Electronic Communication as a Tool to Reduce Elective Surgery Cancellations
A Case Study from Norway

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***Abstract*—Surgery cancellations are undesirable in hospital settings as they increase costs, reduce productivity and efficiency, increase waiting lists, and directly affect patients. The elective surgery cancellation problem in a northern Norwegian university hospital is addressed. Based on observations and interviews conducted at the hospital, lack of information during pre-operative planning was identified as the main cause for elective surgery cancellations. The problems with the existing pre-operative process were identified, and a new process is proposed. By studying the pre-operative planning at the hospital, we have determined that part of the information flow can be moved to the patient at home through electronic communication. From the work presented herein, we conclude that the assessment information required during the pre-operative planning can be compiled in a personal health assessment questionnaire, and requested from the patient, at an earlier stage.**

Keywords-elective surgery cancellations; pre-operative planning; electronic communication; clinical process; context-awareness

I. INTRODUCTION

Surgical departments are simultaneously the major source of investment, and the greatest source of revenue for most hospitals [1][2][3] . However, it is known that between 10 and 40 % of elective surgeries are cancelled [2][4][5][6]. In western countries, up to 20 % of elective surgeries are cancelled on the day of surgery [7][8][9]. Furthermore, it has been reported that 50 % of these cancellations might be avoided [2][10][11].

Surgery cancellations are undesirable in hospital settings as they increase costs, reduce productivity and efficiency, increase waiting lists, and directly affect the patient [4][9][12]. Considerable resources are invested in maintaining operating theatres, and having surgeons and theatre staff available on an agreed schedule [2][13]. In spite of this, the cancellation rate of elective surgeries is high, especially in the public sector [10][14]. Cancellations can significantly inconvenience patients and their families [15][16]. It is also reported that patients may suffer psychological stress, and/or financial hardships [10]. Accordingly, cancellations are stressful and costly, with a high level of emotional involvement before surgery [2].

The causes for elective surgery cancellation are diverse and may be divided in two major categories: (a) hospital, and (b) patient related reasons, when considering who took the underlying decision to cancel. Hospital related reasons are the most frequent and encompass causes such as the unavailability of the surgical team [4][8][9], incomplete pre-operative study/preparation [8][17], lack of surgical/anaesthetic readiness [8][9], and lack of theatre time due to extended duration of scheduled surgeries [8]. On the other hand, patient related causes are mostly due to patient no-shows and refusal to undergo surgery [8][9][17]. It is argued that the majority of cancellations are due to information that existed prior to the day of surgery, but was not available when required [10][14][18][19][20][21].

In line with what is reported in literature, our site of research, the University Hospital of North Norway (UNN), has identified inadequate planning due to lack of information as a main cause for cancellations (Figure 1). The hospital has reported that more than 50 % of all cancellations at UNN are

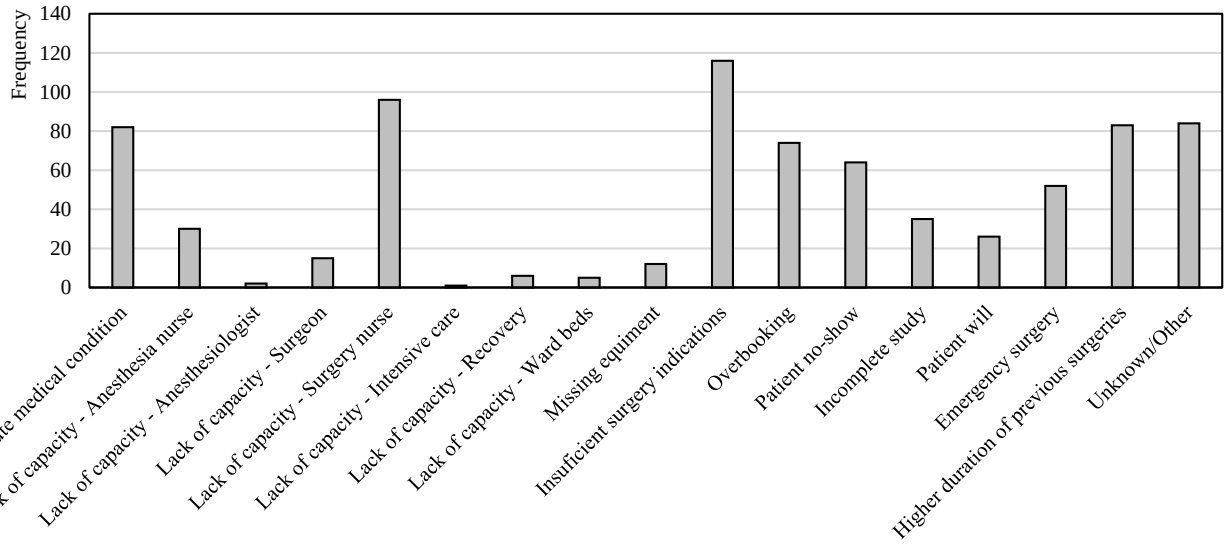

Figure 1. Causes for day of surgery cancellations distribution at UNN from January to June 2011.

related to inadequate pre-operative planning [18]. It is anticipated that the pre-operative planning process may be improved if adequate patient information is gathered at an earlier stage, before the patient is admitted at the hospital. The cancellation problem at UNN is addressed by the eTeam-Surgery project group. This group consists of an interdisciplinary research team, who is studying if and how electronic communication can involve the patient in the pre-operative planning process to provide the missing information.

In this paper, the elective surgery cancellation problem caused by inadequate pre-operative planning, in a university hospital in Norway, is addressed. We started by studying and evaluating the pre-operative planning process at UNN. The aim was to explore a system for gathering information from patients on their condition through a personal health assessment questionnaire. It is suggested an architecture for a two-way electronic communication tool to support the pre-operative planning process.

The paper is divided in six sections. In the first section the problem object of the study is described and classified according to its causes. In the second section a brief review of the state of the art is presented. Data collection methodologies, with which the results were obtained, are presented and explained in the third section. The results are disclosed in section four. In the fifth section, the results are interpreted and discussed in relation to the context-awareness methodology. In the last section conclusions about the results are drawn, and some indicators of future work in the area foreseen.

II. BACKGROUND

In literature, pre-operative planning is reported to be approached in several different ways. A brief state-of-the-art on how information is gathered from the patient prior to surgery is presented below.

A widely studied approach to the elective surgery cancellation problem is the establishment of pre-operative assessment clinics (POACs). The aim of a POAC is to prepare patients for the administration of anaesthesia and for surgery. The implementation of POACs may take different configurations relating to the health worker leading the appointment. Doctor-led POACs were implemented by [17][22][23][24] in an attempt to solve elective surgery cancellations due to lacking information. In this settings, patients are referred to the POAC either from the ward or the outpatient clinic. It was concluded that the number of cancellations was reduced but considered not significant [17]. In nurse-led POACs [25][26][27] the role of the physicians is transferred to the nurse. Thus, in such environments, the pre-operative assessment is undertaken by nurses, with overall supervision of a consultant anaesthesiologist. Nurse-led pre-operative assessment systems POACs do not address the hypothesis that the pre-operative assessment information may be collected from the patient at home.

A different, but still similar, approach to improve pre-operative planning is to re-evaluate the role of health workers in the pre-operative process, and create tools that enable the transfer of responsibilities from physicians to nurses. It is advocated that the pre-operative assessment of elective surgical patients may be undertaken by trained nurses [19][28][29]. Following this hypothesis, nurse-led pre-operative assessment systems have been implemented [19][28][29], using protocols to guide nurses in the decision making process. Nurse-led pre-operative systems do not address the hypothesis that the pre-operative assessment information may be collected from the patient at home.

Searches on the major academic literature databases (i.e., PubMed, Web of Science, Inspec, SCOPUS), on pre-operative planning that use electronic communication with the patient at home, did not retrieve any relevant result. Following, an

approach to the problem of elective surgery cancellations by contacting the patient at home is presented.

Telephone calls are being studied as a solution to reduce elective surgery cancellations, due to patient no-shows, on the day-of-surgery [30][31]. Such studies propose a communication channel between the patient and the provider to enable the confirmation of the patient's intention to attend surgery, or simply address patient's questions and concerns. Information exchange between health personnel and patients, while the patients are still at home, may solve some of today's challenges with late pre-operative planning and, consequently, cancellations of surgical procedures.

In developed countries, like Norway, where the population is well prepared and able to use ICT (e-readiness), a new approach is possible [32] to promote patient-centred health care [33][34]. Many patients [35], including elderly or less-educated [36], are strongly motivated to use electronic services [37]. In order to address the potential of electronic communication in the healthcare sector, a brief state-of-the-art on the use of electronic communication in other health care settings was conducted, and is presented hereafter.

A promising application of health information and communication technology (ICT) is the facilitation of web-based communication between patients and health workers. Such tools are expected to improve health care services by promoting streamlined communication, improving resource usage, facilitating shared decision-making, and patient self-management [38][39][40][41][42].

A web-based questionnaire of patient symptoms in primary care has been implemented at the Mayo Clinic, with a 40 % decrease of office visits [43].

Zhou et al. [44] reported on the use of secure e-mail between physicians and patients at the Kaiser Permanente, for a period of two months. The patient portal was integrated with the EHR, and 35 % of the hospital patients were registered in the portal. The study focus on patients with diabetes and hypertension. During the study period, the authors registered 556 339 e-mails with a total of 630 807 messages, and 85 % of the threads were initiated by the patient. In this study was shown that the use of secure e-mail between the patients and physicians was associated with higher performance of quality measures.

In Rosen and Kwoh's [39] study, a consecutive series of patients' families in paediatric care were offered e-mail access over a 2 years period. The authors reported that 5.7 % of patients' e-mails were urgent (i.e., notification of disease flare or new symptoms) and only 0.002 % of the e-mails required physicians' emergent attention. After 1 year of enrolment in the patient-physician e-mail service, the majority of families agreed that service increased access to the physician and improved the quality of care.

A web-based collaborative care management tool was presented by Ralston et al. [45]. The tool targeted patients diagnosed with type 2 diabetes, and the aim was to support the patient at home in the management of their disease. Features such as patient access to the EHR, and secure e-mail with health workers were included in the tool. During the period from August 2002 to May 2004, 83 patients were randomized to receive care through the web-based tool as an addition to the established care procedures. The authors reported that the use of secure e-mail between the patient and the physician improved glycaemic control in type 2 diabetes.

Increased collaboration with patients, as active participants, through ICT solutions, are also defined as a priority area, as stated in the Norwegian Ministry of Health and Care Services' Coordination Reform [46].

At the same time, an extensive ICT investment is taking place in the northern health region of Norway, including at the UNN hospital, our site of research. Helse-Nord, the Northern Norway Regional Health Authority, is investing €62.5 million in the FIKS (from the Norwegian *Felles innføring kliniske systemer*) project to develop the electronic health record (EHR) for the future – a fundamental tool for high-quality patient treatment [47]. The planning tool on the surgical module in the current EHR system has been recognized as an unused resource by the FIKS project of the Northern Norway Regional Health Authority and the Lean Project [47]. The described health care trends in Norway open new possibilities to approach the elective surgery cancellation problem.

The aim of our research is to reduce the elective surgery cancellations at UNN, by studying pre-operative planning and determine if it may be moved from the hospital to the patient at home. We will explore if surgical patients and health personnel can collaborate in a team while the patient is still at home, through an electronic communication tool, and if this reduces elective surgery cancellations, by better preparing hospitals and patients for surgical procedures.

III. Materials and Methods

To develop an efficient and functional web-based tool for hospital-patient collaboration is not an easy task, and it has not always been successful. As the development of health ICT grows, there is also an increasing number of reports on unsuccessful implementation projects, challenges and unforeseen consequences of ICT in health care, particularly in hospitals [48][49][50][51][52][53][54][55][56][57][58][59]. A contributing factor to such results may be found on the focus of health ICT on improving individual tasks rather than supporting value added care processes. By supporting individual tasks, ICT is focusing on the provider. This is a significant contribution to a lower quality and high cost health care. On the other hand, process focused care is centred on the patient. It integrates the team work (e.g., patients, physicians, nurses, caregivers, managers, and administrative personnel) to provide high quality and efficient care throughout the full process. Value added care processes are the goal of the patient centred health care. However, few health care processes have been modelled comprehensively enough to provide a basis for specifying software requirements to health ICT designers. Thus, health ICT designers have focused on supporting the work of individual care team members by taking existing paper-based tools, as their models. The result is that most health ICT systems do little to support care teams. Hence, prior to development, eTeam-Surgery carried out an in-depth study of the pre-operative planning at UNN.

The management at UNN, our site of research, is determined to reduce the cancellation rate at the hospital. Resources have been allocated, and a Lean process for elective surgical patient pathways at the Operation and Intensive care clinic has been initiated at UNN. Lean projects are commonly used to transform healthcare organizations for improvements in patient care through the development of a quality driven culture [12]. At UNN, Lean is defined to concern the right

things at the right place, time and amount, with a minimum of waste while, at the same time, being flexible and prepared for changes. The Lean process at UNN is organized as a project team, including a project manager, a Lean consultant, a Lean mentor, an economics and an IT-consultant. In addition, the Lean project has an executive board, a project group and a focus group. At the start of the Lean Project, the focus group, which is the actual working group, consisted of; one anaesthetist nurse, one theatre nurse, two anaesthesiologists, three surgeons, one member of the staff responsible for sterilization of surgical equipment, three staff members responsible for elective surgery planning and waiting lists in the surgery ward, one paediatric nurse, two ICT consultants (one of them responsible for the EHR), one employee representative, and one user (patient).

Two researchers from our research team have followed the Lean process since the initial group meeting in April 2012. One has participated solely as a researcher, conducting observations during Lean meetings, while the other had an active role and contributed as an anaesthesiologist in the Lean process. The researchers observed and participated in more than twenty meetings.

The data on the causes for elective surgery cancellation, presented in Figure 1, is a result of the work carried out by the Lean project. In addition to following the Lean process, we have accomplish three weeks of fieldwork at the Operation and Intensive care clinic, conducting observations and unstructured interviews while following an anaesthesiologist and an anaesthetist nurse in their daily work. We have also conducted thirteen structured interviews with physicians, nurses and administrative personnel. Based on the knowledge from the quantitative and qualitative inquiries, it was identified the need to proceed with further analysis of the data on the causes for cancellation provided by the Lean project, as explained in the results section.

Data collected through observations and interviews was analysed together with observational data from the Lean project. Our analytical qualitative approach focuses on the interaction between technical and social factors that produces particular outcomes [60]. The preliminary results are limited to the identification of the information needed for pre-operative assessment from the anaesthetists and surgeons' point of view.

An empirical inquiry of the reported causes for cancellations in the hospital's EHR, and on the pre-operative planning process at the hospital, was conducted. The study was carried out using mixed methods, involving both a quantitative and a qualitative approach. A quantitative approach was used to map the causes for cancellation reported in the hospital's EHR, while a quantitative approach was applied in the study of the current preoperative planning process at the hospital.

The aim of the quantitative approach was to quantify and map the different causes for cancellations at the hospital in order to determine if extended communication between the patient and the hospital is an adequate initiative to reduce surgical cancellations. In order to make an analysis on how such interaction can be organized and integrated in the existing work practices at the hospital, it was identified the need for a qualitative study of the preoperative planning at the hospital. The qualitative approach consisted of an in-depth study of the current preoperative planning process, including observations and interviews at the hospital. The aim was to acquire in-depth knowledge on the information flow and workflow during the pre-operative planning process, and identify bottlenecks and/or challenges that lead to cancellations.

IV. RESULTS

A process model facilitates a systematic description of the events permitting the identification of decision activities, and the health workers responsible for each of them. In addition, it allows us to learn about the information flow, and to identify the underlying process issues that are causing the patient assessment information not to be available when required. The observations and interviews, described in Section III, allowed the identification of the activities involved in the pre-operative planning as it is done today at UNN.

The data on elective surgery cancellation, presented in Figure 1, is categorized according to the causes reported in the EHR system. The data presented in Table I evidences that the identified causes for elective surgery cancellation inside the same category are not all related to the same context. Thus, these causes required further classification according to the decision context for the cancellation: management, medical, or patient. Decisions within the patient context are related to the patient, as patient no-show and will. Decisions in the medical context are related to clinical issues and are, therefore, taken by surgeons and anaesthesiologists. Finally, the decisions taken in the management context relate to planning and operational issues and are taken by secretaries, nurses, and physicians. This allowed us to identify the responsible (e.g., health workers) for the activities required for the process modelling. The mapping of the existing pre-operative process model is shown in Figure 2.

TABLE I. CATEGORIZATION OF THE CAUSES FOR ELECTIVE SURGERY CANCELLATION AT UNN, ACCORDING TO WHO TOOK THE UNDERLYING DECISION TO CANCEL AND THE RELATED ACTOR.

	Cause for elective surgery cancellation		**Decision context**
Hospital	Lack of capacity	Anesthesia nurse	Management
		Anestheseologist	
		Surgeon	
		Surgery nurse	
		Intensive care	
		Recovery	
		Ward beds	
	Missing Equipment		
	Overbooking		
	Emergency surgery		
	Higher duration of previous surgery		
	Insufficient surgery indications		Medical
	Incomplete study		
Patient	Other acute medical condition		
	Patient no-show		Patient
	Patient will		

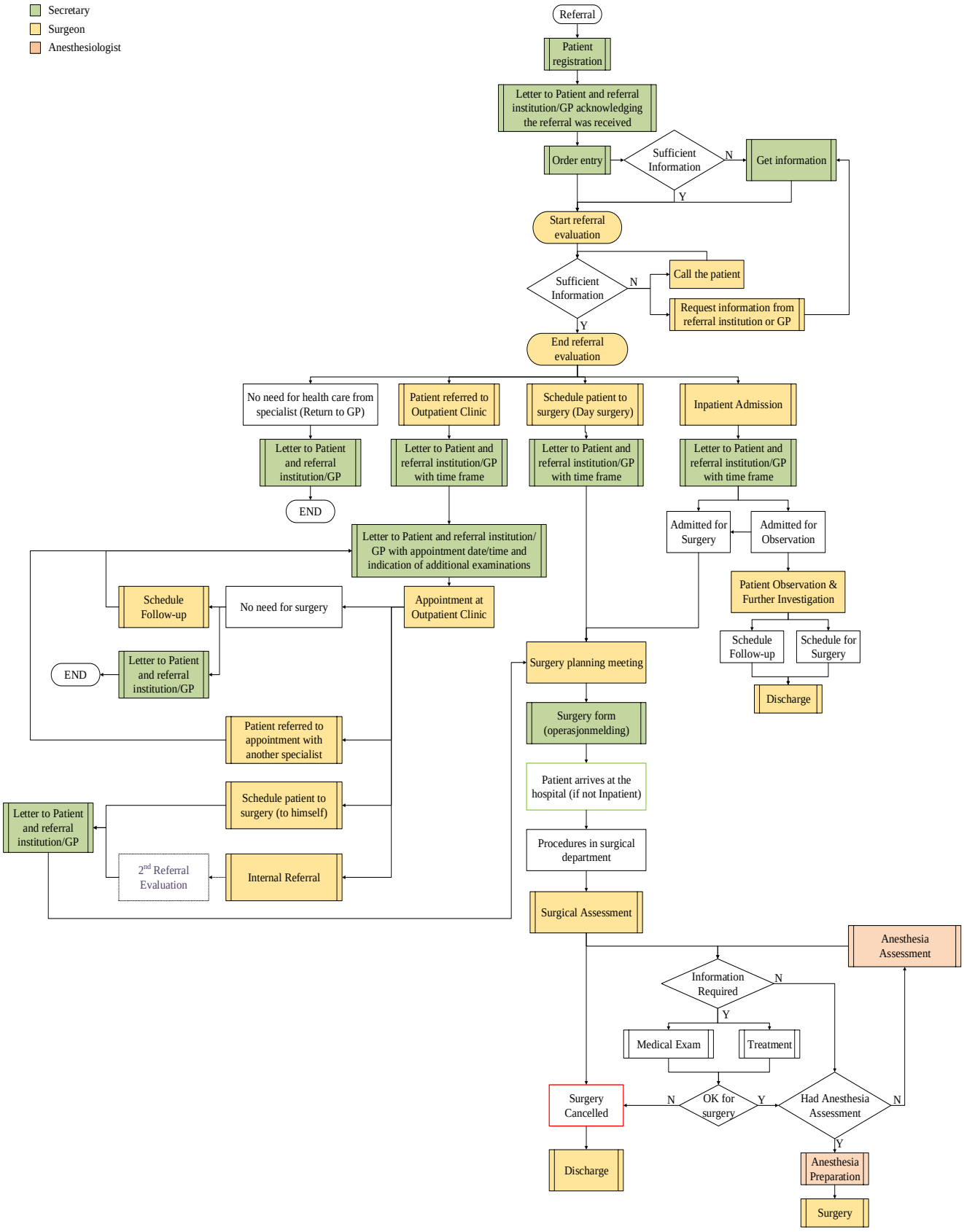

Figure 2. Scheme of the surgery process at UNN. Assessment activities after patient arrival (Box with green border), may contribute to late cancellations (box with red border) while there are many possibilities for hospital-patient interaction at earlier stages (Letters to patient and patient at the hospital).

At UNN, as seen in Figure 2, the final pre-operative planning is often done after the patient has arrived at the hospital for the scheduled surgery. Which means, the final pre-operative planning might be done the day before, or even on the day of surgery. During this final planning process, new information is gathered from patients which may lead to cancellations. Considering the data collected during the observations and interviews, and the analysis of the existing pre-operative process, all the decision activities were identified and characterized. Based on the information requirements on each of those activities, a new pre-operative process was proposed. In the new pre-operative process the assessment information is requested to the patient at an earlier stage and while the patient is still at home. The assessment information identified as required might be included in the personal health assessment questionnaire which some departments ask the patients to fill out and bring to the hospital when hospitalized for surgery.

V. DISCUSSION

This paper addresses the elective surgery cancellations problem at UNN. Observations and interviews were conducted at UNN, and lack of information during the pre-operative planning was identified as the main cause of elective surgery cancellations. The problems with the existing pre-operative process were identified and a new process was proposed. In the new process, the assessment information is systematized in a personal health assessment questionnaire, and provided by the patient at an earlier stage, while the patient is still at home.

The mapping of a generic pre-operative process model facilitated the identification of the decision activities, and the health workers responsible. The identification of activities, and their responsible health worker, allowed us to carry out semi-structured interviews to determine the information required to complete the pre-operative assessment.

Surgeons and anaesthesiologists at UNN considered that the identified information may be provided by the patient. Some departments ask the patients to fill out a personal health assessment questionnaire and bring it to the hospital when hospitalized for surgery. The information classified as required might be included in this questionnaire. Such questionnaires can be sent to the patient through the postal system, and the patient can fill it out at home.

At this stage, the collaboration between surgical patients and health personnel cannot do much for the elective surgery cancellations related to management context. These are mostly due to inadequate planning and should be approached within the adequate research field. On the other hand, the causes for elective surgery cancellation related to the remaining decision contexts, patient and medical, may be positively influenced by such collaboration, either by gathering information on the patient health status based in the afore mentioned personal health assessment questionnaire or, by improving the dialogue through electronic communication.

The aim of the research project "eTeam-Surgery" is to reduce the number of elective surgery cancellations at UNN. In today's surgical process the information required for anaesthetic evaluation is gathered after the patient is hospitalized, as shown in Figure 2. The aim of eTeam-Surgery is to provide a tool for two-way electronic communication, Figure 3, between the hospital and the patient prior to hospital admission. Such tool will enable the hospital to collect the lacking information at an earlier stage in the pre-operative planning process, while the patient is still at home. The tool proposed by the eTeam-Surgery project, will provide two communication channels: (1) Collect the lacking information based on the Patient Health Assessment Questionnaire described in Section I. To guarantee that the information collected through this channel can be shared by the health workers involved in the patient episode, it should be structured data that can be included in the EHR system. However, by collecting the information while the patient is still at home means that patients loose the support from health workers while completing it. Therefore, eTeam-Surgery will support (2) two-way electronic communication. This part of the tool will provide an asynchronous messaging service that will enable the patient to pose questions to the hospital, and vice-versa.

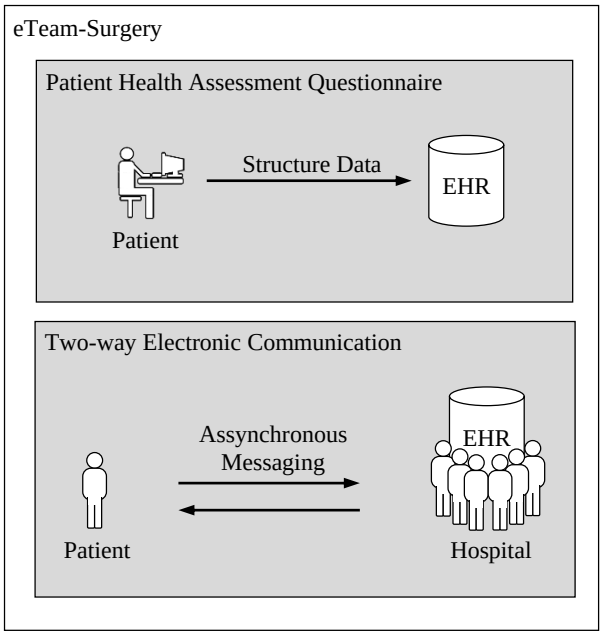

Figure 3. Ilustration of the eTeam-Surgery solution architecture.

The implementation of such tool implies that the pre-operative planning process, described in Figure 2, needs to be restructured. Which means that some of the identified activities might be removed from the process, and new ones be created. It might also involve the re-evaluation of the health workers responsible for the activities. This knowledge, combined with the reports in literature that patients often evidence "selfish" communication practices which could result in an overload of conversations that would not occur if the tools were not available [61], leads to the question: "How to balance the need to gather information from the patient, and the requirements for electronic communication, with the reported consequences of communication tools on clinical processes?"

A possible solution may be found in the field of context-awareness. Let us first define context. Abowd et al. [62] defined context as "*any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant for the interaction between a user and an application, including the user and application themselves*". This definition shows the importance of which information is relevant or not in a context-aware system. A context-aware system could, therefore, be defined as a system allowing interactions between multiple entities using relevant information. In [62] is state that: "*A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task".* This definition shows that a context-aware system can change its behaviour and send some relevant information according to the context, which reflects our view.

The trend in the health IT field has been to push as much information as possible to the users, in order to provide more sophisticated and useful services while, at the same time, making users more available. During a preliminary research study on the Aware Media system [63], they suggested a classification that splits the above listed information along three main axes:

- Social awareness: `where a person is', `activity in which a person is engaged on', `self-reported status';
- Spatial awareness: 'what kind of operation is taking place in a ward', 'level of activity', 'status of operation and people present in the room';
- Temporal awareness: 'past activities', 'present and future activities' that is significant for a person.

A context-aware system, comprises two main modules:

- Context engine: This module interfaces with other information systems and devices to collect raw data. These are then fed to an analyzer to classify raw data and generate context data;
- Rules engine: This module acts as filter between the data and the user. By applying a set of pre-defined conditions that define what, when, and to who the information must be presented. Such rules can be defined manual or automatically.

The adoption of context-aware systems based on these definitions is growing in a variety of domains such as, smart homes, airports, travel/entertainment/shopping, museum, and offices, as mentioned in [64].

In the scope of the eTeam-Surgery project, context information may be used to decide, e.g., who should communicate with the patient, the urgency level of the communication, and time frame when the communication should be available. In this way, it would be possible to balance the eagerness of the patients to communicate with hospital with the fact that communication tools make health care workers "fatally" available.

VI. CONCLUSIONS

By studying the pre-operative planning at UNN, we have determined that parts of the information flow can be moved to the patient at home. From the work presented herein, we conclude that the assessment information required during the pre-operative planning can be compiled in a personal health assessment questionnaire, and requested from the patient, at an earlier stage.

The authors acknowledge that the paper-based pre-operative planning process proposed is not in line with the best practices suggested in literature. When using the postal system the information flow between the patient and the hospital is time consuming, and it is not possible for the hospital to confirm the reception and submission of the personal health assessment questionnaire. At the same time, due to: (a) the patient prioritization rules in Norway, (b) waiting list, (c) and emergency surgeries, surgeries can be delayed and the patient might be requested to complete the personal health assessment questionnaire more than once. On the other hand, when asking the patient to answer a personal health assessment questionnaire from home, the patient might require support from health workers when interpreting the questions, and selecting the relevant information.

The international healthcare trends on paperless and patient focused clinical processes, combined with the e-readiness in Norwegian society, point to new possibilities on how to gather assessment information from the patient at home. To access this information, low-cost communication with patients and their families has been recommended [13]. Thereby improving pre-operative planning, and reducing the number of cancelations, due to lack of information. In order to enable the communication between the patient and the hospital, the interaction with patients should take place through a variety of synchronous and asynchronous secure communication channels, including phone, messaging systems, email, and web-pages. Considering the impact of health ICT in clinical processes, the authors suggest the adoption of the context-aware methodology in the development of electronic communication tools to reduce elective surgery cancellations.

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