Computer Assisted Generation of Patient Discharge Letters Using the CARdiology Information System Greatly Accelerates Clinical Reporting

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Abstract

After each discharge of a patient from our department a patient discharge letter needs to be generated to inform the patient's general practitioner. Previously this was done after discharge by a resident using voice recorder dictation, after which the text was manually transcribed, corrected and sent to the addressees. The Cardiology Information System (CARIS), developed in our department, contains all information pertaining to cathlab studies, pacemaker information, functional test results and images. We developed a dedicated module for CARIS that allows the semi-automatic generation of 70% of the discharge letter upon admission of the patient. At discharge the letter is completed and an electronic message is sent to a supervisor, who must authorize the document. Upon authorization, the letter is automatically sent to a typist who prints out the letter for mailing purposes. This procedure decreased the time needed to generate the discharge letter from 12 weeks to 2 days.

1.   Introduction

After the discharge of a patient from our Cardiology department a discharge letter needs to be generated to report the findings obtained during the hospital stay to the patient's general practitioner and other healthcare providers involved in the treatment of this patient. The discharge letter also serves as a resume of the entire medical history of a patient, containing information on previous and present disease, allergies, medication and other medical data, making it an important document for all medical professionals involved in this particular patient.

The effort involved in the generation and handling of these discharge letters is considerable, and constitutes a major part of the working day of many healthcare professionals, as well of that of administrative personnel.

In our hospital the patient discharge letters typically were dictated into voice recorders after the patient had been discharged. The information needed to generate the discharge letters is taken from the written patient charts that were made during the admission of the patient. Then dedicated medical typists transcribe the tapes containing the texts. The typists are situated in a central location in the hospital, making in-hospital transport of the tapes necessary. The drafts of these letters are then returned to our department where the original author checks the document for inaccuracies and typing mistakes. In case a resident is the author of the discharge letter the draft document also has to be authorized by a supervisor. The supervisor adds notes to the draft of the discharge letter. The document with the written changes and remarks is then physically sent back to the typist who processes the required changes and prints out the final version of the discharge letter. After placing of signatures the letter than can be sent to the general practitioner and other health care providers. With this methodology, the procedure to produce and send a discharge letter takes on average approximately 12 weeks. The time needed to generate the discharge letter itself is approximately 3 hours per letter, including dictation, transcribing, correction, printing and mailing. As our department is a high-throughput department with many admissions lasting only one or two days, this administrative process places a significant burden on the resources of our department. We therefore decided to develop a new tool that should greatly reduce the time and effort needed to produce a patient discharge letter.

2.   Methods

The Cardiology Information System (CARIS, developed at our department) is a central Oracle database server, and a client application developed in Borland Delphi, that contains data on procedures that have been performed at the heart catheterization laboratory, pacemaker implantations, results from exercise tests, Holter monitoring and echocardiography [1]. Angiographic images obtained in the cathlab are stored in DICOM format on an image server (CURAD). Echocardiographic images are stored on a separate image server (GE EchoPAC) with presently 4 TB storage space. The images can be selected and viewed from within CARIS. Information obtained in the cardiac function lab, which is stored in systems separate from the CARIS system, can be assessed using dedicated interfaces that

were developed specifically for this purpose. This includes ECG's (rest ECG's, stress ECG's and Holter ECG's), and reports from echo studies and stress ECG studies. Figure 1 gives an overview of some of the systems that are connected to CARIS.
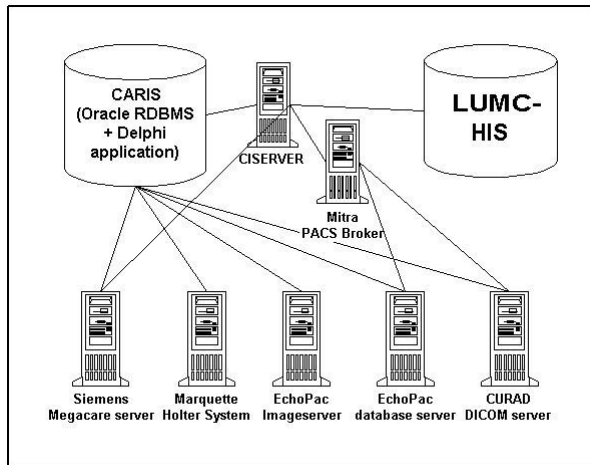

Figure 1. Schematic overview of all systems that are connected to CARIS and that contain clinical data.

Data obtained from the functional studies are stored in various separate systems, but the data can be retrieved and viewed in CARIS [2]. The rest-ECG's and reports are stored in a Siemens Megacare ECG-management system. Holter ECG's are analysed using a Marquette Muse system; the Holter-ECG's can be exported as (Adobe Acrobat) PDF files. Reports from echocardiography and stress-ECG studies are routinely stored in a FileMakerPro database.

2.1 Visit module - design

We decided to add a module to CARIS that should aid the physician in making the patient discharge letter. The requirements were: i) an easy to use interface that would allow new residents as well as older staff members to use the module intuitively, ii) an interface that allows the generation of a letter as quickly as possible, as physicians need to perform their duties as efficiently as possible, iii) optimal integration with the remaining modules of CARIS, preventing the unnecessary duplicate entry of data.

First, the layout of the letters that had been used so far was analyzed and discussed within our medical staff to identify all the components that were considered mandatory for the comprehensive medical document the the discharge letter is meant to be. This analysis of the

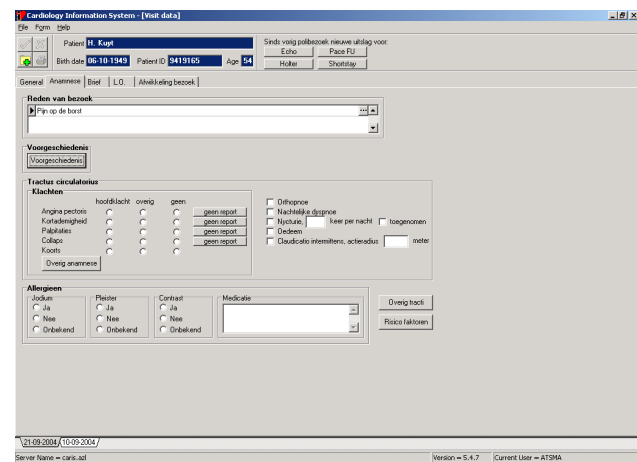discharge letter led to the design of the CARIS generated letters.

Figure 2. Screenshot of the initial part of the Visit module where the user can enter the reason for admission, previous medical history, present chief complaint, allergies and risk factors. After clicking on the various buttons, specific popup windows appear that allow a more detailed description of the chief complaint (see also figure 3)

Then, the various questions needed to take down the medical history were analyzed and the potential answers to them were formulated. We divided the questions into different categories, such as 'chest pain', 'palpitations', 'dyspnea', ' collaps' etcetera. Within each category again all questions that are needed to fully describe a particular medical situation were identified, and the potential answers formulated. Then screen layouts were designed containing these questions in a natural way that would allow the documentation of a conversation with a patient at the same time this conversation is taking place.

The various aspects of the complaint can be recorded by clicking the appropriate radio buttons (see figure 3). For instance with chest pain these items are: time of onset of the pain, the character of the pain, the location of the pain and the presence of irradiation, any accompanying manifestations and the duration and frequency of the pain. It was decided to use large windows with many radio buttons rather than smaller windows with a few drop-down menus, as the latter always require two mouse clicks for each entry, in contrast to radio buttons. This faster input method was thought to enhance the user experience, although the many radio buttons on each screen required a somewhat longer familiarization period for each new user. It was found that indeed the users preferred the radio buttons to the drop-down menus.
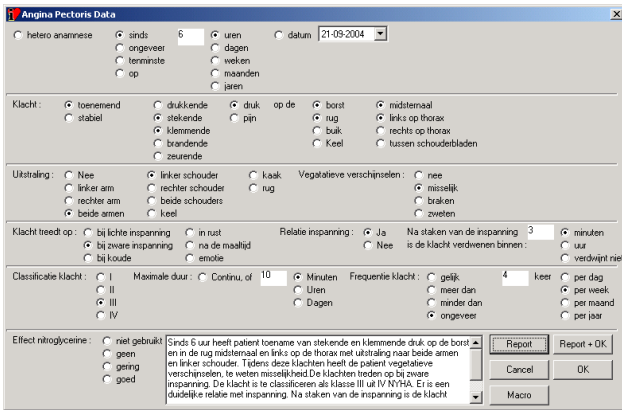
in the discharge letter, making the module flexible enough to be also used in the outpatient clinic where the pressure of time is perhaps even greater than at the ward. Also, it is possible to add or edit the text generated by this part of the module in case the preformulated questions or items are not sufficient to describe the physical examination of the patient.

The various components of the patient discharge letter are combined in the result screen (figure 5). Here, the various items that constitute the letter can be reached using the buttons in both margins of the screen for editing. Results from functional testing such as echocardiography are already available in other modules of CARIS, and can easily be imported in the Visit letter.

When the letter is complete, the supervisor can correct the letter on-screen, and authorize the document by pressing on the button below the text window.

Figure 3: Popup screen that is displayed in case the chief complaint is chest pain. The various variables on the different aspects of the complaint can be recorded in a natural fashion while the patient explains his complaint. The generated text is shown in the window at the bottom of the screen. This text can be edited at will to allow the description of complaints in a fashion not possible with the preformulated questions.

Previous medical history must either be entered manually, or can be copied from the hospital information system (HIS) in case a previous letter is available. Once entered, the previous medical history is used on any subsequent letter. Similarly, allergies, risk factors, and medications are available for subsequent reporting once entered.

Figure 5: Result screen showing the generated letter (center) and buttons leading to the editing windows for the constituting components. Authorization is also performed in this screen.

Upon authorization the letter is entered on a list in CARIS with letters to be printed and mailed by the administrative staff. Built-in checks allow the tracking of the document, to ensure it is being sent to all the health care providers of this patient.

3. Results

The residents and staff were able to get acquainted with the module quickly. On average only a single day was needed to learn a new user to use the module and to explain the method of working that was associated with it. On admission the discharge letter is generated up to 70% of its final contents in approximately 30 minutes. This draft letter is then printed out, and kept in the patient chart. Additional notes during the hospital admission are then added in handwriting by the residents. New
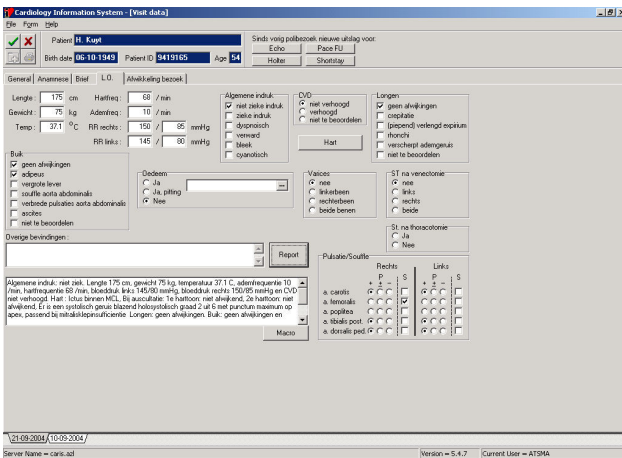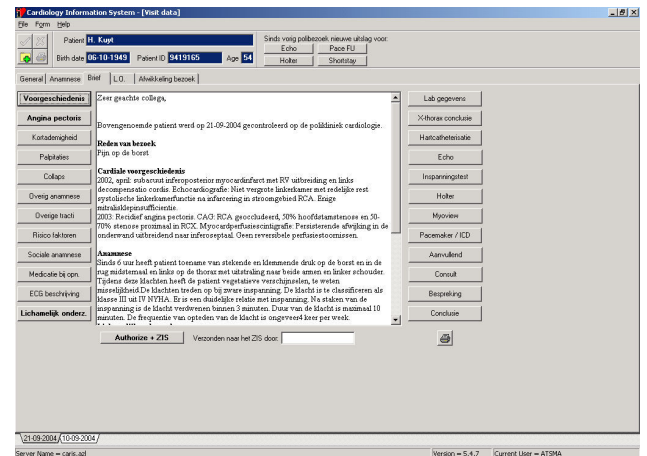
Figure 4: Description of the physical examination using numerical data and check boxes, leading to the generation of the report in the text window. If needed, this text can be edited in place.

The physical examination item of the module allows the fast documentation of the various aspects of this part of the discharge letter (figure 4). As in any part of the Visit module, an item that is not filled in will not show up

information e.g. from functional tests or therapeutic procedures are added to the CARIS module as they become available. Upon discharge of the patient, the remaining approximately 20% of the letter is completed. Then, the supervisor corrects the letter if needed, and presses the 'Authorize' button. The same day or the next day the letter is printed out and mailed to the patient's general practitioner and other healthcare providers involved in the treatment of this patient. The time needed to generate and process the discharge letter has dropped from 3 hours to 1 hour. The delay between the discharge of the patient and the reporting to the general practitioner has decreased from 12 weeks to 1-2 days. The number of administrative personnel needed to process the letters has decreased from 6 to 1, as they no longer need to transcribe the dictations. As CARIS is also available via the departments WiFI network, the module can be used by the residents using tablet-PC's [3]. However, this makes working with the module a bit slower than with a normal PC. The Visit module is also already in use in our out-patient clinic, with similar improvements as those seen in the wards.

4.   Discussion and conclusions

The availability in the Visit module of CARIS has allowed our department to report faster to the general practitioner. Also, since the letter is completed directly after discharge, the information is more complete as compared to the letters generated a several weeks after discharge. These aspects greatly improve the quality of our care. Also, as residents have a lower administrative burden they can be even more involved in the patient related activities. In addition, the Visit module allowed us to rationalize the use of administrative personnel, which is welcome in a time of ever decreasing resources available for health care. We plan to send the letters via secure e-mail to the general practitioners, but the infrastructure for this is not yet in place.

Computer assisted generation of patient discharge letters is feasible, and leads to significant decreases in time needed to generate the letter as well as in time from discharge to reporting to the general practitioner. In addition, the method allows the rationalization and streamlining of the entire administrative process.

References

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