Shared visualization of patient information

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Abstract
Based on field studies of work at the surgical department of a university hospital, we propose ideas for enhancing the visualization of, and collaboration on, patient information. As several specialized physicians are connected to a case for a time period of several weeks or months, we have identified the need for physicians to quickly visualize only the relevant information on a case, as well as to add and highlight the information based on their specialization. During distributed multi-disciplinary team meetings we see the advantages of introducing a shared workspace displaying relevant patient information and the use of interactive tools to support for instance visualization, annotation and search.

Keywords
Electronic patient record, collaboration, multi-disciplinary team meeting

ACM Classification Keywords
J.3 Medical information systems.

General Terms
Design
**Introduction**
Highly specialized medical care in Sweden has been centralized to the regional university hospitals, a rationale introduced to increase medical care, efficiency in treatment and to improve the possibilities for research and education. Patients suffering from severe diseases, and in need of specialized examinations and treatment, are referred from the local to the university hospital. As much as possible, patients are treated at the local hospital and during the specialized care at the university hospital the local physician is still involved in the case. Physicians at the university hospital treat patients during a shorter period of time, when conducting examinations, diagnosis and treatment. Therefore, one physician does not have sole responsibility for a patient, rather, all physicians more or less need to be able to discuss any patient. An important activity in specialized care is the multi-disciplinary team meetings (MDTM), where physicians discuss cases and decide on diagnosis and treatment. It has been reported that MDTMs for instance improve clinical decision-making and communication between specialties [7].

A main challenge is to present patient information in a way which facilitates for physicians to quickly get an overview of a case. Previous research projects include for instance Lifelines2 [8], Persival [6] and CAREVIEW [5], which explore the presentation of patient information using a bird’s-eye view and ways of interacting with patient information.

Another challenge is to introduce collaborative tools in MDTMs to facilitate case discussions, and sharing and annotation of information. Kane & Luz have conducted studies of MDTMs, stating for instance that new knowledge is generated during MDTMs, and that current patient records do not meet users’ needs on interacting with and keeping patient information. They suggest tools for annotation and pointing, and large shared interactive displays, both for personal and collaborative interaction [2, 3]. Lu & Lajoie have investigated interactive, shared displays and found that they enhanced group decision-making, visualization of patient information and communicative interactions [4].

**The setting**
The specialized medical care of patients suffering from severe diseases of the liver, pancreas, and esophagus has been centralized to the department of upper abdominal surgery, called Gastro, at a university hospital in Sweden. Approximately 25 surgeons work at Gastro and it has, due to the complexity of the diseases, a close collaboration with other departments. Patients referred to Gastro follow a process, a clinical pathway, consisting of four main steps:

- **Coordination** Upon referral, patient information is reviewed and, if necessary, complemented with new examinations. This step is to assure that available information is sufficient for the MDTM in the next step.
- **MDTM: Consensus meeting and Pre-operative planning** At the consensus meeting all relevant patient information is discussed and consensus is reached on a diagnosis and treatment. If surgery is decided, the case is reviewed at a surgical planning meeting.
- **Surgery** Before, during and after surgery, surgeons access patient information in order to plan the surgery and write post-surgical notes.
- **Post-operative meeting** A few months after surgery, patient outcome is discussed during a MDTM, in order to present feedback on the treatment.
Patient information is continuously accessed and complemented during the clinical pathway, usually by different physicians and at different occasions. In the end they have produced a full description of the case, including relevant examinations, diagnosis, treatment and outcome in the end.

**Multi-disciplinary team meetings at Gastro**

We have in more detail studied MDTMs at Gastro, specifically on information structure and time-related aspects [1]. A consensus meeting usually lasts 60-90 minutes, handles ten cases and is attended by five to twenty physicians (differences are due to level of complexity of the diseases). As all physicians are not located in the same hospital building, or even the same town, video-conferencing and screen sharing is used.

**figure 1. Consensus meeting** Two projectors show radiology images, controlled by the radiologists in the foreground. The screen on the top left shows participants from other hospitals.

The different roles of the participants, the work-flow of the meeting and the way information is presented, make it possible to follow a clear structure [1]. The chair (a senior surgeon) makes sure they follow the meeting structure and reach a decision. Each case discussion begins with the presenter (a younger surgeon or the referring physician) giving a short introduction of relevant patient information. The radiologist then presents a radiological diagnosis by showing images and pointing out specific areas. After the two presentations, prepared in advance, the chair leads the discussion. Questions can be directed to a specialist, or any participant can state his/her opinion directly. At the end of each discussion, a decision on diagnosis and treatment must be made, and the presenter later dictates the decision on the patient record.

The meetings use advanced technology, such as radiology software and screen sharing, but when it comes to presenting and searching for patient information, physicians rely on their own memory of the cases. The presenter and the referring physician are best updated on the patient, but they are not always able to answer specific questions, which make MDTMs vulnerable as to whom is present and what they remember.

**A clinical information workspace**

Our research project has a close collaboration with physicians at Gastro and we have conducted initial studies during the last three years. Field studies of their work and MDTMs have led us to propose ideas on collaborative tools to be used through the clinical pathway.

On an overall level we suggest a shared workspace to be used by all physicians connected to the work at Gastro, i.e. both physicians at the university hospital and at the local hospitals. The workspace would present information from any source of patient information, but only specific information relevant for a case is kept in
the workspace, such as specific radiology images, a description of the patient’s general condition or a plan on how to perform the surgery. In the beginning of the clinical pathway there might not be much displayed in the workspace, but as physicians start highlighting information, adding images etc., the description of the case evolves. Along the clinical pathway, physicians get an overview of what has been decided and what is important for the case, and can add new information which is relevant at that time. In the end, a complete description of relevant information for the case, from referral to sign-off and outcome, is presented. A time-line-based visualization ([8]) would be a natural basis for presenting both all the current patients at Gastro, as well as information regarding one patient.

The ideas have been refined in workshops and discussions with physicians and the department director. They identified opportunities to tackle challenges in their current processes, such as information hand-over between physicians, feedback loops during the clinical pathway and access to relevant information. The ideas will be realized together with the physicians, focusing on implementing the shared workspace and collaborative tools in MDTMs. As the MDTM is an activity where a lot of information is presented, asked for and created, easy-to-use visualization and collaboration tools would really be beneficial.

Some of the ideas are based on software design, such as time-line visualization of patients, case-based presentation of cases, annotation tools etc. Other ideas will be more hard-ware-based, for instance interactive screens and pointing devices. In all, the tools will enhance collaboration between all physicians during both synchronous and asynchronous communication, as well as co-located and distributed communication.

References