7/minus 451 USD	0.3/minus 951 USD
MDI treatment plus FGM	0.7/minus 451 USD	0.3/minus 951 USD

Table 2b. CAE output for chronic complications

Complication	Chronic complications in general	Chronic complications in general
	Probability of 50% reduction	Probability of 33% reduction
	CE Ratio/CE net	CE Ratio/CE net
CSII treatment plus FGM	0.5/minus 721 USD	0.3/minus 969 USD
MDI treatment plus FGM	0.5/minus 721 USD	0.3/minus 969 USD
Complication	DKD – Dialysis	DKD – Dialysis
	Probability of 50% reduction	Probability of 33% reduction
	CE Ratio/CE net	CE Ratio/CE net
CSII treatment plus FGM	9/11,779 USD	6/7,281 USD
MDI treatment plus FGM	9/11,779 USD	6/7,281 USD

Note: CSII – Continuous Subcutaneous Insulin Infusion; DKA – Diabetic Ketoacidosis; DKD – Diabetic Kidney Disease; MDI – Multiple Daily Injections.

Discussion

In recent years, self-monitoring in the form of continuous glucose monitoring has become an essential part of DM1 therapy. The full reimbursement of immediate monitoring (FGM) by the health insurance company for type 1 DM patients (i.e., 26 sensors/year) in the Czech Republic since 2020 has been behind their mass expansion in our country.

Since the first blood glucose monitoring (FGM) system was launched in autumn 2014, several studies have been published on the system's effectiveness and safety (Bolinder et al., 2016; Deshmukh et al., 2020; Evans et al., 2020; Messaaoui et al., 2019). Dover and colleagues (2017) demonstrated improved compensation for adult DM1 patients receiving immediate blood glucose monitoring as early as in 16 weeks. In their study, a significant decrease in glycosylated haemoglobin was reported [median HbA1c decreased from 8.0 ± 0.14 % to 7.5 ± 0.14% (–0.48%, $p = 0.001$)], then a decrease in hypoglycaemia was demonstrated, as well as an improvement in the quality of life of patients (according to the Diabetes Distress Scale). Later, an extensive meta-analysis involving a total of 25 studies (comprising 1,723 patients with type 1 diabetes mellitus) looking at the clinical effect of initiating immediate monitoring (FGM) on the trend in glycated haemoglobin levels confirmed their observation. This meta-analysis demonstrated in adult patients the mean change in HbA1c of 0.56%, and this decrease was sustained throughout the follow-up period (i.e., 12 months; Evans et al., 2020). In our retrospective study, we also demonstrated a statistically significant improvement in diabetes mellitus compensation in terms of reduced glycated haemoglobin. The decrease in the value of glycated haemoglobin correlated with the number of used FGM sensors in 2020. The largest decrease was unsurprisingly achieved by those patients who used all 26 sensors paid for by the insurance company in a given calendar year. Regarding other monitored clinical parameters (LDL cholesterol, glomerular filtration rate -eGF, microalbuminuria), the change in these clinical parameters very closely reflected the change in HbA1 and showed a statistically significant decrease compared to the available laboratory values from 2019.

Several studies have demonstrated the effect of immediate monitoring (FGM) in terms of reducing acute diabetic complications, i.e., severe hypoglycaemia and the development of diabetic ketoacidosis (Al Hayek and Al Dawish, 2021; Bolinder et al., 2016; Deshmukh et al., 2020; Messaaoui et al., 2019). The decrease in these acute complications thus brings with it a reduction in the number of hospitalizations, as well as a decrease in the time spent on incapacity for work in patients with type 1 diabetes mellitus. In none of the 115 monitored patients was any information obtained in 2020 about severe hypoglycaemia, requiring the assistance of another person, as well as other serious complications that would lead to premature termination of monitoring via FGM.

There was a positive correlation in terms of a decrease in glycated haemoglobin and the level of education of patients. Meanwhile, a negative correlation was demonstrated between a decrease in glycated haemoglobin and the increasing age of patients. Patients treated with an insulin pump achieved better HbA1c values than others, but only in the initial values, and this difference was only marginally statistically significant.

In terms of the performed economic analysis, there are a variety of approaches to economic analysis and methods, the suitability of which depends on the purpose of an assessment and the availability of data and other resources. The validity of a cost-related study depends on the sources of the data for costs and outcomes. We are aware of limitations of our economic analysis for several reasons. First, it is not possible to determine the costs in general. The costs reported by medical studies and health insurance companies significantly differ. It seems that health insurance companies sometimes encounter the problems to assign an accurate diagnosis (DM1/2) or to record concrete chronic diabetic complications. We also had data available from only two of the seven health care payers, even the largest ones. We are also aware that this is an analysis of only one, albeit large, clinic, and it is therefore problematic to draw general conclusions.

For our purpose, we had to process administrative data provided by authorities, not clinical ones as a detailed analysis of the complications and the costs involved is not the purpose of the data collection. Even IHIS CR does not regularly publish data on costs according to individual diseases, because they are not directly available – firstly it is not possible to assign all costs to a specific disease, and secondly, not all the health care is calculated in monetary units (CZK). A large part is reported in points which may cause various distortions. Therefore, it is scarcely impossible to identify and precisely quantify all costs and benefits.

Another problem was that we had to approximate the long-term effect on the development of chronic complications. Although we used data from the most fundamental studies focusing on the development of chronic complications in patients with DM1, these studies assessed the effect of the insulin regimen and not glycemic self-monitoring (DCCT/EDIC Study Research Group, 2016; Nathan and DCCT/EDIC Research Group, 2014). The results of various lifetime analyses indicate that sensors reduce the average incidence rates of all major complications and extend QALY (the Quality-Adjusted Life Year). According to the Swedish clinical trial of Ólafsdóttir et al. (2017), the therapy with FGM sensors prolonged life in full health (QALY) by 0.56 years. The price of this extension was USD 33,586/QALY. Unfortunately, we did not have the necessary data to determine QALY. In our case, therefore, it is a model of the economic effect, rather than a precise prediction. We wanted to show that there is a need to analyze economic factors more.

We believe that illustrating the results in this way makes them more understandable, not only for physicians, but also for the authorities who decide on health care financing. Our results suggest that the economic savings the expansion of FGM can bring are mainly in terms of chronic diabetic complications. Both medical and economic results imply wide powers also for type 2 diabetics and a challenge for health insurance companies to reimburse sensors for all diabetics treated with insulin.

Thanks to innovative medicine, however, life expectancy increased between 2012 and 2018 across all age groups. In the group of 20-year-old patients, the increase was 3.7 years, in 30-year-old patients one month less, in 50-year-old patients the expectancy was extended by 2.8 years, and in 70-year-old patients by 1.8 years (General Health Insurance Company of the Czech Republic 2018, 2019). In addition to the length of life and the declining trend in hospitalizations, the relatively higher costs of innovative treatment also compensate for the longer working activity of patients.

We thought about why only a few patients have taken advantage of the generous opportunity. We started to think about possibilities how to improve patient knowledge and education. For instance, no group education of patients newly using this form of glucose monitoring was performed before this study. We believe that various nudge strategies can also help here, targeted at both patients and health care professionals (VanEpps et al., 2016). Based on the results of the study, we introduced specific measures (joint regular seminars, comparison of results, etc.) towards the medical staff and patients, so that they are maximally motivated to use the most modern technologies, especially when they are free.

Conclusion

Our results show that investing in treatment pays off in the long run. Modern technologies bring new possibilities. Thanks to this, in our case they bring better diabetes control for patients. We just must learn to think about medical problems in a broader context, including socio-economic and psychosocial ones.

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Ethical aspects and conflict of interest
The authors have no conflict of interest to declare.

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