TRANSFER OF KNOWLEDGE FROM THE SPECIALIST TO THE GENERALIST BY VIDEOCONFERENCING - POTENTIAL IMPACT ON DIABETES CARE

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Short running title: Telemedicine improves diabetes care in the extramural field

Summary

We conducted a 12 month prospective interventional study, examining the effectiveness and feasibility of Videoconferencing between primary and secondary care. The primary intention was improvement of diabetes care by means of new technologies. A treatment network consisting of a diabetes specialist and 4 general practitioners was established, using a video-conferencing system as the central communication medium.154 type 2 diabetic patients participated in the study. For the evaluation of medical parameters a screening for micro- and macroangiopathic risk factors was performed at the diabetes center. Patients were also asked about the frequency of acute complications and the need for hospitalisation. Common goals of treatment were formulated and if these goals were not achieved or if acute complications occurred, the patients were presented to the specialist via the video out-patient facility. The specialist was contacted 94 times via videoconferencing. Metabolic and hemodynamic parameters were significantly improved: Hba1c from 8.1 % to 7.8 % ($p<0.05$), systolic blood pressure from 156 to 148 mm Hg ($p<0.0005$), and diastolic blood pressure from 88 to 83 mm Hg ($p<0.005$). The frequency of severe hypoglycemia and hospital admissions could be reduced by videoconferencing. The study shows that permanent therapeutic counselling by video conferencing is feasible and permits the improvement of diabetes care .

INTRODUCTION

The treatment of patients with type 2 diabetes mellitus is a major challenge for health care systems and its structures worldwide. The multifactorial disease process causes early morbidity in patients and results in a considerable economic burden for the health care system [1,2]. Recent studies in large type 2 populations have shown that persistent therapeutic interventions with a multifactorial approach can delay and even prevent the onset of microvascular and macrovascular complications [3,4,5,6,7,8,9].

The diffusion of such Evidence-Based Medicine (EBM) from diabetes centers to general practitioners is hampered by learning barriers on the one hand, and by problems at the points of intersection between primary and secondary care on the other. Learning barriers include poor access to relevant information sources, lack of interest and time on the part of physicians, paucity of knowledge (skills), and poor awareness of the necessity to integrate EBM into clinical routine and defensive routines [10,11,12,13]. The role of information systems has become increasingly important in the context of evidence-based medicine as a new decision-making paradigm in the evolution of new communication structures. Direct transfer of knowledge by the main recipients of EBM with the help of modern communication tools might serve as a major pacesetter in terms of improving the quality of extramural diabetes care. Some very recent publications have addressed the subject of improving communication at the above mentioned points of intersection by means of videoconferencing (VC) [14,15,16]. In these studies, overcoming time and space barriers is mentioned as the main argument in favour of videoconferencing. In our opinion, improving communication at points of intersection not only involves the resolution of space and time barriers, but also raises issues such as coping with personal unfamiliarity, distrust or competition [17,18].

Most studies focus on doctor-patient telecommunication, only little investigated tele-communication between specialist and generalist. [19,20]

To prove feasibility and efficiency of the use of a “physician to physician communication tool” , we conducted a 12 month prospective interventional study. We initiated a project that connected 5 network partners, a diabetes specialist and 4 general practitioners through a videoconferencing system and we measured the impact of a specialist`s knowledge on quality of diabetes care.

RESEARCH DESIGN AND METHODS

The network

The treatment network consisted of the diabetes centre of a hospital and four general practitioners within the catchment area of the hospital. The diabetes centre is a special out-patient facility for the treatment of type 1 and type 2 diabetes and its complications. Besides improving the quality of diabetes care, the specialists at the centre wished to disseminate their knowledge and its application. The measure was expected to reduce workload and to enable the specialists to concentrate on their core tasks, namely the treatment of acute and special cases and follow-up. At the diabetes centre, a consultant qualified in diabetology and endocrinology was available for the video out-patient facility.

After informal interviews, four general practitioners were selected by the diabetes centre. Experience in EDP was desired but was not mandatory. The physicians’ motives to be involved in the program were interest in innovative technology, improving patient care, and on-the-job learning from diabetes specialists. At the beginning of the project the network partners agreed upon fixed target values for Hba1c, serum lipids and blood pressure. The target values were based on the ADA recommendations for good diabetes control and were

adapted to practicability within the limits of the project [21,22].
Based on theories of organisational learning, we assumed that the cognitive and emotional acceptance of EBM and the implementation of knowledge into situation-oriented diabetes therapy depends, to a large extent, on mutual trust between physicians at the diabetes centre and general practitioners [23]. Intensive personal interaction is required in order to develop trust. A space in which mutual expectations can be voiced and clarified, and an environment that promotes learning and reflection of relationships are needed to achieve this end [18,23]. Within such "soft networking", cultural values, norms and rituals that are necessary for successful learning are developed [24,25,26]. Therefore, personal meetings between network partners at 2-month intervals were introduced as a measure to flank videoconferencing.

Videoconferencing-System
The central communication medium in the treatment network was a videoconferencing system installed at the diabetes centre and in the practices of the 4 physicians. It is a desktop system that can be easily integrated into the medical practice.

Technische Details von Apross eingefügt

Patients in whom the goals of treatment were not achieved or patients who developed acute complications were introduced by the practitioners to the specialist via videoconferencing, at previously fixed consultation times. Along with the patient, this digital council made therapeutic decisions. This virtual "out-patient triangle" was intended not to exceed 15 minutes per patient.

Selection of patients and medical performance
Patients were selected by the 4 physicians in accordance with pre-given inclusion criteria: type 2 diabetes mellitus defined in accordance with the new classification, a minimum one-year duration of diabetes and minimum one-year treatment by the recruiting practitioner [27]. Attendance of a diabetes centre over the preceding twelve months was an exclusion criterion. A total of 154 patients were included in the study. (Table 1)
After an informative interview concerning the nature of the study, the patients signed the declaration of consent in accordance with the ethics protocol of the hospital.
For evaluating medical parameters at the beginning and the end of the 12-month investigation period, patients were made to undergo a screening for late complications (examination of the foot, urine investigated for micro- and macroalbuminuria) and metabolic and hemodynamic parameters (HbA1c, total cholesterol, LDL cholesterol, triglycerides, blood pressure) at the diabetes centre. Patients were instructed to undergo eye examinations by an ophthalmologist once every year, and were interrogated with regard to the frequency of severe hypoglycemia necessitating external help the year before the project and during the year of the project. They were also asked about the incidence and duration of hospital stays due to hypo- or hyperglycemia and diabetic foot complications over both time periods. Data were collected and recorded through semi-structured interviews.

Statistical analysis
The distribution of data was analysed with the Shapiro-Wilk W test. Since all data were not normally distributed, a non-parametric Wilcoxon's matched pairs test was performed to compare values at the beginning with those at the end of the study (dependent variables). Values are given as means plus minus standard deviation. All results nominally significant at $p<0.05$ are indicated.

RESULTS

Videoconferencing

The diabetes centre was contacted 94 times for video consultation. It was used to a varying extent by the physicians, the lowest application being registered in the physician with the least technical training. (Table 2) The reasons for contacting the specialist were non-achievement of target values in 86 cases (in 7 of these additionally because of poor compliance on the part of patients), a new crural ulcer in 3 cases, and the patient's curiosity in regard of the novel technology in 5 cases. The quality of transmission was adequate for a therapeutic interview and for evaluating the course of ulcer healing. The duration of the out-patient video interview was on average 12 minutes (minimum 4 minutes; maximum 23 minutes). Patients' questions were related to therapy and required changes in therapy. The most frequently voiced questions by general practitioners concerned possible therapy combinations for hypertension and switches to insulin therapy.

Medical performance

Hba1c as an expression of diabetes control was significantly reduced by 0.3 % after 12 months ($p<0,05$). Systolic and diastolic blood pressure was also significantly reduced by 8 mm Hg and 5 mm Hg, respectively ($p<0.0005$). Serum lipids were improved, although the level of significance was not achieved. (Table 3)

Compared with predefined target values for HbA1c, blood pressure and serum lipids, the proportion of patients who achieved the target values was found to be increased for all parameters. (Table 4) Improvements in the above mentioned parameters were independent of the treating physician.

Prescribing patterns

Initially 12 % of patients were on diet alone, 65% on oral antidiabetic agents and 23% on insulin therapy. At the end of the project 10% of patients were on diet, 54% on oral antidiabetic agents and 36 % on insulin therapy.

Sixty-eight patients (50%) were on antihypertensive therapy at the beginning of the study and 80 patients (58%), at the end of the study. Blood pressure medication was increased in 41 patients (30%) during the study. The main additional drugs were ACE inhibitors, which were increased from 41 % at the beginning to 53 % at the end; and diuretics, which were increased from 24 % to 38 %. The increases resulted from the recommendations of the specialist in the diabetes center, which were conveyed to general practitioners on a face-to-face basis by videoconferencing. No changes in the prescription of ß-blocking agents, alpha blocking agents and calcium channel antagonists were observed. The proportion of patients with 2 or more blood pressure drugs increased from 29 % at the beginning to 41 % at the end of the study. Likewise, the prescription of statins increased from 25 % at the beginning to 40 % at the end of the study.

The principal change in the prescription habits of practitioners was that ACE inhibitors and statins were prescribed more often.

Acute and chronic complications

The incidence of admissions to the hospital because of acute diabetic complications (hypo- and hyperglycemia, diabetic foot problems) was reduced from 12 during the year before the project to 7 in the year of active, intensified communication. Accordingly, the days of hospitalization for the whole patient group for the treatment of acute complications were reduced from 110 to 68 days per year. The frequency of severe hypoglycaemia requiring assistance from other individuals was reduced from 12 patients per year (8 %) before the

project to 3 patients (2 %) during the year of the project.
Late complications and metabolic parameters were measured more frequently by all the physicians. HbA1c measurements were performed 1.2 times during the year before, and 2.8 times during the year of the project. Lipid measurement increased from 0.5 per year to 1.0 per year and measurement of microalbuminuria from 0 to 0.8 times per year. Retinopathy was also assessed more frequently. During the year of the project 54% of patients underwent ophthalmological examinations, whereas staging of retinopathy was done in only 22 % of patients prior to the project.

DISCUSSION

Diabetes is a model illness for improving chronic disease management in a large population. The disease affects approximately half a million people in Austria and causes significant complications that incur high costs in terms of health care. Careful glucose monitoring and adequate treatment can prevent severe complications. Studies focusing on the types of intervention that are likely to succeed in improving overall diabetes care are scarce [1]. The present interventional project is based on quality improvement by the introduction of infrastructural, behavioural and cultural changes in communication between primary and secondary care. The basic instrument of change was a videoconferencing system, which permitted a systematic approach to risk stratification and targeted intervention in diabetes patients by transfer of knowledge and EBM from the specialist to the general practitioner. The implementation of "best evidence" in the extramural field might be an effective approach for successful implementation of strategies to counteract diabetes mellitus [11,28].

Metabolic control, hypertension and elevated serum lipids did improve during the project. This is not common, as we know from large studies in type 2 diabetic patients that the natural course of the disease is characterized by steady worsening of metabolic control over the years [29,30]. The present study shows that it is possible to improve the quality of diabetes care in type 2 diabetic patients who are mainly under treatment in primary care. Success in diabetes care, defined as the reduced incidence of acute and late complications (micro- and macrovascular), is also dependent on the frequency of screening for risk factors before organ damage occurs. The regularity of screening procedures is a major factor connected with the occurrence and progression of late complications. Screening examinations were performed more frequently during the project when compared to the period prior to the project. Long-term effects, e.g. relieving the economic burden by reducing diabetes-associated complications, need to be evaluated.

The frequency of severe hypoglycemia was reduced from 8 % to 2 %, although many patients were switched to insulin therapy. This proportion is similar to the frequency reported in the UKPDS, in which type 2 diabetic patients were studied [29]. The incidence of hospital admissions because of acute diabetic complications was significantly reduced by the use of telecommunication. The number of days of hospitalization was halved compared to the year before the project was started. This reduction resulted from an overall decrease in severe hypoglycemia, improvement in diabetes control with fewer episodes of hyperglycemia, and the treatment of diabetic foot problems via videoconferencing. The measures reduced hospital stays on the one hand and the cost of health care on the other.

Prescription routines and prescription patterns among general practitioners were changed. The substantial increase in the use of ACE inhibitors and statins reflected the successful transfer of knowledge and implementation of EBM into routine practice.

The learning environment created by this project maximised interaction. Thus, its effect on treatment strategies was proved. The presence of the patient and his/her participation in videoconferencing was evaluated as a highly positive factor because it permitted face-to-face communication between the three individuals involved in the treatment triangle. It was considered superior to telephone consultation and consultation by letter [31,32].
Current medical education for general practitioners appears to be effective when it is implemented at the actual place of work and when it contains the information needed in daily practice. For rural areas located at a substantial distance from a treatment centre, a "web-based classroom" might be the best option for implementing EBM and tele-education might serve as a major source of generating knowledge [33,34].
Explicit concerns in regard of participating in the project were related to the effort involved, the fear of transparency and of disclosing knowledge deficits, and the fear of being devaluated by colleagues from the hospital hierarchy [28]. All these concerns were unfounded.
The aim of the present study was to improve diabetes care in primary care and to resolve typical problems at the points of intersection between extra- and intramural fields by means of an innovative technology. Telemedicine is modifying classical health care by providing effective solutions for an increasing number of new situations. A user-oriented technical installation of VC, resolving minor breakdowns in the initial phase, and learning its application, require a willingness to learn and a certain amount of time. In general, the technology was well integrated into clinical routine and the learning effort was balanced by the learning effect in the course of the study [35,36]. At the strategic level, based on the evolution of modern societies and their medical systems, telemedicine appears to be safe [37].

Efforts to transfer patients with chronic diseases from the outpatient departments of hospitals to primary care physicians are now being regulated by the government of Austria - a move that was anticipated by the designers of the project and was expected to permit expensive hospital departments to concentrate on their core tasks as highly specialised competence centres. However, health authorities and decision makers are also required to ensure that state-of-the-art therapy standards and sustained quality of care are provided to patients even after the changes have been introduced. As in other European countries, successful cooperation between health care providers can only be effected within intelligent financial distribution systems and with the goodwill of the involved parties [38,39,40]. Furthermore, substantial cuts in health care budgets have made it necessary to base all future endeavours on economic considerations aimed at the best application of available resources and at reducing costs while ensuring optimum care for patients.
The advantages for all individuals involved in the network (patient, specialist, generalist), especially the realisation of modern learning strategies by transfer of knowledge and the avoidance of double-tracking diagnostic and therapeutic measures, should serve as an impetus to extend this new communication culture.

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Table 1. Patients and demographic data

	Original study population		Study compleeters	
N	154		136	
Age, a	69,2	± 11,1	69,1	± 11,0
Duration of Diabetes, a	11,6	± 10,7	11,7	± 13,2
female/male	89	/ 65	81	/ 55
Lost for follow up			18*	

Data are means ± standard deviation, * 7 died, 7 refused to complete the study, 4 were unable to visit the diabetes center

Table 2. Number of videoconferences

GP	A	B	C	D
Age, years	54	40	41	65
Gender	m	f	m	m
Patients (total 136)	23	38	46	29
N (total 94)	9	17	43	25

Table 3. Metabolic parameters

n =136	start		end	
HbA1c, %	8,1	± 1,3	7,8	± 1,1 *
Total cholesterol, mmol/l	5,38	± 1,08	5,26	± 1,01
LDL-Cholesterol, mmol/l	3,34	± 0,87	3,34	± 0,88
Triglycerides, mmol/l	2,04	± 2,03	1,82	± 1,08
Systolic blood pressure, mm Hg	156	± 26	148	± 20 †
Diastolic blood pressure, mm Hg	88	± 13	83	± 11 †

Data are means ± standard deviation, * $p<0,05$, † $p<0,0005$

Table 4. Therapeutic targets

	target		target reached * start	end
HbA1c	< 7,5	%	36,0	40,4
Total cholesterol	< 5,20	mmol/L	63,2	70,6
LDL-Cholesterol	< 3,35	mmol/L	48,1	53,7
Triglycerides	< 2,25	mmol/L	73,5	76,5
Systolic blood pressure	< 130	mmHg	8,9	16,2
Diastolic blood pressure	< 85	mmHg	35,6	55,2

* Data are percentage