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# First Steps Towards Process Mining in Distributed Health Information Systems

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## ABSTRACT:

Business Intelligence approaches such as process mining can be applied to the healthcare domain in order to gain insight into the complex procedures taking place. Disclosing as-is processes helps to identify room for improvement and answers questions from medical professionals. Existing approaches are based on proprietary log data as input for mining algorithms and only work in special environments. Integrating the Healthcare Enterprise (IHE) defines in its Audit Trail and Node Authentication (ATNA) integration profile how real-world events in healthcare must be recorded. Since IHE is used by many healthcare providers throughout the world, an extensive amount of log data is produced. In our research we investigate if audit trails, generated by the means of an IHE based information system, carry enough content to successfully apply process mining techniques. We simulated the radiological workflow and found that the information recorded sufficed the requirements of process mining.

## 1 INTRODUCTION

Process mining is an emerging discipline based on existing data mining techniques that also takes the complexity of the underlying business processes into account. By deriving process models from observed system behaviour (i.e. event logs) process mining is able to provide understanding of the as-is processes [1].

The findings of several research initiatives already propose the use of process mining to extract information from event logs in healthcare [2], [3], [4]. Some aim to assess how those systems are used or misused, others try to gain clinical knowledge from data or to improve the efficiency of hospital workflows. The event data used in these approaches originated from various different sources such as hospital information systems, medical devices or department specific information systems. For every source, the event data needs to be preprocessed and converted into a standardized log format to meet the requirements of process mining tools [5].

The goal of this research is to find a way to enable process mining in distributed health information systems, without having to deal with an increasing preprocessing effort. The core question is: Does log-data, produced by means of the standardized *Audit Trail and Node Authentication* (ATNA) Integration Profile, provide sufficient information to apply process mining methods?

## 2 METHODS

*Integrating the Healthcare Enterprise* (IHE) is an international initiative by healthcare professionals and industry to improve the integration and interoperability of Health Information Systems [6]. One of the basic IHE Integration Profiles, the ATNA Profile, defines how to build up a secure domain that provides patient information confidentiality, data integrity and user accountability. A secure domain can scale from a department, to enterprise or cross-enterprise size. To ensure user accountability, ATNA specifies the use of a centralized *Audit Record Repository* where every access to all kinds of patient-identifiable information is recorded [7].

To map real-world activities to event logs, ATNA makes use of the *Security Audit and Access Accountability Message XML Data Definitions for Healthcare Applications* (RFC-3881). It incorporates the viewpoints of different organizations like HL7, IHE, and DICOM [8].

For the creation of audit messages an IHE test system, based on the OpenHealthTools<sup>1</sup>, was utilized. The test system recorded audit trails from transactions between actors.

### 3 RESULTS

We simulated the radiology workflow based on our findings in the research project WIRE. Hence different transactions including queries for patient data and document access were recorded. The resulting audit messages conformed to the IHE schema consisting of four parts: *EventIdentification*, *ActiveParticipant* (twice), *AuditSourceIdentification* and the *ParticipantObjectIdentification* (twice) [8].

- *EventIdentification* contained general data about the performed event such as time and type of event.
- In *ActiveParticipant*, two participants were described. These corresponded to the IHE actors performing the transaction.
- *AuditSourceIdentification* contained a description of the system that detected an auditable event and created the audit message.
- The *ParticipantObjectIdentification* described participants affected by the performed action, e.g. on the one side the patient and on the other side the document which was registered for this patient.

### 4 CONCLUSION

To evaluate the results and decide whether the information provided by the event log was sufficient to enable process mining, we transformed the log to a standardized format using the approach described in [5]. We then visualized the result utilizing the process mining tool proM<sup>2</sup>.

In our test case the information provided by the recorded audit messages was sufficient to enable process mining. Therefore it allowed to reconstruct the basic as-is process regarding the radiological workflow.

Based on the classification system presented in [1] we classify our log as level 3. There is an automatic recording mechanism and recorded events do match reality. It does not qualify for level 4 because of the lack of explicit notations of process instances and activities. It exceeds level 2 - completeness is guaranteed as it is not possible to bypass the information system.

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<sup>1</sup> www.openhealthtools.org, last access 28.01.2015

<sup>2</sup> www.promtools.org, last access 28.01.2015