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DADIVOX
Integration of Medical Audit and an Electronic Patient Record for use in Diabetes Mellitus Out-patient Clinics in Denmark

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Abstract Diabetes is a chronic disease with characteristic long-term complications compromising important functions of the body, such as vision, kidney-function, nerves, and blood-vessels. Strict metabolic control, a high degree of self-care and tertiary prophylactic treatment of complications can prevent deterioration of body functions or cushion the impact on life-quality of the diabetic patient. Diabetes treatment is a complex, multidisciplinary task.

To assure quality of the care provided in government hospital's out-patient clinics the Danish Endocrine Society intends to set up a central database (DADIVOX) for medical audit in Hillerød, Denmark. The clinics, which participate, report 47 essential and 28 optional parameters on each diabetic patient to the register annually.

To assure data-quality a special DADIVOX data-entry software was constructed. Clinics can enter the DADIVOX-programme on three levels depending on their technical abilities. The data-entry software of level two and three are fully functional electronic patient records, thus facilitating the consultation process and assuring high quality of data and care, since standard operational procedures are build-in.

The DADIVOX approach can be used for other chronic diseases controlled in outpatient clinics hence assuring medical audit on two levels and higher functionality of electronic patient records.

Introduction

Diabetes mellitus (DM) is a chronic disease, that once contracted - with our present knowledge - is incurable. The disease is the most common endocrine disorder. DM is characterized by metabolic abnormalities and by long-term complications involving the eyes, kidneys, nerves, and blood vessels. Long-term complications are more frequent in a population with poor metabolic control than among patients with a near-normalization of blood-sugar concentrations [1,2].

In Denmark, the tertiary prophylaxis of long term complications is based on regular consultations for the diabetic patient at general practitioners or in specialized out-patient clinics connected to the departments of internal medicine at government hospitals. Usually patients, who require insulin-treatment or have long-term complications are seen at the out-patient clinics. Teams of specialized doctors, nurses, dietitians and chiropodists are usually involved. Quality of patient care is pursued through optimization of treatment, incentives to self-care and self-monitoring of blood-glucose, and monitoring of eye, kidney, blood-vessel and nerve-function by means of clinical and para-clinical tests. The joint efforts in treatment, self-care, monitoring and treatment of long-term complications in a chronic disease as diabetes is termed "disease stage management" (DSM).

The Danish Endocrine Society has two aims in the DADIVOX[1]-project. First, to use the formalized data in generated patient records for local and nationwide medical audit of the DSM, and second to construct a specialized electronic patient record, focused on diabetes with the ability handling the complex clinical picture of diabetes in all stages.

Method

The Danish Endocrine Society formed a group with representatives from diabetes clinics throughout the country (see last page of this paper). Based on scientific information [1, 2] and international consensus activities for diabetes care and research in Europe [3,4,5] combined with knowledge of Danish traditions and organizational structures [6], the group compiled a "parameter list" with 75 parameters of which 47 were considered as "essential". It was considered compulsory to report "essential" parameters on each patient to the central database, while the last 28 parameters were considered optional.

The group also made suggestions of standard operational procedures (SOP) for diabetes control and gave recommendations for monitoring procedures of long-term complications.

Furthermore the group considered the legal aspects and handled the necessary applications for approval of the local and central databases. The Danish National Board of Health and the Ministry of Health have each stimulated the establishment of disease-specific databases, where aggregated data can be used for medical audit [7]. The initiative for establishment of a database arises from the medical community, but if it is approved, the county where the database is situated will provide the funding. The central DADIVOX database will be situated in Hillerød in Frederiksborg County, north of Copenhagen.

The user-interface was done using object-oriented means of transforming parameters into variables. The software used was 32-Bit VisualBasic (version 4.0) from Microsoft Corporation. The database software used was Microsoft SQL-Server (version 6.0) running on the Microsoft Windows NT-operating system (version 3.51) on stand-alone PC's or in networking environments.

Results

Around fifty out-patient clinics with a range of 10 - 5000 diabetes patients have shown interest in participating in DADIVOX. Data collection is estimated to start January 1th, 1997. Since the clinics vary in size and degree of technical sophisticality a three level entry programme was devised. Level one uses printed forms that are filled in by hand and are entered into the computer either by manual means or by optical recognition. Level two uses stand-alone PC's in the consultation room, and all data are entered manually into the

[1] DADIVOX is an acronym for "*Da*tabase for *di*abetes hos *voks*ne" (Database for diabetes in adults)

DADIVOX user-interface in connection with the consultation. Data from self-monitoring and self-care (questionaries) can be entered into the computer by optical recognition. The most advanced level three features networking PC's with full access to the rest of the Hospital Information System, including a high speed connection to the most preferred laboratory information system in Denmark (LABKA).

Figure 1 shows the outline of the main composite window in the user interface from level two and three. Most consultations can be done without leaving this window. Information is redundant on the user-interface, since data will display in all situations of relevance. The window is composed using an assumed standard consultation work-flow and the SOP from the DADIVOX working-group. Each major long-term complication group (nerve, vessels, eyes, kidney) was represented by a hierarchic severity of that particular complication in 2-5 stages, e.g. kidney damage from no detectable damage, over incipient nephropathy, overt nephropathy, severe nephropathy to lost kidney function. Criteria for each stage is described in detail by the DADIVOX-group. To each stage of each complication a default set of clinical and para-clinical procedures and tests are attached. This enables the program to suggest tests, procedures and the time-frame of which they should be carried out. "Hyper links" between tests, text and diagnostic images (e.g. retinal photos), which also can be entered into the program, can be used to foundate the graduation of long-term complications. These "Hyper links" provide the basis for a structured summary of the patient history and display of a "time-line" too.

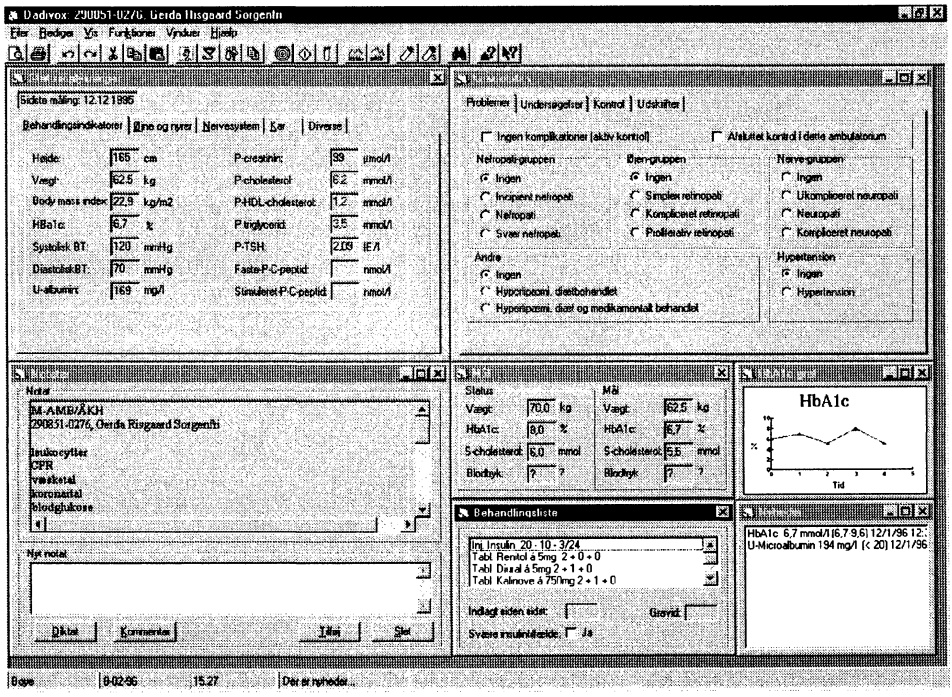

Figure 1: The main composite window

Discussion

The potential of the electronic patient record to supply assessment of amount and quality of health care is an encouragement for both decision makers and staff in the hospitals.

However, the capture of data, derived from the interaction between the care-provider and the patient in the consultation room, should be as easy, complete and "invisible" as possible to ensure the highest data-quality.

The graphical user interface (GUI) should follow standard rules, e.g. as described in [8]. We recommend that the DADIVOX data-entry programme runs on high resolution 17" monitors with a fast graphic card in the PC to facilitate the overview of the composite window, which on the other hand holds nearly all relevant information for the care provider.

The completeness of the data-set is obtained by the build-in standard operational procedures (SOP), which also have the purpose of ensuring quality of care including the monitoring and treatment of long-term complications of diabetes locally and nationwide in Denmark. The nationwide aspect is underlined by the planned DADIVOX central database in Hillerød - that on the basis of transferred, aggregated data from the local databases can make a qualified, professional medical audit. The Danish Endocrine Society plans to set up travelling teams, that will visit all clinics for discussion of technical and medical-professional semantic questions.

The data-entry programme should support the consultation process [9, 10] to ensure acceptance and "invisibility" of the computer in the consultation room and a smooth consultation process. This calls for the medical professionals to play a leading role in the development of the electronic patient record software.

The DADIVOX parameter list and SOP are available for other software developers for integration in present and future electronic patient records and the DADIVOX database will accept data in a range of standard formats.

The "DADIVOX-approach" to out-patient electronic medical records can be employed by other medical societies. The medical society can issue a parameter list and SOP, set up the central database and manage the audit and professional semantic questions. Software developers can use this as a "customerization" of the user-window toward the database in an electronic medical records software. This will ensure higher functionality of the software, procedures for quality assurance of health care and a higher data quality, thus enabling Management Information Systems on all levels in the Danish health care sector to function.

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