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Shared Care for Diabetes: Supporting Communication between Primary and Secondary Care

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Abstract

As health care becomes more complex, interest in the benefits of coordination of care has increased. Especially patients that are being treated jointly by more than one physician (shared care), are vulnerable to adverse effects resulting from inadequate coordination and communication. We describe a study in which care providers support shared care by using computer-based patient records for data storage, and structured electronic data interchange (EDI) as a means of communication.

The study showed that the electronic communication network for exchanging consultation outcomes significantly increased frequency of communication and the availability of data to the general practitioner on diagnostic procedures performed in the hospital, thus providing more complete information about the care that patients are receiving

Keywords

Diabetes Mellitus, Computer Communication Networks, Practice Patterns.

Introduction

Diabetes mellitus still leads to large morbidity and mortality, although impressive improvements in the management of blood glucose levels have been achieved. In the United States, around 5.5 million patients suffer from this disease; diabetes is the underlying or contributing cause of approximately 323,000 deaths annually [1]. Evidence exists that during the past decades the number of diabetes patients has increased, independently of demographic changes [2-4]. This trend is expected to continue; for the Dutch situation an increase from 244,000 patients in 1990 to 355,000 patients in 2005 (an increase of 46%) is predicted [5].

In 1989, government health department representatives of all European nations formulated the St Vincent Declaration [6]. This Declaration sets guidelines to reduce morbidity and mortality from diabetes. Among the most important targets are the reduction of complications resulting from diabetes, such as blindness, and end-stage diabetic renal failure.

Previous studies have indicated that, in order to further improve the treatment of diabetes patients, several problems have to be solved. First, Hempel argues that , because early diagnosis and treatment of complications are key elements in managing these complications, well-kept medical documentation is essential [7]. A study by the same author, however, showed that the quality of this documentation was poor [8]. Deeb et al. also demonstrated that documentation of complications in primary care was poor, but that a multidisciplinary educational program could improve this situation [9]. Second, during the management of diabetes, more than one physician is often involved in the treatment of a patient: this may lead to fragmentation of medical records and discontinuous care [10].

In order to improve the documentation of medical activities and to facilitate the efficient communication between physicians, several studies have assessed the potential benefit of computer-based patient records. Tierney et al. showed that using a network of computer workstations in a public hospital for inpatient order writing significantly reduced patient charges and hospital costs [11]. In an earlier study, Branger et al. showed that using electronic communication to deliver laboratory reports from hospitals to general practitioners improved the speed of communication, decreased workload, and eliminated transcription errors [12].

In this paper we describe a project that evaluated the use of electronic communication between general practitioners and an internist working in an outpatient clinic. Our study attempts to assess the value of electronic data interchange in improving documentation of the total care that diabetes patients are receiving, and improving communication between physicians simultaneously treating a patient. We also studied whether changes in glycemic control occurred during the project.

Research setting

In The Netherlands, the general practitioner functions as a gatekeeper between primary and secondary care. Typically, patients first consult their general practitioner. If considered necessary, the general practitioner refers the patient to a specialist. The specialist will report the results of the treatment back to the general practitioner. In the case of diabetes patients, as a general rule, non-insulin dependent patients are treated by the general practitioner, and insulin dependent patients are treated by a hospital-based consultant. Recent research has shown that 40% of

diabetes patients over 65 years suffer from one or more other diseases for which they also visit a specialist [13]. Thus, an important task of the Dutch general practitioners is to coordinate such shared-care situations. In order to meet this challenging task, general practitioners need to be aware of the total care that their patients are receiving, especially in the case of chronic disorders such as diabetes.

Our study was carried out in the Apeldoorn region, a region with approximately 180,000 inhabitants, one general hospital (on two locations, with in total 750 beds), and 65 general practitioners. Of the general practitioners, 32 used the same computer-based patient record system [14]. This system allows the general practitioner to fully replace the paper patient record with a computer-based patient record. The physician uses the system during patient consultations to inspect and record clinical data. The physician may code the content of the patient record in great detail, such as reasons for encounter, diagnoses, medications, referrals, laboratory tests, and risk factors. The system also contains an electronic communication module. This module enables electronic information exchange with other information systems. This technology is known as *electronic data interchange (EDI).* Walker defines this type of communication as *"the replacement of paper documents by standard electronic messages conveyed from one computer to another without manual intervention"* [15]. Using a standardized message, a laboratory can, for example, transmit test results electronically to a GP's computer system. The GP's computer system can process and integrate the data automatically in the computer-based patient record. In The Netherlands, the National Board for Public Health (Nationale Raad voor de Volksgezondheid) has adopted EDIFACT as the standard for EDI between systems used in health care [16]. In 1989, the general practitioners in the Apeldoorn region started to use EDI for the exchange of messages among each other, for receiving admission and discharge reports from the hospital administration department, and for receiving laboratory reports from the hospital laboratory [12].

In the Apeldoorn hospitals, 2 of the in total 10 internal medicine consultants provide medical care for approximately 80% of all diabetes patients referred to the outpatient clinic. In the outpatient clinic of one of these diabetes treating consultants, we installed a system, similar to the ones in primary care, containing all the functions available to the general practitioners. We tailored this system to the information needs of the participating consultant.

Materials and Methods

We approached the 32 general practitioners who were already working with the computer-based patient record and EDI; all GPs agreed to participate.

Organization of EDI

The computer-based patient record system of the 32 GPs already contained a communication module that allows electronic data exchange with other information systems [12]. We designed an EDIFACT message standard that can be used for the electronic transmission of a complete medical record, or sections of it. The message can contain both administrative and medical data. This message standard, the so-called MEDEUR message, was described in detail in an earlier paper [17].

When initially referring a patient, a physician can send a referral message electronically using MEDEUR. To do so, the physician first specifies the patient and the period about which he wants to report. The system then creates a MEDEUR message, based on the data stored in the computer-based patient record. The physician can, before the message is actually transmitted, edit the message by specifying what data to discard, or add free text to the message.

The physician receiving such a MEDEUR messages can directly store the patient data into the computer-based patient record, without the need to retype the data. Prior to storing the data, the physician can select and subsequently discard the data from the received message he considers to be irrelevant. The system keeps track of the diabetes patients who are also treated by another physician. At the end of a patient encounter, the system prompts the physician to compose a message, thus reminding the physician of the shared care aspects.

Formation of intervention and control groups

In order to try to assess the value of EDI for inter-physician communication, we divided the 32 GPs in two groups, using the following strategy: (1) at the participating consultant's outpatient clinic we counted, for every GP, the number of referred diabetes patients; (2) for a GP to gain sufficient proficiency in using the new module, regular use of the module was required, in order to avoid too long a learning period. We therefore

we selected the 20 GPs with the highest number of referred patients and called them the *intervention group;* (3) the remaining 12 GPs were called the *control group.* In January 1994 the intervention GPs were equipped with the newly developed inter-physician communication module [17], the control GPs continued to work as usual.

Data collection, measurements, and statistical methods

The assessment of the use of EDI for the support of shared care for diabetes patients was performed in two parts.

Firstly, on each information system of the 32 GPs, we ran a query procedure which analyzed the total number of patients enrolled in each practice, the average age of the patients, and the male-female ratio. The query also analyzed the number of contacts between physicians and patients, and the contents of the computer-based patient record of each diabetes patient. For each patient, we especially looked for laboratory parameters or comments considered to be important for diabetes care [18]. We counted the number of letters (either paper or electronic) sent and received by the general practitioner. We collected these parameters for two periods: the one-year period (1993) before the intervention study (i.e., the introduction and the start of EDI between

GPs and the consultant), and the one-year period (1994) of the intervention study. Outcome variables were the number of letters sent and received by the general practitioners, and the number of diabetes-related parameters (e.g., results of labora-

Table 1 - Frequency of patient-physician contacts and document exchange betweenGP and consultant

	Control GPs (GPs:12; Patients:60)		Intervention GPs (GPs:20; Patients:215)		
	1993	1994	1993	1994	P-value***
Patient contacts with					
the GP	12	14	12	14	NS
the consultant*	4	4	4	4	NS
Letters from					
the GP to consultant**	10 (0.2)	14 (0.2)	34 (0.2)	151 (0.7)	NS
the consultant to GP**	30 (0.5)	24 (0.4)	104 (0.5)	339 (1.6)	0.00

* Average number per patient per year.

** Absolute numbers are shown with average numbers per patient per year in parenthesis

*** P-values are based on F-tests in the analysis of covariance; significance for $p<0.05$.

tory tests, for complete list see Table 3) in the patient records. Patients were nested within general practices, and general practitioners were nested within study groups (intervention or control). In order to compare intervention and control groups we performed an analysis of covariance. We used the values of the parameters in 1993 as covariate, thus assessing to what extent differences in outcome parameters were explained by baseline differences or by study group (intervention or control).

Secondly, we collected mean HBA1C levels for each patient in the intervention and in control practices during the first 6 months of the intervention study (January-June 1994), and compared these values with the mean HBA1C values collected during the second 6 months of the intervention study (July-December 1994). We performed a paired t-test to compare group means of the two periods. We used a t-test to compare intervention and control groups.

For the analyses mentioned above, we defined significance for p-values of less than 0.05.

Results

Study population

A total of 275 patients were included in our study; 215 patients were treated by the 20 general practitioners in the intervention group, and by the internal medicine consultant who was involved in the communication project; 60 patients were treated by the 12 general practitioners in the control group, and by the same internal medicine consultant involved in the communication project. Practices in the intervention group were larger (2797 vs 2217 patients), and the average patient age was higher (39.2 vs 35.2 years). The intervention group contained less type I patients (62; 29%) than the control group (24; 34%).

Patient management characteristics

The number of contacts between the patients and the general practitioners, both in the control group and the intervention group, increased from an average of 12 per patient per year in 1993 to an average of 14 in 1994 (Table 1). The number of contacts between the patients and the consultant remained constant at an average of 4 per year for both groups.

Frequency of communication

Table 1 shows the number of letters from GP to consultant and vice versa. There was a significant increase in the number of letters sent by the consultant to the intervention GPs when compared to the control group ($p < 0.01$). The number of letters from intervention GPs to consultant increased as well, but this increase was not significant.

Contents of patient records

Table 2 shows for 10 parameters the mean number of notes registered per patient during the one-year period preceding the intervention study (1993) and the one-year period after the start of the intervention study (1994). Using EDI, the patient records of the intervention group contained significantly more data on 6 of these 10 items (HbA1C levels, fructosamine levels, blood pressure, cholesterol levels, triglyceride levels, and weight) than did patient records of the control group. No significant differences were found for recordings of creatinine levels, proteinuria, outcomes of ophthalmological assessments, and glucose levels.

Care parameters

As part of the usual checkup routine by the hospital consultant, HBA1C levels were measured during both the first semester and the second semester for 123 patients (57%) in the intervention group, and 32 (53%) patients in the control group. Table 3 shows the group means for both periods. Intervention patients showed a slight but significant decrease of HBA1C levels in the second semester of 1994 (from 7.0 to 6.8, $p=0.03$), control patients also showed a slightly decreased group mean, but this change was not significant (from 6.6 to 6.5, $p=0.52$). The magnitudes of these mean differences, however, were not significantly different (intervention group: 0.21; control group: 0.12, $p=0.68$).

Discussion

Diabetes mellitus is a chronic disorder that requires lifelong medical attention. The complexity of the disease leads to the involvement of many health-care professionals from various disciplines. In our study of the use of EDI for shared diabetes care we looked at three aspects: The frequency of communica-

Table 2 - Medical record contents: recorded items per patient

	Control*				Intervention*				
	1993		1994		1993		1994		P-value**
Kidney function									
Creatinine level	9	(0.2)	21	(0.4)	34	(0.2)	106	(0.5)	NS
Proteinuria	11	(0.2)	29	(0.5)	17	(0.1)	20	(0.1)	NS
Eye condition									
Assessment ophtalmologist	19	(0.3)	18	(0.3)	51	(0.2)	64	(0.3)	NS
Insulin control									
Glucose level	93	(1.6)	105	(1.8)	211	(1.0)	400	(1.9)	NS
HBA1C level	0	(0.0)	9	(0.2)	1	(0.0)	177	(0.8)	0.003
Fructosamine level	1	(0.0)	0	(0.0)	22	(0.1)	47	(0.2)	0.01
Other									
Blood pressure	78	(1.3)	81	(1.4)	128	(0.6)	417	(1.9)	0.000
Cholesterol level	6	(0.1)	25	(0.4)	22	(0.1)	149	(0.7)	0.03
Triglyceride level	1	(0.0)	7	(0.1)	6	(0.0)	52	(0.2)	0.02
Weight	12	(0.2)	27	(0.5)	71	(0.3)	448	(2.1)	0.000

* Absolute numbers are shown with average numbers per patients per year in parentheses.
All statistics are analysis of covariance.

** Significance for $p<0.05$

tion between GP and consultant, the availability of data to the GP, and the clinical condition of the patient as indicated by HBA1C levels. We compared an intervention group for whom an EDI-link between general practitioner and consultant was established with a control group that communicated in the traditional paper-based manner. Comparing these two groups we found that the use of inter-physician communication resulted in significant changes in patient information management

Table 3 - Mean HBA1C levels

	1994 1st half	1994 2nd half	Mean difference (± 95% CI)*	P-value**
Control (n=32)	6.6	6.5	-0.12±0.36	0.52
Intervention (n=123)	7.0	6.8	-0.21±0.19	0.03

* Magnitude of this mean difference between control and intervention group was not significant
(t-test, p=0.68)

** Paired t-test

Firstly, previous research has pointed out that, when care is provided by more than one physician, discontinuous care may be the result [10]. Our study underlines that the frequency of communication about diabetic patients between primary and secondary care is low. The use of EDI has led to a significantly higher frequency of communication from consultant to general practitioner (from a mean number of messages per patient of 0.5 in 1993 to 1.6 in 1994, $p < 0.01$). Communication from general practitioner to consultant also increased (by a factor of 3.5) but, comparing the control and intervention group, this increase was not significant.

Secondly, our study showed that a higher availability of data to the GP about the care diabetes patients received in the outpatient clinic could be achieved by using EDI: a significant increase was found in the number of entries in the computer-based patient records of the intervention GPs for HBA1C, fructosamine, blood pressure, cholesterol, triglyceride, and weight. During the project, no significant changes were found for items concerning kidney functions (creatinine level and proteinuria), data on ophthalmological examinations, and glucose.

Thirdly, evidence exists that good glycemic control reduces the risk of diabetic complications, such as blindness, lower extremities amputations, and renal failure [19]. In our study, patients in the intervention group showed a significantly decreased mean HBA1C level (from 7.0 in the first half of 1994 to 6.8 in the second half, $p = 0.03$). Because also in the control group a (not significant) decrease in mean HBA1C level was observed, and because the magnitude of the decrease in the intervention group was not significantly different from the changes in the control group, further research during a longer follow-up period is needed to confirm the effect of EDI on the outcomes of patient care.

The results indicate that EDI may prove to be a valuable method for improving communication between physicians. Assessing the contribution of this improved communication on the quality of diabetes care is difficult, especially since long-term effects of EDI on patient management could not be observed during our study. Furthermore, only limited numbers of physicians and patients were involved in the project. Finally, we could not establish randomized control and intervention groups: Because of the limited number of diabetic patients referred to the participating consultant, we selected the GPs with the largest practices, and the highest number of referred patients. This selection may have created a bias. On the other hand, if we consider the recognized importance of well-kept medical records of diabetes patients [7-10], it can be argued that the structured way of communication, implemented in our project, strengthens the coordination of care.

Diabetes is one example only of a chronic disorder, requiring a lifelong, close cooperation between patient, general practitioner, and specialist. Although many issues connected to the use of EDI still have to be resolved, the results of this study indicate that EDI may prove to be a powerful tool in managing patient information and improving the quality of care.

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