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Challenges and Approaches to Make Multidisciplinary Team Meetings Interoperable – The KIMBo Project

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Abstract. Background: Multidisciplinary team meetings (MDTMs) are already in use for certain areas in healthcare (e.g. treatment of cancer). Due to the lack of common standards and accessibility for the applied IT systems, their potential is not yet completely exploited. Objectives: Common requirements for MDTMs shall be identified and aggregated into a process definition to be automated by an application architecture utilizing modern standards in electronic healthcare, e.g. HL7 FHIR. Methods: To identify requirements, an extensive literature review as well as semi-structured expert interviews were conducted. Results: Results showed, that interoperability and flexibility in terms of the process are key requirements to be addressed. An architecture blueprint as well as an aggregated process definition were derived from the insights gained. To evaluate the feasibility of identified requirements, methods of explorative prototyping in software engineering were used. Conclusion: MDTMs will become an important part of modern and future healthcare but the need for standardization in terms of interoperability is imminent.

Keywords. Workflow, HL7 FHIR, BPMN, Automation, Multidisciplinary Team Meeting, Interoperability

1. Introduction

Multidisciplinary collaboration between healthcare professionals plays an important role in modern healthcare and scenarios of integrated care. A specific form of collaboration can be Multidisciplinary Team Meetings (MDTMs) when healthcare professionals with different areas of expertise discuss medical cases. When it comes to specific disciplines of medicine, these meetings can be mandatory by legal obligation, e.g. to discuss the treatment of cancer patients [1].

MDTMs are usually held synchronously in person or via video conferencing solutions involving professionals of different practice settings like oncology, radiology, psychology etc., at the same time across different locations. As a result, the available information and documentation for the discussed cases must be available to all participating specialists in the same quality at the same time allowing consensus and informed decisions on further patient treatment [2].

The objective of the research project KIMBo (Kollaborative Interdisziplinäre Medizinische Boards) is to identify common requirements for MDTMs from a process perspective and to find a solution to be able to allow (inter-) institutional collaboration

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through the use of healthcare IT standards, mainly HL7 Fast Healthcare Interoperability Resources (HL7 FHIR).

2. Methods

The activities in KIMBo concerning MDTMs are based on the requirements of hospitals. These requirements were identified by the conduction of an extensive systematic literature review to evaluate the state-of-the-art concerning MDTMs [3]. Furthermore, the analysis was extended by conducting semi-structured expert interviews [4]. Target partners were coordinators of MDTMs, specifically coordinators of tumor boards in different healthcare institutions across Austria, to gather requirements and identify differences between the requirements elicited from the literature and real world applications.

The next step was an analysis of the different processes identified from literature and expert interviews to get a consistent and refined description of the necessary steps in typical MDTM settings. The results of the analysis were transferred into discussions and committee work with the HL7 community to further refine the definitions to handle workflows in the draft standard HL7 FHIR STU3 [5]. To validate findings and assumptions against applicability the methods of explorative prototyping in software engineering were utilized.

Different Healthcare Standards and Communication Profiles were analyzed. Omitting standards concerning the exchange of healthcare data in general (such as HL7 standards), the IHE Cross Enterprise Tumor Board Workflow Definition (XTB-WD) [9] Profile is specific to Tumor Board Meetings. It is based on the IHE Cross-Enterprise Document Workflow Profile (XDW) [12], which defines Content Creator, Consumer and Updater actors communicating with each other, and how these communications are documented. XTB-WD defines generalized, linear steps to conduct a tumor board. It was not selected for implementation because it primarily deals with documenting what happened in the workflow, as opposed to enabling definition and automation of it, as was the goal of the KIMBo project.

3. Results

3.1. Literature review

The results of the conducted literature review have previously been published in [3]. A total of 837 articles have been reviewed, of which 25 articles were then thoroughly analyzed. The publication identifies participating parties in an MDTM (oncologists, pathologists, radiologists, surgeons, radiotherapists etc.), what information is required to conduct the MDTM (imaging results, patient summary, histological findings, etc.), the workflows of MDTMs in thirteen different hospital settings and identified technical and organizational problems and solutions therein. [3]

The review shows that there is an overarching workflow which all hospitals follow when conducting an MDTM. However, each hospital conducts the meetings with some differences, primarily concerning the medical issue addressed. Differences were also found to be caused by the local law [6], culture and set policies of the hospital administration or MDTM participants [7]. From a technical perspective a lack of

interoperability, as well as a potential for automating parts of the process were identified. These areas are what the KIMBo project is focused on addressing. [3]

3.2. Expert interviews and process analysis

During the analysis phase of the project, semi-structured interviews with different institutions were conducted. The requirement for the selection of interview partners was, that a defined process/implementation to conduct MDTMs must be in operation at the potential interview partner's institution and the interview partner must be directly involved in planning or coordinating the boards in operation at the corresponding institution.

The interviewed organizations included the Comprehensive Cancer Center Graz/University Hospital Graz, Hospital of Elisabethinen Linz, Vienna Hospital Association (KAV) and the Hospital "Krankenhaus der Barmherzigen Schwestern" Linz. The interviews were conducted following an interview guide/question catalogue in order to deliver comparable results and to identify differences in the MDTM-setup of the corresponding interview partner's institution. Questions were derived partly from the outcomes of the already conducted literature review [3] to validate the findings but also to get more detailed information on specific topics not treated in the found literature so far (e.g. "How important is it for your organization to involve external specialists ad hoc to specific boards?") to allow a proper architecture and system design phase.

The interview recordings were gathered and common requirements as well as major differences were identified for each of the interview questions.

The identified processes to handle MDTMs were very similar from a high level perspective, but differed in detail. Examples are the handling of patients to be discussed inside the board, which were not yet available inside the institutions' documentation systems as well as patient data management, or the invitation of MDTM participants preparatory for the actual conduction of the MDTM.

In the implemented setup, the accessibility of the discussed patient's documentation in the used board solution showed considerable differences, spanning from selective access and assignment of specific documents to the board participants to complete access to the patient's data within the corresponding organizations boundaries.

At three institutions it was additionally possible to attend cancer boards to evaluate the interview results against the real world implementation of the designed processes. This comparison showed that the designed processes were mainly followed at all institutions, but also showed the necessity of flexibility, e.g. in terms of urgent cases that need to be discussed and were initially planned for future MDTMs.

3.3. Committee work

In order to cope with interoperability issues, the HL7 FHIR draft standard was identified. Since HL7 FHIR is currently under development, some of the essential FHIR resources weren't finished or didn't exist at all when KIMBo was started. Thus, it was necessary for the project team to be actively involved in the standardization work driven by various HL7 work groups. This comprises the participation in the weekly calls of the FHIR work group "Workflow" as well as regular attendance at the HL7 Working Group Meetings (WGMs) beginning with spring 2016.

Besides further development of necessary FHIR resources, another purpose for the active involvement in the FHIR work groups is to be aware of potential changes of the

used resources as soon as possible. During this phase the work group developed workflow related patterns for requests and events and the use of the corresponding FHIR resources, which were later applied by other HL7 work groups to all relevant resources. Furthermore, with the resource "task" a special workflow resource was created.

3.4. Architecture and process

To reach the desired outcome and to cover the identified requirements, two different perspectives were considered for the approach being (1) the architecture of the necessary (software) components as well as (2) the process definition to be executed within the MDTM.

3.4.1. The architecture blueprint

The underlying paradigms of the KIMBo architecture are *interoperability* and *automation.* To achieve *interoperability* between different hospitals, as well as other participants in the process, such as radiologists, family physicians and even the patients themselves, a centralized server architecture serves as host for the MDTM process. This server architecture is called the KIMBo Workflow Broker (KWB, see Figure 1). The communication with participating organizations is based exclusively on HL7 FHIR restful webservices. This allows for fast implementation based on the FHIR specification, as well as the definition of required profiles and extensions for the MDTM, to empower interoperable communication with the KWB placed at the hosting organization of the MDTM, making the architecture provider-independent applicable.

The KWB can act in an MDTM setting either as a hosting broker or as participant broker. When acting as a hosting broker the KWB takes over the responsibility for collecting information required in the MDTM, distributing it to the participants as needed and also executing the MDTM workflow itself. When participating as a participant broker the KWB follows the workflow of the hosting system and notifies local users of any changes.

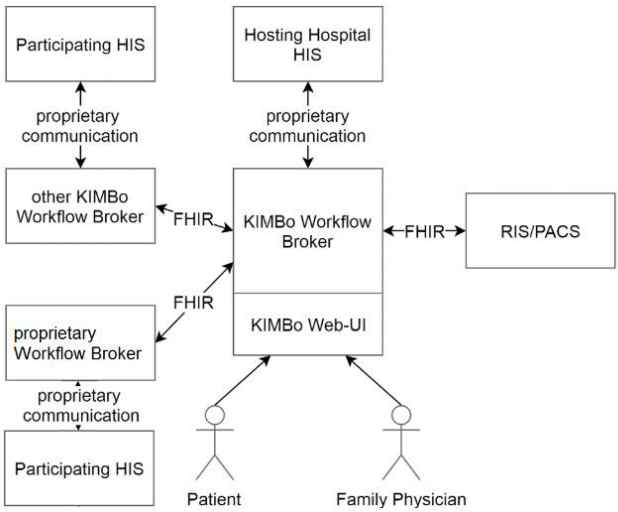

Figure 1. Architecture overview of the KIMBO Project, showing participating Hospital Information Systems (HIS) and Radiology Information Systems (RIS) / Picture Archive and Communication Systems (PACS)

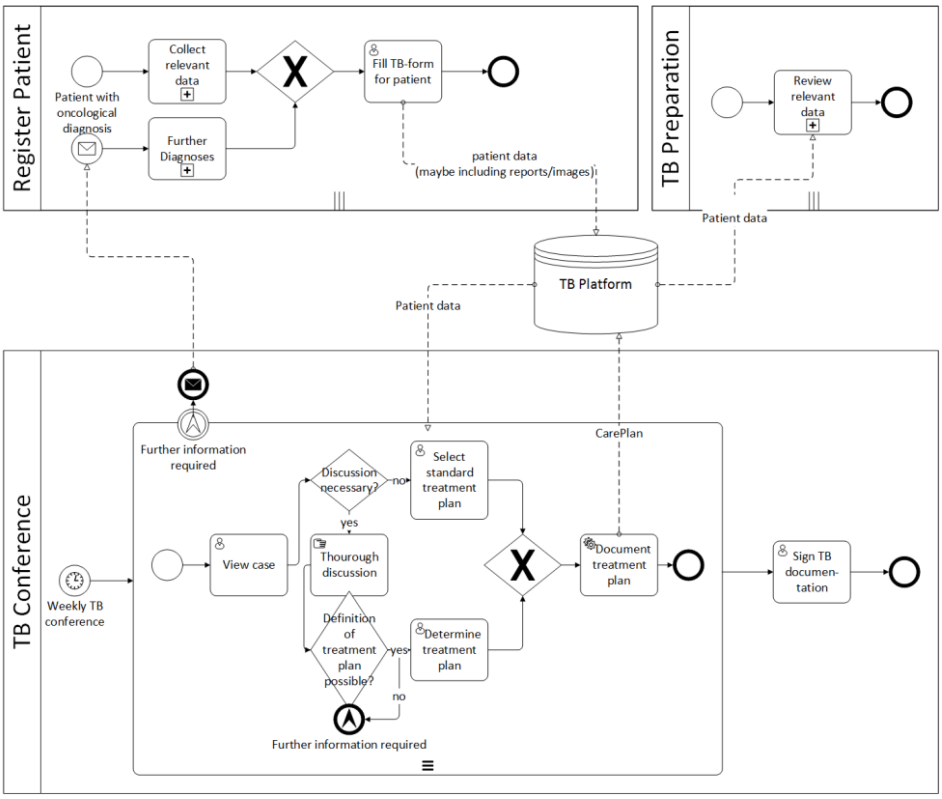

Figure 2. Generic MDTM workflow.

A Web-UI is attached to the KWB which allows access during the MDTM meeting for authorized participants. Thus, intermittent participants of MDTMs, like the patient or the family physician, who will likely participate in only a single meeting, can participate without the need of installing additional software bundles.

3.4.2. The process perspective

The general KIMBo workflow can be seen in Figure 2. It represents a simplified workflow based on the literature review results and expert interviews.

Preparatory to an MDTM, the patient is registered to be discussed in the next MDTM, and relevant data needed to make an informed medical decision is collected and entered into the system. MDTM participants have the option to prepare for an MDTM meeting by reviewing gathered information beforehand.

When the MDTM is started, the cases are reviewed sequentially. Usually, in clear-cut patient cases, a pre-defined treatment plan fitting the patient's medical situation is selected as a recommendation for further treatment. If further discussion is required, additional information can be requested for review or a specific treatment plan for the patient can be designed. Finally, the results of an MDTM are verified by the participants and made available.

The workflow is represented as a FHIR PlanDefinition resource. This allows the hosting organization to change and develop the PlanDefinition, and with that the actual MDTM workflow, according to its needs in a standardized way that is understood by all participating brokers.

To *automate* parts of the workflow the KWB uses a Business Process Model Notation (BPMN) [8] workflow engine. At the start of a process (triggered by a user or notification from a participating system) the FHIR PlanDefinition defining the workflow is transformed into a BPMN that is then executed by the engine. This automatically drives the workflow forward when users finish their assigned tasks. It also allows automation of some tasks, such as sending out e-Mails as reminders to the participants or documenting (auditing similar to IHE XTB-WD [9]) the MDTM process.

Anonymisation and pseudonymisation of patient data can also be achieved automatically through the nature of FHIR resources. When information is provided to a host system, the data can be cleared by the workflow engine before it is transmitted using the Request-Event pattern of FHIR [10], which builds the basis for the communication between participating systems.

3.5. Prototyping

At the time of writing this paper most prototyping was done from the perspective of integration of the necessary backend components defined within the architecture blueprint and how the necessary business logic can be executed (especially in the context of utilization of the HL7 FHIR resources) upon them to see if the identified requirements and assumptions are technically feasible.

Upcoming prototypes will also include user interfaces to see how the backend components will integrate with user actions/workflows to satisfy the desired requirements from a usability perspective.

4. Discussion and Outlook

The need for multidisciplinary team meetings will gain traction in upcoming years because of current political (e.g. Primary Health Care settings as outlined in [11]) as well as organizational challenges (e.g. interdisciplinary models of care, collaborative treatment of patients and discussion of their paths through the healthcare landscape). To facilitate the transition to- and execution of these models, information technology as well as a common standard (e.g. HL7 FHIR resources) for the interoperability of the involved participants' IT-systems needs to be established.

As discovered in the literature review in [3] as well as in the conducted expert interviews, a key issue with existing software solutions is to be found concerning their interoperability amongst other IT-systems in place as well as in the lack of (organizational) interoperability when external specialists need to be involved. Utilization of modern standards (in development) like HL7 FHIR can helpfully exploit the potential of MDTMs across different areas of healthcare and support collaborative efforts of interdisciplinary care.

The next steps within KIMBo will be to further prototype and integrate the necessary components as well as evaluations with relevant stakeholders to validate the coverage of identified requirements. Expected results of this evaluation are new requirements which

haven't been identified yet, leading to an iterative refinement process of architecture as well as process definition and execution.

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