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ORIGINAL RESEARCH

Use of Healthcare Services Following Severe Hypoglycemia in Patients with Diabetes: Analysis of Real-World Data

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ABSTRACT

Introduction: Severe hypoglycemia is a burden for both patients and the healthcare system payer alike. This study aimed to quantify the resource use associated with a severe hypoglycemic event (SHE) in patients with diabetes.

Methods: This retrospective cohort study compared resource use (e.g., physician visits, hospitalizations, and medications) 1 month pre- and post-SHE among patients with type 1 (T1D) or type 2 diabetes (T2D) from a large not-for-profit healthcare provider.

Results: From 2005 to 2014, 284 patients with T1D (52.5% male, mean age 29.8 years, mean HbA_{1c} 7.9%) and 3691 patients with T2D (47.6% male, mean age 67.1 years, mean HbA_{1c} 7.3%) were eligible for inclusion in the study. In total, 95.4% of patients with T1D and 32.8% of patients with T2D were insulin treated, while 3.5% of patients with T1D and 70.4% of patients with T2D were treated with oral drugs that could cause hypoglycemia (sulfonylureas or meglitinides). Hospital admissions increased by 95% in T1D and 127% in T2D ($P < 0.001$) 1 month post-SHE versus 1 month pre-SHE. Of those admitted to hospital (T1D $n = 59$; T2D $n = 1214$), the mean length of stay was significantly longer during the month post- versus pre-SHE [2.08 vs. 0.88 days, $P = 0.036$ (T1D) and 4.17 vs. 1.45 days, $P < 0.001$ (T2D)]. Outpatient visits also increased by 37% for T1D and 47% for T2D between these two time periods ($P < 0.001$). The total monthly expense per patient increased by 46% and 87% for T1D and T2D, respectively, from \$485 pre-SHE to \$708 post-SHE for T1D, and from \$601 pre-SHE to \$1121 post-SHE for T2D ($P < 0.001$). The greatest expense was hospital care, with increases of 179% and 166% for T1D and T2D, respectively, to \$312 and \$706 per patient/month.

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Conclusion: This real-world analysis from a large diabetes registry indicates an increased use of healthcare services, including more frequent and prolonged hospital admissions and outpatient visits after an SHE, which resulted in an increase in healthcare expense.
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Keywords: Hospitalization; Hypoglycemia; Resource use

INTRODUCTION

Hypoglycemia is a common and serious side effect associated with glucose-lowering therapies. Hypoglycemia occurs frequently in insulin-treated patients, and prevalence is higher in patients with type 1 diabetes (T1D) than type 2 diabetes (T2D), but increases in frequency in T2D with disease duration as treatment intensifies [1–3]. Hypoglycemia is a major burden for the healthcare sector and society, due to the treatment cost and the associated lost productivity [4–6]; it is also a burden for patients, resulting in fear and anxiety, and disruption to their sleep, and their domestic and social life [4, 7, 8]. Moreover, hypoglycemia is associated with death, adverse cardiovascular outcomes, dementia, falls, and fractures [9]. Furthermore, hypoglycemia can occur suddenly and with varying severity [4, 9]. Severe hypoglycemic events (SHEs, requiring third-party assistance) may require hospitalization and inpatient care, leading to significant resource use and costs [10–12].

The aim of this study was to quantify the resource use and expense associated with an SHE in adult patients with diabetes, using the Maccabi Healthcare Services (MHS) database registry. The majority of studies investigating resource use following hypoglycemia provide retrospective data on resource use after an event, with many only including patients who report resource use. This study is unique in that data were collected before and after an SHE for a designated time period, enabling assessment of the change in resource use after an SHE. The time period under consideration for this analysis was 1 month pre-SHE and 1 month post-SHE.

METHODS

MHS is the second-largest Health Management Organization (HMO) in Israel, serving 25% of the country's total population with approximately two million members. Since 1997, information on all members' interactions with MHS has been collected, including diagnoses, visits to primary and secondary care physicians, visits to outpatient clinics, hospitalizations, laboratory tests, and purchased and dispensed medications.

This observational, retrospective, non-interventional, cohort study analyzed de-identified patients' electronic medical record (EMR) data to compare resource use 1 month before and after the date that the index SHE was reported. The inclusion criteria for the MHS diabetes registry have been described previously [13, 14]. Briefly, the registry used criteria defined by the American Diabetes Association and included any patient with one or more of the following: HbA_{1c} $\geq$7.25%, blood glucose (BG) $\geq$11.1 mmol/L, a preceding diagnosis of diabetes [identified using International Classification of Diseases version 9 (ICD-9) codes] together with a measurement of HbA_{1c} $\geq$6.5% or BG >6.9 mmol/L. The diabetes registry also included those who purchased $\geq$2 monthly packs of

anti-hyperglycemic medication during a 6-month period. The MHS diabetes registry was created for clinical purposes and its data are routinely updated by the patient's physicians, to maintain a very high level of validity. Patients were excluded if they were <18 years of age, were diagnosed with diabetes for <12 months, had <12 months' follow-up after their SHE, or if their type of diabetes was unknown. Data are presented for 1 month pre- and 1 month post-SHE. Data were also collected for 1 week and 12 months pre- and post-index date to conduct sensitivity analyses (data not shown).

Patients were included in this analysis if they had at least one SHE, identified by ICD-9 codes in the MHS registry between January 1, 2005 and April 30, 2013. Study index date (baseline) was defined as the earliest date of SHE diagnosis after a 12-month SHE-free period. This analysis considers data collected during 1 month before and after the SHE.

Data retrieved for this study included sociodemographic details, diabetes duration, body mass index (BMI), HbA_{1c}, hypertension and cardiac comorbidities, and healthcare services utilization. Utilization data included hospitalizations, emergency department visits, outpatient visits and laboratory, pathology, radiology and imaging visits, medication, and purchases of self-measured blood glucose (SMBG) strips. The BMI value was the value taken nearest to the SHE (before or after it). HbA_{1c} value was the most recent result before the SHE. Socioeconomic status was based on residential socioeconomic index, ranging from 1 (lowest) to 20 (highest). In the patient records where diabetes type was not recorded, a classification of T1D was made if the patient was using insulin or had a positive glutamic acid decarboxylase (GAD) or islet cell antibody, and was under the age of 40 years. A classification of T2D was made if the patient was not using insulin for at least 1.5 years or had a positive C-peptide test. In other cases, the diabetes type was classified as unknown and the patient was excluded from the analysis.

Costs of different healthcare services were taken from the Israeli Ministry of Health price list in Israeli new shekels and were converted to $US dollars. Costs per patient represent mean values for all patients included in the study. The study was approved by MHS' ethics committee and performed in accordance with the Declaration of Helsinki [15]. The study was performed according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) Statement for cohort studies [16].

Statistical Analysis

Resource utilization and healthcare costs were compared in the time period (1 month) before and after index SHE. Continuous variables (length of hospital stay and healthcare expenditure) were compared using a paired Student's t test. Chi square (number of hospitalizations) and McNemar's tests (hospital visits comparison) were used to compare categorical variables. Wilcoxon signed-rank test was used to compare ordinal variables (the number of hospitalizations per patient and expense comparisons). A Kruskal–Wallis test was used to compare between-group differences following stratification by BMI and socioeconomic status, and a Mann–Whitney test was used to compare insulin-treated versus non-insulin-treated groups. Statistical significance was set at $P < 0.05$. All analyses were conducted using IBM SPSS software (IBM SPSS Statistics for Windows, version 21.0, released 2012, IBM Corporation, Armonk, NY, USA).

RESULTS

Study Population

A total of 3975 patients were eligible for inclusion in the study; their characteristics at index/time of SHE are summarized in Table 1. Overall, 7.1% of patients in the study were categorized as T1D ($n = 284$), and 92.9% as T2D ($n = 3691$). At index, 95.4% of patients with T1D and 32.8% of patients with T2D were insulin treated, 3.5% with T1D and 70.4% with T2D were treated with oral antidiabetic drugs that could cause hypoglycemia (sulfonylureas or meglitinides), and 7.7% with T1D and 76.4% with T2D used oral drugs known to cause hypoglycemia only rarely (metformin, gliptins, glitazones, and acarbose). During 9 years of the study, there were only slight and insignificant differences in the number of SHEs reported by patients with diabetes in the registry each year.

Hospital Visits

In the month following an SHE, 25% ($n = 992$) of the study population were hospitalized and 10% ($n = 401$) visited the emergency

Table 1 Study population characteristics

Characteristics	T1D	T2D
n	284	3691
Age, years	29.8 ± 6.7	67.1 ± 11.7
Males, *n* (%)	149 (52.5)	1756 (47.6)
Duration of diabetes, years, *n* (%)		
<5	97 (34.2)	938 (25.4)
5–9	131 (46.1)	1824 (49.4)
10+	56 (19.7)	929 (25.2)
BMI, kg/m^2	25.5 ± 4.6	29.9 ± 5.6
HbA_{1c}, % (most recent prior to SHE)	7.9 ± 1.8	7.3 ± 1.5
Cardiac comorbidity—yes, *n* (%)	14 (4.9)	1653 (44.8)
Hypertension comorbidity—yes, *n* (%)	25 (8.8)	2914 (78.9)
Hospitalization a week around index date, *n* (%)	47 (16.5)	973 (26.4)
Socioeconomic status[a]	11.1 ± 4.2	11.3 ± 4.2
Fractures 1 month around SHE, *n* (%)	3 (1.1)	79 (2.1)
Additional SHE within 12 months of index, *n* (%)		
1	52 (18.3)	661 (17.9)
2	16 (5.6)	173 (4.7)
3	16 (5.7)	159 (4.3)

Data are mean ± standard deviation, unless otherwise specified

BMI body mass index, *SHE* severe hypoglycemic event, *T1D* type 1 diabetes, *T2D* type 2 diabetes

[a] On a scale from 1 (lowest) to 20 (highest)

Table 2 Number of hospitalization episodes

	Total no. of hospitalizations	1 month pre-SHE	1 month post-SHE	Change (%)	*P* value
T1D					
Total	68	23	45	95	<0.001
Non-surgical	65	22	43	95	<0.001
Surgical	3	1	2	100	0.861
T2D					
Total	1598	488	1110	127	<0.001
Non-surgical	1460	430	1030	139	<0.001
Surgical	138	58	80	37	0.075

Total number of hospitalizations divided according to type of procedure (non-surgical or surgical) and diabetes type. Analysis conducted using a Chi-square test

SHE severe hypoglycemic event, *T1D* type 1 diabetes, *T2D* type 2 diabetes

department. The number of hospital admissions increased significantly (by 95% for T1D and by 127% for T2D, $P < 0.001$) in the month following the SHE (Table 2) compared with the month before the SHE. Additionally, the proportion of patients with 1, 2, or 3+ hospital admissions also increased significantly during this period versus the previous month (Fig. 1). The proportion of patients with T1D hospitalized on one occasion increased 1 month post-SHE but there was no increase in the number of patients requiring two or three hospitalizations. In patients with T2D, there was an increase in the proportion of patients with 1, 2, and 3+ hospitalizations 1 month post- versus 1 month pre-SHE.

Of the patients admitted to hospital pre- and/or post-SHE (T1D: $n = 59$, 1.4%; T2D: $n = 1214$, 30.5%), the overall mean duration of stay was significantly longer during the month post- versus pre-SHE in both patients with T1D and T2D (T1D: 2.08 vs. 0.88 days, $P = 0.036$; T2D: 4.17 vs. 1.45 days, $P < 0.001$; Table 3). The mean increase in hospital stay post-SHE was longer in patients with T1D and T2D admitted for non-surgical procedures and patients with T2D admitted for surgical procedures, but not patients with T1D admitted for surgical procedures (Table 3). Of the 1273 patients who were hospitalized in the month pre- or post-SHE, 148 (3.7% of the total study population; 11.6% of the hospitalized patients) were hospitalized both in the month pre- and the month post-SHE. The mean duration of stay in patients with T2D hospitalized pre- and post-SHE was significantly longer in the month post-SHE compared with the month pre-SHE (9.36 vs. 5.84 days, $P = 0.002$), whereas there was no significant difference in those with T1D (Table 3).

In the month following an SHE, the total number of outpatient visits increased significantly from 744 to 1022 (37% increase, $P < 0.001$) in patients with T1D, and from 10,626 to 15,685 (47% increase, $P < 0.001$) in patients with T2D. The greatest increases were in visits to endocrinologists, nurses, and dieticians (Table 4). There was a non-significant increase in outpatient pathology, radiology, and imaging visits, and a significant increase in the number of

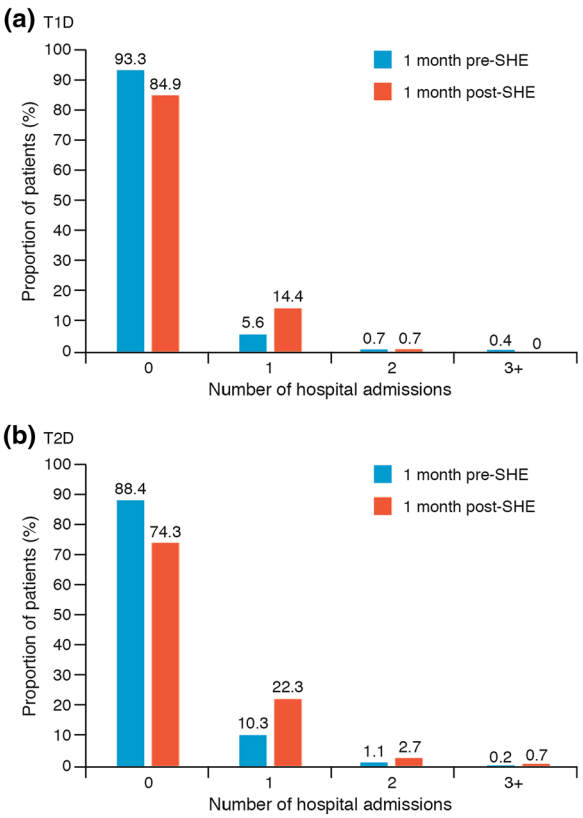

Fig. 1 Proportion of patients with **a** T1D and **b** T2D who had hospital admissions 1 month pre-SHE versus 1 month post-SHE. **a** $P < 0.009$; **b** $P < 0.001$ for comparison of number of hospitalizations pre-SHE versus post-SHE (Wilcoxon test). *SHE* severe hypoglycemic event, *T1D* type 1 diabetes, *T2D* type 2 diabetes

lab tests conducted following an SHE in patients with T2D (Table 4). There was also a significant increase in the number of medication purchases post-SHE, including a 61% increase in SMBG sticks purchases in patients with T2D ($P < 0.001$) and a 20% increase in diabetic medication purchases in patients with T1D ($P = 0.014$; Table 4).

Cost of Treatment

The increase in frequency and duration of hospitalization and the frequency of outpatient visits resulted in a significant increase in the total costs, hospital costs, and outpatient costs in the month following an SHE compared with the month before (Fig. 2). The total expense per patient per month increased by 46% ($P = 0.001$) from \$485 to \$708 for T1D and 87% ($P < 0.001$) from \$601 pre-SHE to \$1121 post-SHE for T2D. The greatest expense, and the greatest increase in expense, was hospitalization, with an increase per patient per month from \$112 to \$312 (+179%, $P = 0.003$) in T1D, and from \$265 to \$706 (+166%, $P < 0.001$) in T2D. Additionally, there was a significant increased expenditure of 37% in T1D and 46% in T2D for visits to healthcare specialists, and 34% in T2D for emergency department visits in the month following an SHE compared with the month pre-SHE (Fig. 2). In this analysis, there was no significant change in the expenses associated with pathology, radiology, and imaging or lab tests.

As additional sensitivity analyses, healthcare expenses were also stratified by BMI, socioeconomic index, whether or not the patient was insulin treated, Charlson comorbidity index, and HbA_{1c} (Table 5). There were no significant differences in expenses across BMI categories, socioeconomic status, HbA_{1c} levels, or insulin treatment in both patients with T1D and T2D. In patients with T2D, there was a significant increase in expenses for Charlson index categories, with patients with Charlson index of +4 having a 91% increase in mean expenses per patient in the month post-SHE versus pre-SHE. No significant differences for Charlson index categories were detected for patients with T1D (Table 5).

DISCUSSION

In this real-world, non-interventional analysis of data from a large-scale diabetes registry, severe hypoglycemia was associated with

Table 3 Mean duration (days) of hospital stay per patient 1 month pre- and 1 month post-SHE

	Number of patients	1 month pre-SHE	1 month post-SHE	Change (%)	*P* value
All hospitalized patients					
T1D					
Total	59	0.88 ± 2.32	2.08 ± 3.45	136	0.036
Non-surgical	57[a]	0.91 ± 2.36	2.21 ± 3.46	142	0.041
Surgical	3[a]	0.00	0.66 ± 1.15	–	0.423
T2D					
Total	1214	1.45 ± 3.28	4.17 ± 8.40	187	<0.001
Non-surgical	1146[a]	1.29 ± 2.71	3.95 ± 7.68	206	<0.001
Surgical	138[a]	2.07 ± 5.04	3.85 ± 7.97	85	0.044
Patients hospitalized both pre- and post-SHE					
T1D	2	5.50 ± 0.70	7.00 ± 7.07	27	0.830
T2D	146	5.84 ± 5.71	9.36 ± 13.29	60	0.002

Data are mean ± standard deviation for hospitalized patients only. *P* values are based on a paired *t* test, which assumes independence between groups

SHE severe hypoglycemic event, *T1D* type 1 diabetes, *T2D* type 2 diabetes

[a] Some patients had both surgical and non-surgical procedures during the time period assessed

increased use of healthcare services and resources, resulting in a significant increase in healthcare expenses in the month following an SHE compared with the month pre-SHE. These results indicate that in the month following an SHE, patients have significantly more frequent and prolonged hospital admissions and outpatient visits versus the month pre-SHE. While it is recognized that factors other than the SHE could influence the data over the time period, the non-significant change in pathology, radiology, and imaging visits would suggest that there was no change in concomitant serious illnesses.

The increase in the proportion of patients with 1, 2, and 3+ hospitalizations and the increase in length of hospital stay 1 month post- versus 1 month pre-SHE were higher for patients with T2D compared with T1D, possibly due to the higher rate of comorbidities and greater age in these populations. It is possible that patients with T1D and their carers may also have more experience at coping with SHEs, and therefore be less inclined to go to the hospital, compared with patients with T2D who may not be insulin treated or have been treated with insulin for a shorter duration, and therefore have experienced fewer SHEs. It should also be noted that the number of patients in the T1D category was smaller than in the T2D category, and this may partly explain why the results did not reach significance. However, other studies have also shown that hospitalization for severe hypoglycemia is more frequent in patients with T2D compared with T1D [10, 17]. These include a study of the resource use associated with severe hypoglycemia in insulin-treated patients with diabetes from a large clinical trial program, which showed that severe hypoglycemia often results in the use of emergency services or

Table 4 Number of outpatient visits, tests and medication pack purchases 1 month pre- and 1 month post-SHE

	1 month pre-SHE	1 month post-SHE	Change (%)	*P* value
Outpatient visits				
T1D				
Endocrinology	78	147	88	<0.001
Nursing care	52	79	51	0.023
Dietician	42	71	69	0.008
Mental care	13	24	84	0.100
General medicine	359	534	48	<0.001
Physiotherapy	17	18	5	1.000
Cardiology	4	1	−75	0.375
Internal medicine	89	95	6	0.712
Ophthalmology	40	23	−42	0.044
Surgery	13	2	−84	0.007
Orthopedics	37	28	−24	0.321
Total	744	1022	37	<0.001
T2D				
Endocrinology	346	960	177	<0.001
Nursing care	747	1287	72	<0.001
Dietician	341	556	63	<0.001
Mental care	210	307	46	<0.001
General medicine	6079	9326	53	<0.001
Physiotherapy	595	747	25	<0.001
Cardiology	148	185	25	0.049
Internal medicine	832	962	15	0.002
Ophthalmology	506	556	9	0.133
Surgery	367	376	2	0.769
Orthopedics	455	423	−7	0.295
Total	10,626	15,685	47	<0.001
Outpatient tests				
T1D				
Pathology, radiology and imaging	9	4	−125	0.166
Lab tests (all)	122	110	−9	0.470
HbA_{1c} tests	83	68	−18	0.225

Table 4 continued

	1 month pre-SHE	1 month post-SHE	Change (%)	*P* value
T2D				
Pathology, radiology and imaging	203	240	15	0.073
Lab tests (all)	2221	2590	16	<0.001
HbA_{1c} tests	1019	1117	9	0.036
Medication packs				
T1D				
Total medication	1170	1313	12	0.045
Diabetic medication	493	594	20	0.014
SMBG sticks	492	584	18	0.091
T2D				
Total medication	40,711	44,895	10	<0.001
Diabetic medication	8494	8893	4	0.069
SMBG sticks	1774	2864	61	<0.001

Outpatient visits and outpatient tests comparisons were conducted using a McNemar's test. Medication packs comparisons were conducted using a Wilcoxon test

SHE severe hypoglycemic event, *SMBG* self-measured blood glucose, *T1D* type 1 diabetes, *T2D* type 2 diabetes

ambulance calls and in hospital treatment [17]. Severe hypoglycemia is recognized as a common cause of hospitalization in elderly patients with diabetes and those with comorbidities [18, 19], and in one study accounted for 94.6% of all endocrine emergency hospitalizations in older patients [20].

The results presented here are consistent with those from several other studies reporting the extensive resource use and cost implications of severe hypoglycemia for healthcare providers/payers. Although the costs vary depending on the countries included and their healthcare systems [6, 10–12, 17, 21], together they illustrate that hypoglycemia is a significant burden and that efforts to minimize it are likely to reduce the economic burden of diabetes.

Previous studies into hypoglycemia-related resource use did not compare the before and after costs for a specific population of patients. This study benefits from the pre- and post-event design, allowing for elucidation of the change in resource use and expenses to be compared, while correcting for background resource use. In support of the robustness of these results, sensitivity analyses conducted with 1 week and 1 year pre- and post-SHE data showed similar results (data not shown). The study also benefits from the level of detail captured and the size of the population included in the registry. Following the 1994 Israel National Health Act, MHS may not deny coverage to applicants on any grounds, including age or state of health, and thus these results are a representation of all sectors of the Israeli population, except for young adults aged 18–21 years, due to the

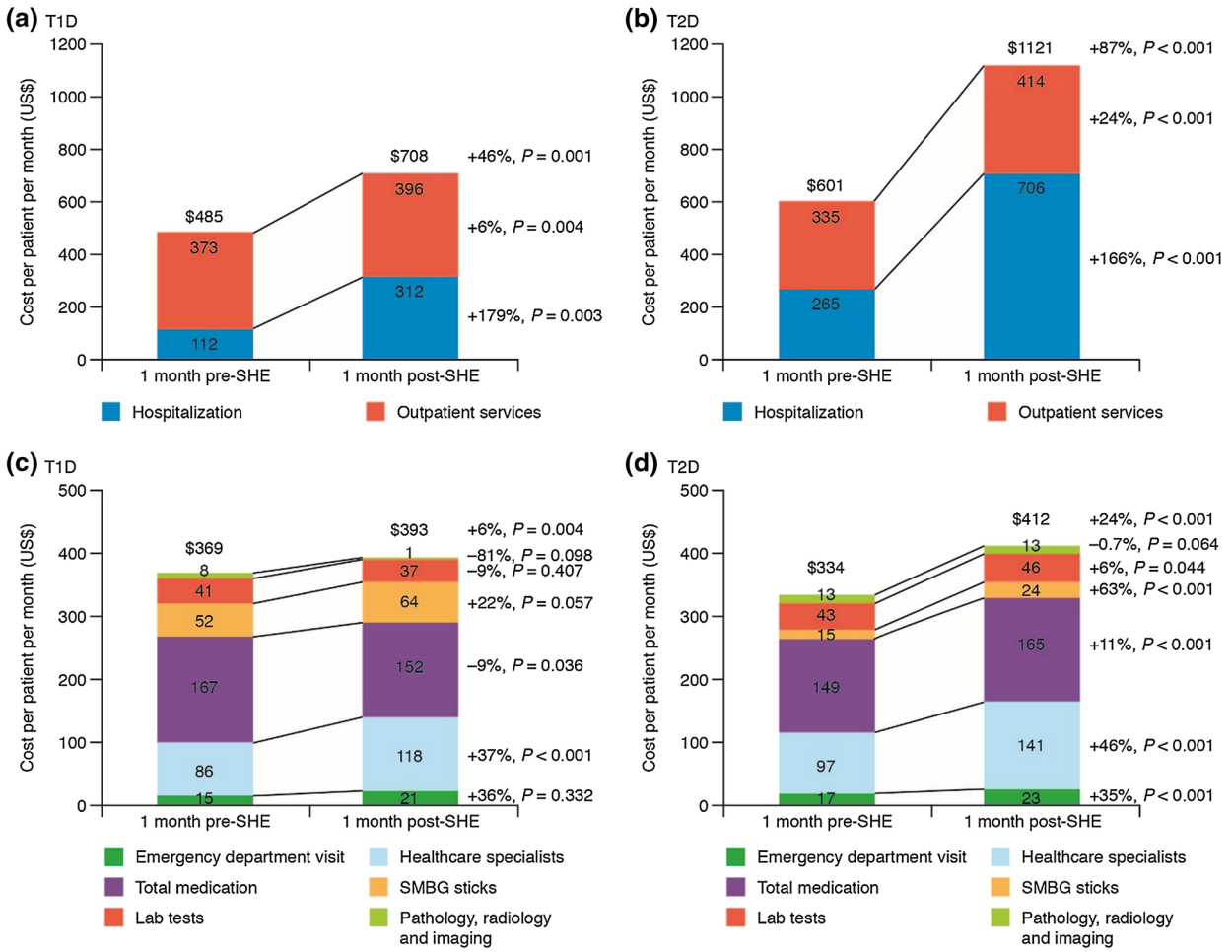

Fig. 2 Healthcare costs per patient 1 month pre- and 1 month post-SHE total costs for **a** T1D and **b** T2D, and breakdown of outpatient costs for **c** T1D and **d** T2D. Cost comparisons conducted using Wilcoxon test. *SHE* severe hypoglycemic event, *SMBG* self-measured blood glucose, *T1D* type 1 diabetes, *T2D* type 2 diabetes

high percentage of them being enlisted in the Israeli Defense Forces.

A limitation of this study is that the registry did not record the cause of SHEs or the reason why patients were hospitalized, so the primary reason for hospitalization may not have been related to diabetes or hypoglycemia in all cases. Some patients were hospitalized pre-SHE; however, in the patients who were hospitalized both pre- and post-SHE, the duration of stay was significantly increased post-SHE, so experiencing an SHE may have contributed to their longer hospital stay. The number of patients with T1D included in the analysis was low, and they may not be considered a representative sample of patients with T1D because of their age (>18 years) and late diagnosis age (around the age of 20 years). It is also not known how many non-severe hypoglycemia events the study population experienced during the designated time period, or whether they contributed to the increase in resource use observed here; nonetheless, this should not affect the conclusion of the study. Furthermore, the patients' diabetes-related complications may also have contributed to resource use.

Table 5 Total expenses per patient stratified by BMI, socioeconomic status, and insulin use

		Costs US $		Pre-SHE vs. post-SHE		Between-group comparison
		1 month pre-SHE	1 month post-SHE	Change (%)	*P* value[b]	*P* value
T1D						
BMI, kg/m^2 (*n*)	<25 (172)	441	740	67	0.004	0.865[c]
	26–30 (80)	571	677	18	0.173	
	>31 (30)	531	646	21	0.192	
Socioeconomic status[a] (*n*)	Low (37)	638	708	10	0.839	0.680[c]
	Medium (115)	596	769	29	0.051	
	High (72)	333	656	96	0.037	
Insulin use (*n*)	Yes (271)	494	677	36	0.001	0.883[d]
	No (13)	298	1366	357	0.650	
Charlson comorbidity index[e] (*n*)	Low (166)	448	612	36	0.008	0.385[c]
	Medium (88)	431	730	69	0.212	
	High (30)	849	1177	38	0.072	
HbA_{1c} (*n*)	≤7% (99)	538	776	44	0.061	0.984[c]
	7–9% (122)	420	541	28	0.013	
	>9% (61)	530	899	69	0.227	
T2D						
BMI, kg/m^2 (*n*)	<25 (908)	652	1271	94	<0.001	0.574[c]
	26–30 (1311)	538	990	83	<0.001	
	>31 (1358)	564	1007	78	<0.001	
Socioeconomic status[a] (*n*)	Low (563)	590	955	61	<0.001	0.528[c]
	Medium (1600)	603	1187	96	<0.001	
	High (1057)	589	1139	93	<0.001	
Insulin use (*n*)	Yes (1210)	687	1363	98	<0.001	0.187[d]
	No (2481)	558	1003	79	<0.001	
Charlson comorbidity index[e] (*n*)	Low (776)	315	552	75	<0.001	<0.001[c]
	Medium (1056)	483	865	78	<0.001	
	High (1859)	787	1504	91	<0.001	

Table 5 continued

		Costs US $		Pre-SHE vs. post-SHE		Between-group comparison
		1 month pre-SHE	1 month post-SHE	Change (%)	*P* value[b]	*P* value
HbA_{1c} (*n*)	≤7% (1870)	600	1156	92	<0.001	0.882[c]
	7–9% (1382)	568	1036	82	<0.001	
	>9% (436)	712	1243	74	<0.001	

BMI body mass index, *SHE* severe hypoglycemic event, *T1D* type 1 diabetes, *T2D* type 2 diabetes

[a] Socioeconomic status: Residential socioeconomic index ranging from 1 (lowest) to 20 (highest); low 1–6; medium 7–13; high 14–20

[b] Statistical analysis based on a Wilcoxon signed-rank test

[c] Statistical analysis based on a Kruskal–Wallis test

[d] Statistical analysis based on a Mann–Whitney test

[e] Charlson comorbidity index: comorbidity index ranging from 1 (lowest) to 16 (highest); low ≤1; medium 2–3; high ≥4

CONCLUSIONS

In conclusion, this real-world analysis of nearly 4000 patients with diabetes who experienced an SHE documents the healthcare resources used, and expenses associated with severe hypoglycemia. The frequency and length of hospital stay increased, the number of outpatient visits increased, and the cost of treatment increased in the month post-SHE compared with the month pre-SHE.

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