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Evaluation of educational needs in patients with diabetes mellitus in respect of medication use in Austria

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Abstract *Background* Effective control of diabetes mellitus type 1 (DM1) and type 2 (DM2) can reduce the development and progression of diabetic complications. Therefore, patient education should be considered as an integral part of diabetes management. *Objective* The aim of the study was to assess DM patients' perception of knowledge for their medication and attitude towards self-management and pharmacist's role. *Setting* The study was conducted at the diabetes out-patient clinic at the Vienna General Hospital (AKH), Division of Endocrinology and Metabolism, Department of Internal Medicine III, Austria. *Method* The study was a cross sectional survey using patient data from a validated patient questionnaire and medical records. Medical records were evaluated by applying a medication assessment tool. *Main outcome measure* To assess the quality of diabetes self management the following outcome measures are considered: HbA1c levels, pre- and post-prandial blood glucose levels, prevention of acute episodes of hypo- and hyperglycaemia,

reduction of macrovascular risk factors, short term quality of life, adverse effects and treatment tolerance. *Results* The present study comprised 225 patients with DM1 and 201 patients with DM2, respectively. In comparison to DM2 patients, cardio- and cerebrovascular diseases were diagnosed very rarely in patients with DM1. The risk for these diseases was higher in patients with other factors of the metabolic syndrome, in addition. Overall, 118 of these patients participated in the questionnaire. The level of positive response on diabetes self-care and knowledge with respect to medication for the prevention of diabetes complications, glycaemic control, and treatment goals in diabetes was 81.8 %. The comparison of patients' perceptions of diabetes self-care and knowledge showed differences among subgroups. Higher perceived knowledge and self-care apparently was associated with DM1. Additional findings of this study indicate that patients do not expect community pharmacists to be integrated in a multidisciplinary diabetes care team. *Conclusion* Although the level of positive response was found to be high there is still a minority of patients whose level of comprehension appears to be insufficient. Intense pharmaceutical care including patients' education within a multidisciplinary team could contribute to improvements in those patients.

Steve Hudson—Deceased.

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Impact of findings on practice

- In addition to successful intensified diabetic therapy, prevention and therapy of comorbidities should be implemented especially in patients with DM2.

- Different sub-groups of diabetes patients have different levels of perceived knowledge and self-care.
- Risk for DM-related macro- and microvascular complications has to be communicated to diabetic patients in an intelligible manner to improve quality of health care.

Introduction

According to the International Diabetes Federation (IDF) in 2011 the number of diabetes cases worldwide among the adult population (aged 20–79 years) was estimated to be 366 million in total. It is anticipated that by the year 2030 the number of estimated cases of diabetes in total will increase to 552 million; that means one adult in ten will have diabetes in 2030. IDF also estimates that as many as 183 million people are unaware that they have diabetes [1]. In the IDF Diabetes Atlas 2011, the estimated prevalence of diabetes in Austria was 9.08 % of the adult population which is among the highest prevalence rates within Europe [1, 2]. Effective control of diabetes mellitus (DM) in terms of glycaemic levels, blood pressure and dyslipidaemia can reduce the development and progression of diabetic complications [3–5].

Patient education in diabetes should be considered as an integral part of diabetes management [6–8], and is recommended as a necessary component in promoting good diabetes control [9]. The main priorities of the national diabetes plan are primary prevention, special care and services for people with diabetes, education of people with diabetes for improved self-care, development of guidelines and protocols for standards of care, information systems, supply of medication and equipment, research, diabetes and complications, prevention of DM2 in obese people, and promoting the community awareness [10]. One component of the plan included the introduction of the Disease Management Programme (DMP) for DM2 based on the US and German DMPs for diabetes in 2006. Diabetes education programmes are offered to reduce the incidence of diabetes by focusing on lifestyle factors. Information campaigns are developed to raise awareness, and to encourage people for a medical check-up. According to American Diabetes Association (ADA) guidelines, diabetes self-management education is the ongoing process of facilitating the knowledge, skill, and ability necessary for diabetes self-care. This process incorporates the needs, goals, and life experiences of the person with DM and is guided by evidence based standards [11]. The value of pharmacological treatment in achieving and adhering to DM control has clearly been established. Randomised, controlled trials such as the United Kingdom Prospective Diabetes Study (UKPDS) demonstrated undoubtedly that intensive blood glucose control benefits long-term diabetes complications in patients with DM2 [12].

Moreover, it was shown that tight blood pressure control and efficient management of diabetes reduces the risk of developing diabetes complications as well as the financial burden placed on health care systems, respectively [13]. Therefore, and taking in consideration the multitude of complications and risks associated with DM, a multidisciplinary approach including physicians, pharmacists, nurses, dieticians, and chiropodists will be required in the management of diabetic patients.

Aim of the study

The study aimed to assess (1) DM patients' perception of knowledge for their medication of DM1, DM2 and comorbidities, (2) patients' attitude towards self-management, and (3) pharmacist's role in diabetes care.

Methods

Study design

The study was a cross sectional survey using patient data from patient questionnaire and medical records. Literature review on current standards of diabetes care and delivery, in particular with regard to medication for prevention of cardiovascular diseases and blood glucose control was conducted. The following evidence-based clinical guidelines were analysed to devise questions which cover identified standards in diabetes care: Österreichische Diabetes-Gesellschaft (OEDG) [10], American Diabetes Association (ADA) [11], National Institute for Health and Clinical Excellence (NICE) [14], and Scottish Intercollegiate Guidelines Network (SIGN) guidelines [15].

The paper-based questionnaire was structured into three parts. The main component of the questionnaire which is based on a pharmaceutical diabetes model [16], included medication in the prevention of diabetes complication, blood glucose control and treatment goals. A second component was designed in order to assess patients' perception of the pharmacist's role in diabetes care. The last component of the questionnaire included demographic questions on the participants which could be used to correlate performance among different subgroups of diabetic patients. Consideration was also given to a primarily closed questionnaire format since patients had to be enabled to fully comprehend the questionnaire and to give predefined answers (YES; NOT SURE; NO). These questions were expressed as statements, whereby patients indicated their knowledge. After the completion of the questionnaire the patient data were anonymised. Overall, the questionnaire consists of two pages and 25 questions. This condensed

format was chosen due to the setting at a diabetes out-patient clinic in Austria's most frequented hospital.

Setting

The study was conducted at the diabetes out-patient clinic at the Vienna General Hospital (AKH), Austria. The diabetes out-patient clinic is part of the Division of Endocrinology and Metabolism, Department of Internal Medicine III.

The data for the implementation of the medication assessment tool (MAT) was collected under permissions granted for a prior study using the MAT from former studies [17, 18]. The patient questionnaire and protocol for interviewing the patients were approved by the ethics committee governing the hospital.

Participants

Overall, the medical records of 225 DM1 and 201 DM2 patients, who attended the out-patient clinic at the Vienna General Hospital in July/August 2009, were evaluated. Of these, 118 diabetic patients agreed to complete the questionnaire and to participate in this part of study. All patients with DM1 and DM2 with a minimum age of 18, regardless of gender or origin, identified through their medical records at the out-patient clinic were eligible for the survey. Patients additionally could be diagnosed obese and concomitantly have cardiovascular disease. Patients with a diagnosis of gestational diabetes were excluded from the study. A language barrier was also considered a reason for exclusion.

Intervention(s)

The procedure of administering the questionnaire and collecting data for the MAT was tested and refined during the first week. Due to some difficulties in understanding of the questionnaire, assistance was offered by the investigators.

Relevant information for the questionnaire and the data collection sheet were obtained from patient medical records prior to the administration of the questionnaire. The obtained information for the questionnaire was then validated during the administration of the questionnaire and missing data were added. The gathered information was likewise used to confirm information obtained from medical records for the data collection sheet.

Prior to the administration of the questionnaire patients were asked if they consent to the use of their anonymised data. The administration lasted on average for about 10 min, while patients were waiting for their regular DM review by their consultants. After the completion of the questionnaire the patient data were anonymised.

Data were entered into SurveyGizmo© [19], an online survey tool which allows to export collected data to text or spreadsheet for further analysis. All subsequent analysis was conducted using Microsoft Excel©; Fisher's exact test was carried out by using the online GraphPad Software© [20].

Due to the heterogeneous patient sample, questions were not applicable for all patients. Data were therefore presented as level of positive response to individual questions and by each patient. Level of positive response in percent was defined as total number of YES counts divided by applicability (summation of YES; NOT SURE; NO COUNTS). The total number of respondents who completed each question was indicated as "n", referred to as applicability.

For each MAT criterion six statements were possible: Not applicable (N/A), YES, Justified non-adherence (NOJ), Unjustified non-adherence (NOU), Insufficient data for the qualifier (IDQ), Insufficient data for the standard (IDS). The percentage of adherence was calculated by dividing the summation of all criteria rated as YES (if the standard and the qualifying statement could be applied to the patient) by the summation of all applicable criteria rated as YES + NOU + IDS multiplied with 100. Levels of adherence were optional judged as high, intermediate or low as follows: high level of adherence: $\geq 70\%$, intermediate level of adherence: 50–69.9%, low level of adherence: $< 50\%$. The final MAT comprised 40 criteria including 13 criteria for general cardio-preventive measures, 10 hypertension criteria, 11 criteria for diabetes management and 6 criteria for anti-obesity medication.

To determine statistically significant differences within a subgroup, *P* values were calculated by using Fishers's exact test.

Main outcome measure(s)

Principle goals of diabetes management include the prevention of complications and therefore an improvement of quality of life and avoidance of premature mortality. Those goals can be achieved by tighter glycaemic control and adequate management of other risk factors such as high blood pressure, dyslipidaemia, smoking and obesity. To achieve those goals patient education plays an important role.

The aim of DM education is to improve patients' knowledge and skills to allow them to control their own condition and to integrate self management into their daily lives. To assess the quality of diabetes management the following outcome measures are considered: glycated haemoglobin A1c (HbA1c) levels, pre- and post-prandial blood glucose levels, prevention of acute episodes of hypo- and hyperglycaemia, reduction of macrovascular risk factors, short term quality of life, adverse effects and treatment tolerance.

This research project was the first attempt to measure patients' perceptions of diabetes self-care and knowledge with respect to medication in a health care setting in Austria.

The questionnaire reflected current guideline recommendations and standards in terms of self-management and education. The short DM questionnaire was quickly to administer and evaluate. It was a single test which allowed the investigators to make subgroup comparisons.

Clinical audit is defined as quality improvement process that aims to improve patient care and outcomes due to systematic review of care against explicit criteria. Thereby outcomes of care are selected and systematically evaluated against explicit criteria. According to the results the audit is then used to implement changes or to confirm that current practice meets the expected level of performance [14]. A criterion based instrument to test the quality of patient care is the MAT. The MAT was developed to examine medication prescribing in definite medical conditions and to evaluate changes in prescribing which are connected with pharmaceutical care initiatives. Medication related criteria are created based on current information from clinical guidelines [21].

Results

The present study included 225 DM1 and 201 DM2 patients. Within this study population cardio- and cerebrovascular diseases were diagnosed very rarely in patients with DM1 compared to patients with DM2 (Tables 1 and 2). Overall, in DM1 patients there was a tendency for higher prevalence of macrovascular diseases (angina pectoris, myocardial infarction, cerebral ischaemia, peripheral artery occlusive disease, PAOD) when they additionally suffered from hypertonia, hyperlipidaemia, obesity and poor blood sugar

control (Table 1). In hypertensive DM2 patients the risk for developing macrovascular diseases was even increased significantly. In addition, significantly more patients had percutaneous transluminal angioplasty/coronary artery bypass grafting (PCTA/CABG) when suffering from hypertension (Table 1). Similar results were observed for hyperlipidaemic patients (Table 1). Despite intensified treatment of patients with DM1 and DM2, microvascular diseases were detected in an even higher number of patients, and the risk for these disorders significantly increased with other factors of the metabolic syndrome (Table 2). Notably, the percentage of patients suffering from micro- and macrovascular diseases was higher in DM2 patients with and without co-morbidities compared to DM1 patients.

These results clearly demonstrate the importance of an adequate therapy together with education of patients to improve the outcome. The demographic data of 25 DM1 and 93 DM2 patients, who agreed to complete the questionnaire and to participate in the survey, are given in Table 3. Of the 118 patients, 85 % (14 DM1 and 86 DM2) were aged above 50 years which is line with the reported age characteristic of DM patients in that DM2 accounts for 80–85 % of patients with diabetes [3].

Responses to questions concerning blood sugar control, life style advice and medication were collected and evaluated for all 118 patients as well as for subgroups as follows: DM1 and DM2, male and female patients, age <50, ≥50, <65, ≥65 and ≥75 years. The questions which are related to criteria of the MAT are listed in the Appendix.

Table 4 shows the percentage of positive responses to each individual question concerning blood sugar control, life style advice and medication. The overall level of positive response to the comprehension questions in the whole study sample was 81.8 % [CI: 80.1–83.5]. The majority of questions can be attributed high comprehension

Table 1 Percentage of DM1 (n = 225) and DM2 (n = 201) patients suffering from macrovascular diseases (PAOD, PCTA/CABG, angina pectoris, myocardial infarction, cerebral ischemia) in presence and absence of major components of the metabolic syndrome

Factors of metabolic syndrome	PAOD DM1/DM2	PCTA/CABG DM1/DM2	Angina pectoris DM1/DM2	Myocardial infarction DM1/DM2	Cerebral ischaemia DM1/DM2
Hypertension	5.5/38.2*††	4.4/20.3**†	2.2/21.2**††	1.1/20.6**††	3.3/9.4*
Normotension	0.9/18.2†	0.9/4.6	0/4.6	0/4.5	0/0
Hyperlipidaemia	6.2/38.9††	4.9/20.3†	1.2/20.5†	1.2/21.1**††	2.5/9.6*
Normolipidaemia	0.8/26.2†	0.8/17.1†	0.8/17.1†	0/4.5	0.8/0
HbA1c >6.5 %	3.6/39.8††	3.6/20.2†	1.5/21.0†	0.7/21.0††	1.5/10.2†
HbA1c ≤6.5 %	1.5/30.8††	0/15.5†	0/17.2†	0/14.0†	1.5/5.5
BMI ≥30 kg/m ²	7.0/38.0††	7.0/16.3	0/20.0†	3.5/22.0†	7.0/8.0
BMI ≤30 kg/m ²	0/30.8††	0/18.3†	0/22.6†	0/21.7†	0/10.2†

PAOD (peripheral artery occlusive disease), PCTA (percutaneous transluminal angioplasty), CABG (coronary artery bypass grafting)

Statistically significant differences between hyper- and normotensive patients, patients with and without hyperlipidaemia, patients with good versus bad long term blood glucose control as well as obese and overweight/normal weight patients are indicated by asterisks (* $P < 0.05$, ** $P < 0.01$). Statistically significant differences between DM1 and DM2 patients in the respective subgroups are indicated by crosses († $P < 0.05$, †† $P < 0.01$)

Table 2 Percentage of DM1 (n = 225) and DM2 (n = 201) patients suffering from microvascular diseases (nephropathy, peripheral neuropathy, retinopathy) in presence and absence of major components of the metabolic syndrome

Factors of metabolic syndrome	Nephropathy DM1/DM2	Peripheral neuropathy DM1/DM2	Retinopathy DM1/DM2
Hypertension	27.4**/58.3 [†]	14.5/30.6	45.2**/22.3**
Normotension	3.7/43.2 [†]	12.0/30.3	19.3/4.5
Hyperlipidaemia	20.8*/59.8 [†]	18.1/31.0	36.9/20.6
Normolipidaemia	9.5/54.5 ^{††}	9.1/27.3	27.0/25.0
HbA1c >6.5 %	12.4/57.9 ^{††}	14.6/31.9	34.4*/23.9*
HbA1c ≤6.5 %	18.5/58.3 [†]	10.2/27.5	22.2/14.6
BMI ≥30 kg/m ²	22.6/50.0 [†]	20.2/32.7*	45.0*/17.8
BMI ≤30 kg/m ²	14.8/58.1 [†]	16.1/18.3	20.9/11.1

Statistically significant differences between hyper- and normotensive patients, patients with and without hyperlipidaemia, patients with good versus bad long term blood glucose control as well as obese and overweight/normal weight patients are indicated by asterisks (* $P < 0.05$, ** $P < 0.01$). Statistically significant differences between DM1 and DM2 patients in the respective subgroups are indicated by crosses ([†] $P < 0.05$, ^{††} $P < 0.01$)

(≥70 % positive responses), especially in respect to blood sugar control. Moreover, in terms of patients' blood glucose treatment goals and adjustment of insulin, the knowledge of patients with DM1 was higher than that of patients with DM2 (Table 5). A high percentage of patients seemed to be well informed about the importance of glycaemic control, regular exercise and a healthy diet. 93.2 %

of patients remember having received dietary advice and 90.7 % patients stated to be aware of their ideal body weight. However, 12.9 % were obese and 39 % were overweight with an actual mean body mass index (BMI) for the whole sample of $30.0 \pm 5.9 \text{ kg/m}^2$ (Table 3).

Three questions concerning blood pressure and lipid lowering drugs show intermediate comprehension (50–69.9 % positive responses), and only one question about blood cholesterol is judged as low comprehension (<50 % positive responses) (Table 4). Only 69.6 % of patients were able to name all their prescribed medication aimed for prevention of long term complications of DM. This reflects about 30 % of patients who are not aware of the aims of their prescribed drugs. Moreover, the questionnaire indicated that about 30 % of the patients did not have any knowledge about their cholesterol and/or blood pressure lowering medication. These findings indicate the need for a more comprehensive education and support in this population.

Some questions reveal that female diabetic patients tend to have more knowledge about their medication and treatment goals compared to their male counterparts. However, the differences were not of statistical significance (Table 5). The level of positive response for all subgroups can be considered high, with DM1 patients being at the top end (85.6 %) and the age group ≥75 years (78.8 %) at the lower end (Table 6).

Optimized patients' education and the provision of multifaceted interventions can contribute to a better compliance. Furthermore, it improves patients' behaviour

Table 3 Demographic data of patients with DM1 and DM2, who completed the questionnaire. In addition, information about their medication and self control of blood glucose and blood pressure is given

Parameter	All patients n = 118	DM1 n = 25	DM2 n = 93
Male (n)	63	18	45
Female (n)	55	7	48
Age (years)	62.6 ± 12.7	51.0 ± 13.4	65.7 ± 10.6
Age <50 years (n)	18	11	7
Age ≥50 and <65 years (n)	43	9	34
Age ≥65 and <75 years (n)	35	5	30
Age ≥75 years (n)	22	0	22
Duration of disease (years)	15.4 ± 11.2	22.0 ± 16.2	13.6 ± 8.8
Smokers (%)	20	36	16
BMI (kg/m ²)	30.0 ± 5.9	26.6 ± 5.1	30.9 ± 5.9
Patients with hypertension (>130/80 mmHg) (%)	68.8	45.5	91.2
Patients with hyperlipidaemia (%)	65.1	40.5	90.0
Patients with HbA1c >6.5 (%)	68.6	68.5	68.7
Patients on antihypertensive drugs (%)	80.5	56.0	87.1
Patients on statin (%)	60.2	44.0	64.5
Patients on aspirin (%)	49.2	28.0	54.8
Patients on insulin (%)	71.2	100	63.4
Test blood glucose themselves (%)	94.9	100	93.5
Test blood pressure (%)	85.6	76.0	88.2

Table 4 Percentage of positive responses of all diabetes patients (n = 118) to each individual question, ranked from highest to lowest positive response

Question	Level of positive response (%) [95 % CI]
I have received advice of keeping my blood sugar under control	98.3 [96.0–100]
I am confident in the way I test my blood sugar at home	98.2 [95.8–100]
I am confident about the way I use my insulin injection device	97.6 [94.4–100]
I have received advice on life style (the type of exercise I need to take, smoking cessation)	96.6 [93.3–99.9]
I record my home blood sugar measurement results	93.8 [89.4–98.2]
I have received adequate dietary advice to help me eat healthily	93.2 [88.7–97.8]
I know the name of the insulin type that I adjust for myself	91.7 [85.8–97.6]
I know my ideal body weight	90.7 [85.4–95.9]
I know the names of tablets that I take to control my blood sugar	87.5 [79.4–95.6]
I understand the purpose of my taking aspirin	81.0 [70.9–91.1]
I know my recent hospital test result that my doctor uses to tell me whether my diabetes is well controlled	80.5 [73.4–87.7]
I am confident I can adjust my insulin after testing my blood at home	79.8 [71.2–88.4]
I know what is the ideal blood pressure for me	78.0 [70.5–85.4]
I know the name of the blood test that tells me and my doctor how well controlled my blood sugar is compared with the last time	75.4 [67.7–83.2]
I know which of my medicines I am taking to control my blood pressure	73.7 [64.8–82.5]
I know the names of all medicines I am taking which aim to prevent the long term effects of diabetes on heart and blood vessels	69.6 [61.1–78.2]
I know the name of a medicine I take to control my blood cholesterol/blood lipids	69.6 [59.3–80.4]
I know what my blood pressure measurement was last time I came to hospital	67.8 [59.4–76.2]
I know what my blood cholesterol measurement was last time I came to the hospital	34.7 [26.2–43.3]

Table 5 Responses with notable differences ($P < 0.1$) in distinct subgroups

Question	Level of positive response (%) [95 % CI] in subgroups		P value
I know the name of the insulin type that I adjust for myself	DM1	DM2	0.0978
	100 [100]	88.1 [79.9–96.4]	
I am confident I can adjust my insulin after testing my blood at home	DM1	DM2	0.0020
	100 [100]	71.2 [59.6–82.7]	
	<65	≥65	
I know the name of the blood test that tells how well controlled my blood sugar is	88.4 [78.8–98.0]	70.7 [56.8–84.7]	0.0930
	<65	≥65	
I know the names of all medicines I am taking which aim to prevent the long term effects of diabetes on heart and blood vessels	68.9 [57.2–80.5]	82.5 [72.6–92.3]	0.0996
	Male	Female	
I know which of my medicines I am taking to control my blood pressure	62.1 [49.6–74.6]	77.8 [66.7–88.9]	0.0616
	Male	Female	
I know my recent hospital test result that my doctor uses to tell me whether my diabetes is well controlled	64.6 [51.1–78.1]	83.0 [72.2–93.7]	0.0623
	Male	Female	
	87.3 [79.1–95.5]	72.7 [61.0–84.5]	

which, in turn, will lead to better health outcomes. Within a multidisciplinary diabetes care team, the pharmacist could contribute to support the diabetic patients to obtain their treatment goals. However, as summarized in Table 7, it is evident that in Austria the pharmacist plays only a minor role in diabetes care. In the patients' opinion

the pharmacist is not very well versed in diabetes care, and therefore they do not consider a pharmacist in diabetes care, because they are thought just to dispense medicines. There were no significant differences between responses of DM1 and DM2 patients. The question about patients' preferred pharmacy revealed that 87.3 % favour

Table 6 Overall level of positive responses for the subgroups

Subgroup	Level of positive response (%) [95 % CI] in subgroups
DM1	85.6[82.2–89.0]
DM2	80.8[78.9–82.8]
Male	82.2[79.9–84.5]
Female	81.4[78.9–83.9]
Age <65 years	81.5[79.1–83.9]
Age ≥65 years	82.2[79.8–84.6]
Age ≥75 years	78.8[74.7–83.0]

visiting the same pharmacy for the supply of their medicine. Therefore, pharmacists are ideally placed to provide extensive information and additional comprehensive and continuous support as he/she is in regular contact with those patients.

Discussion

Besides other aspects the main priorities of the national diabetes plan include primary prevention, care and services for people with diabetes, as well as education of people with diabetes for improved self-care [10]. Korszako et al. [22] demonstrated that a teaching and treatment program for patients with DM2 who are not using insulin for glycaemic control was successfully implemented province-wide at the primary health care level. The present study focused on DM1 and DM2 patients' perception of their knowledge of DM with respect to their medication and attitudes towards self-management. Furthermore, patients' perspective on the role of the pharmacist in diabetes care in Austria was assessed. The study identified areas where patients require additional information and creates opportunities for future care projects. Both research instruments, the questionnaire and the MAT, showed good interaction in respect to diabetes management, and thus findings of these instruments proved to be complementary. However, differences

between MAT and questionnaire, especially in comprehension of life style matters, were obvious.

The essential goals of education areas include control of vascular risk factors (blood glucose, blood lipids and blood pressure), management of diabetes-associated complications and quality of life. Effective diabetes management can then be assessed by the following outcome measures: target glucose levels HbA1c, pre-meal and post-meal blood glucose levels, occurrence of episodes of hypo- and hyperglycaemia, reduction of macrovascular risk factors (dyslipidaemia, high blood pressure, smoking and obesity), and quality of life, adverse effects and treatment tolerance. Other important outcomes for educational interventions focus on diabetes-related knowledge, motivation and improved anxiety or depression, respectively [14].

Compared to DM2 patients in the present and a former study [23], macro- and microvascular diseases were diagnosed very rarely in patients with DM1. Besides intensified therapy, the reason for this finding might be due to the lower age of DM1 patients. Although, DM1 patients were suffering from DM much longer than DM2 patients, they had less comorbidity. Obviously, patients with DM1 are more aware of the risks of DM, and thus they accept to live a more disciplinary life. This was also reflected by the level of positive response for almost all questions in the survey that was highest for DM1 patients. The general level of positive responses to DM self-management and knowledge appears to be high. The findings of this study suggest that diabetic patients believe to have a high overall knowledge about medication used for the prevention of diabetes complications, as well as glycaemic control and treatment goals in diabetes. In fact, our findings are in line with several studies, which have shown that proper and adequate knowledge of DM was associated with good DM control [24–26]. Although the level of positive responses can be considered high, the present study revealed that knowledge is declining with age, which confirms other reports [27, 28]. Still, there is a minority of patients whose level of comprehension is considered to be low or intermediate, in particular concerning general cardio-preventive criteria. Although patients are convinced that they have a good comprehension of self-

Table 7 Patients' perceptions about available support of the pharmacist in diabetes care (n = 118). Values are given in percent

How often the pharmacy supports patients with regard to	Often	Sometimes	Seldom	Not at all
Checks my blood pressure	0.8	4.2	1.7	93.2
Questions about diabetes	0	9.3	1.7	89.0
Questions about my diabetes medication	0	9.3	0.8	89.8
Understanding of my treatment goals	0	4.2	0.8	94.9
Questions about other medication I am taking	5.1	29.7	6.8	58.5
Understanding of the changes I must make to my life style	2.5	8.5	1.7	87.3

management, this is not necessarily reflected by a behavioural change as shown by the comparison of ideal BMI to actual BMI (30.0 kg/m²). Moreover, patients' perceptions of ideal blood pressure and blood lipid profile revealed that only a minority of patients indicated blood pressure and lipid level targets that were within the target ranges. This is the more important as it is evident that the risk for the development of micro- and macrovascular disorders positively correlates with hypertension, dyslipidaemia and body weight, despite good blood sugar control. So, in addition to the successful intensified diabetic therapy, knowledge about prevention and therapy of co-morbidities should be forced.

Intense pharmaceutical care within a multidisciplinary team can contribute to improvement in diabetes self-care and knowledge. Pharmacists are involved in diabetes care through traditional core activities such as health promotion and education for the diabetes patient. Pharmacist involvement in diabetes care in the hospital setting revealed a significant reduction of blood pressure and blood lipids in patients who could previously not meet their treatment targets. This improvement was sustained after discharge [29]. Furthermore, pharmacist intervention compared to usual diabetes care produced significant reductions in the risk of cerebrovascular accident and coronary heart disease in hypertensive DM2 patients [30]. Although studies of community pharmacy based-interventions on diabetes control, adherence, medication problems and patient knowledge in DM2 found limited evidence for these interventions, they suggested that educating patients and discussing patients' perceptions of DM can contribute to effective pharmacists' interventions. Additionally, it was shown that patients accept extended services by pharmacists, however, they do not expect them to be involved in diabetes care [31–33].

In Austria, regional pilot projects [34] for prevention and diabetes care, started in 2006. Screening by pharmacists covered blood glucose, blood pressure, cholesterol,

abdominal girth, weight and lung function. If one of the levels were out of range, a referral to the general practitioner was recommended. In particular, pharmacists should be involved in diabetes care concerning medication problems. However, findings of the present study indicate that patients in Austria do not expect pharmacists to be integrated in a multidisciplinary diabetes care team. The majority of the patients tend to use the same pharmacy for the supply of their medication. As the pharmacist is in regular contact with those patients, he/she is ideally placed to provide comprehensive and continuous support. This might implicate an opportunity for future pharmaceutical care projects.

Conclusion

Diabetes care is a complex, time-consuming process and its success is mainly dependent on the participation of the patient. Education represents a cornerstone in diabetes care and should enable the patient to control diabetes by self-monitoring his/her condition. Based on our findings, the general level of positive responses to DM self-management and knowledge was high. Compared to DM2 patients, DM1 patients had less co-morbidity and were more aware of the risks of DM. Furthermore, they accepted to live a more disciplinary life. Overall, DM1 patients and younger patients tend to have higher knowledge and better adherence to medication than DM2 patients and patients ≥ 75 years. Despite intensified treatment of DM, the risk for macro- and microvascular diseases significantly increased with other factors of the metabolic syndrome. The awareness of this fact has to be communicated to diabetic patients in an intelligible manner to improve quality of health care.

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Table 8 Questions related to criteria of MAT and level of adherence (L, low, <50 %; I, intermediate, 50–69 %; H, high, >70 %)

MAT criteria		Questionnaire	
<i>(A) General cardiopreventive criteria</i>			
Patient diagnosed with diabetes and with at least one additional CV risk factor is prescribed aspirin	L	I understand the purpose of my taking aspirin	H
Patient aged ≥ 50 years is prescribed aspirin	L		
Patient aged <50 years with significant CV risk factors is prescribed aspirin	L		
Patient aged ≥ 40 years is prescribed a statin	I	I know the name of a medicine I take to control my blood cholesterol/blood lipids	I
Patient aged <40 years old with high CV risk factor profile (>20 % in 10 years) is prescribed a statin	L		
Patient who is prescribed a statin has achieved LDL levels <2.6 mM	L		
Patient who is prescribed a statin has achieved a TC <4 mM or LDL levels <2 mM	L	I know what my blood cholesterol measurement was last time I came to the hospital	L

Table 8 continued

MAT criteria		Questionnaire	
Patient with CVD or history of MI is prescribed a beta-blocker	H	I know the names of all medicines I am taking which aim to prevent the long term effects of diabetes on heart and blood vessels	I
Patient with a history of MI is prescribed an ACE-I or ARB	H		
Patient with microalbuminuria or proteinuria is prescribed an ACE-I or ARB	H		
<i>(B) Hypertension criteria</i>			
Diabetes patient diagnosed with hypertension is prescribed antihypertensive drug therapy	H	I know what my blood pressure measurement was last time I came to hospital	I
Patient WITHOUT co-existing kidney, eye or CV damage AND/OR without two or more features of the metabolic syndrome has achieved blood pressure control of $\leq 140/80$ mmHg (DM2) or $\leq 135/85$ mmHg (DM1)	L	I know the ideal blood pressure for me	H
Patient WITH co-existing kidney, eye or CV damage AND/OR without two or more features of the metabolic syndrome has achieved blood pressure control of $\leq 130/80$ mmHg	L		
Patient prescribed aspirin has achieved a blood pressure $<145/90$ mmHg	L		
Patient with hypertension is prescribed an ACE-I or an ARB	H	I know which of my medicines I am taking to control my blood pressure	H
Patient on ACE-I or an ARB and uncontrolled blood pressure is added a CCB and/or a diuretic	H		
Patient with treated hypertension is NOT prescribed a combination of thiazide diuretic and beta blocker	H		
Patient diagnosed with hypertension and on thiazide diuretic as a single antihypertensive agent does NOT have gout, CrCL <30 ml/min, hypokalaemia, dyslipidaemia	H		
<i>(C) Diabetes management</i>			
Patient stabilised on insulin has achieved HbA1c <7.5 % or a documented individual agreed target	H	I have received advice of keeping my blood sugar under control	H
		I record my home blood sugar measurement results	H
		I am confident in the way I test my blood sugar at home	H
		I know my recent hospital test result that my doctor uses to tell me whether my diabetes is well controlled	H
Patient with a diagnosis of diabetes of at least 15 months has had two HbA1c measurements taken at least twice within the past 15 months	H	I know the name of the blood test that tells me and my doctor how well controlled my blood sugar is compared with the last time	H
Patient requiring oral antidiabetic agent and without apparent contraindication/intolerance is prescribed metformin	H	Know the names of tablets that I take to control my blood sugar	H
Patient NOT on metformin due to apparent contraindication/intolerance is prescribed a sulfonurea	H		
Patient prescribed highest recommended/tolerated dose of metformin and whose glucose control remains inadequately controlled is additionally prescribed a sulfonurea	H		
Patient prescribed a thiazolidinedione and metformin OR sulfonurea because of apparent contraindication/intolerance of sulfonurea OR metformin OR inadequate diabetes control	H		
Patient who does not accept insulin and who is on a DPP4-inhibitor OR thiazolidinedione has prescribed it with metformin and sulfonurea	I		
Patient prescribed metformin and sulfonurea and whose glucose levels remain insufficiently controlled is prescribed additional insulin	H	I am confident about the way I use my insulin injection device	H
		I know the name of the insulin type that I adjust for myself	H
		I am confident I can adjust my insulin after testing my blood at home	H

Table 8 continued

MAT criteria		Questionnaire	
<i>(D) Life style/anti-obesity management</i>			
Patient prescribed an anti-obesity drug (orlistat) has had documented body weight showing failure to respond to non-pharmacological measures (>2 body weight measurements show a plateau or increase in body weight within the preceding 8 months)	L	I have received advice on life style (the type of exercise I need to take, smoking cessation)	H
		I have received adequate dietary advice to help to eat healthily	H
		I know my ideal body weight	H
Patient prescribed orlistat is receiving support as dietary advice and counselling from dietician/nurse	L	I have received adequate dietary advice to help to eat healthily	H
Patient prescribed orlistat had a BMI >28.0 kg/m ² before starting the drug	L	I know my ideal body weight	H
Smoking cessation advice	L	I have received advice on life style (the type of exercise I need to take, smoking cessation)	H

ACE-I angiotensin converting enzyme inhibitor, *ARB* angiotensin receptor blockers, *CCB* calcium channel blocker, *CrCL* creatinine clearance, *CV risk* cardiovascular risk, *CVD* cardiovascular disease, *DPP4-inhibitor* dipeptidylpeptidase 4 inhibitor, *MI* myocardial infarction, *TC* total cholesterol

Conflicts of interest None.

Appendix

See Table 8.

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