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A Concept of a MIABIS based Register of Biosample Collections at the Medical University of Innsbruck

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Abstract. The knowledge about the quality of samples and associated clinical data in biospecimen collections is a premise of clinical research. An electronic biosample register aims to facilitate the discovery of information about biosample collections in a hospital. Moreover, it might improve scientific collaboration and research quality through a shared access to harmonized sample collection description data. The aim of this paper is to present a concept of a web-based biosample register of the existing biosample collections at the Medical University of Innsbruck. A uniform description model is built based on an analysis of the sample collection data of independent sample management systems from two departments within the hospital. An extended set of attributes of the minimum dataset used by the Swedish sample collection register (MIABIS) has been applied to all biosample collections as a common description model. The results of the analysis and the data model are presented together with a first concept of a sample collection search register.

Keywords. Biosample register, Biosample collection, Minimum data set, MIABIS, BBMRI

Introduction

Quality indicators of biosample collections like pre-analytical sample processing, long term storage and the availability of clinical data have a significant impact on medical research [1][2].

Biospecimen collections at the Medical University of Innsbruck are managed by their respective departments which often use individual in-house sample management software, sample description terminologies and operating procedures. Currently, there exists no common sample management system. Due to this heterogeneity, many researchers are unaware of existing biospecimen repositories outside their departments.

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A common biosample register shall not only facilitate the access of information to collections available but also improve collaboration and research quality through the exchange of harmonized data about sample quality and processing standards.

This paper presents a concept of a hospital-wide biosample register which enables queries for existing biosample collections at the Medical University of Innsbruck.

The register will be accessible through a web-interface from any workstation with an internet/intranet connection and a standard browser.

The biosample register should facilitate researchers to find out which samples can be used within the scope of their study using a set of quantitative/qualitative query parameters. Quantitative parameters can be for example the number of aliquots contained in a collection or the sample collections that exist from patients with a certain diagnosis. Examples of quality indicators might be the preprocessing and long-term storage of samples in a collection. Such information has a significant influence on the outcome of research projects and should be kept in the register for each sample collection. A set of attributes for describing biosample collections is provided by the MIABIS [3] dataset. A main objective is to integrate MIABIS elements into the local biosample register. Primarily, the system is intended to be used by clinical researchers and clinicians within the hospital. Moreover, it might be used to share information about biosample collections across clinical boundaries in the future.

The integration of an additional interface allowing a connection of the local sample register with a future Austrian biobank register had also to be considered in the requirements specifications.

1. Methods

First, an overall system analysis of existing collections of biomaterials at all departments was conducted to obtain a detailed overview of the current sample collections, databases and IT-infrastructures. The departments of Gynaecology and Urology were selected as pilot clinics. Therefore, comparisons of the amount and the level of granularity of the clinical data and sample data were made between the departments observed. The communication processes between the different information systems were investigated and the bottlenecks identified. A graphical visualisation of the data communication between the different IT-based systems within each department was made using the 3LGM model [4].

Next, data representations from different departments were harmonized to obtain a unified model of all sample collections. Therefore attributes from the MIABIS dataset were mapped to semantically equal data elements used by the different sample management systems.

Finally, a list of functionalities of the biosample register was created based on the harmonized data model and the definition of the functional and non-functional requirements that were identified during the preceding analysis.

2. Results

2.1. Current situation

We identified 50 biosample collections at the Medical University of Innsbruck. All of the biospecimen collections are disease-oriented, i.e. they consist of samples that are collected continuously from patients during disease courses. Usually, these kinds of biosample collections are not associated with one particular study. There are no automated mechanisms or processes for the storage and retrieval of samples. The department of Gynaecology run both a biochemical and a morphological laboratory which are both ISO/IEC 9001 certified. A locally developed LIMS[2] PGS-IT [5] and Microsoft Access is currently used at the department of Gynaecology to manage the data associated with collected tissues and body fluids. The laboratory at the Department of Urology uses the proprietary database system Filemaker [6] which keeps sample data and clinical data together in a single system. The data is entered manually into the LIMS by the laboratory members at each department.

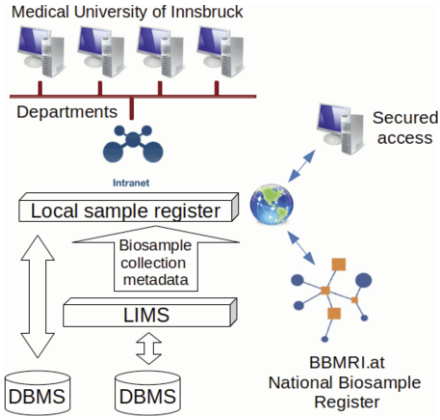

Figure 1. Integration of a local biosample register within the hospital and BBMRI.at

2.2. Definition of the MIABIS use cases

Four query examples identified in cooperation with several department members shall demonstrate some typical search activities of a user who is logged in to the register:

a) Find all collections of body fluids at the department of Gynaecology.
b) How many tissue sample collections exist with ICD-10 diagnosis “neoplasm of..”?
c) How many collections with more than 1000 samples exist at the department of Urology?
d) Find all collections of fresh frozen tissues or FFPE tissue samples from the prostate.

[2] Laboratory information system

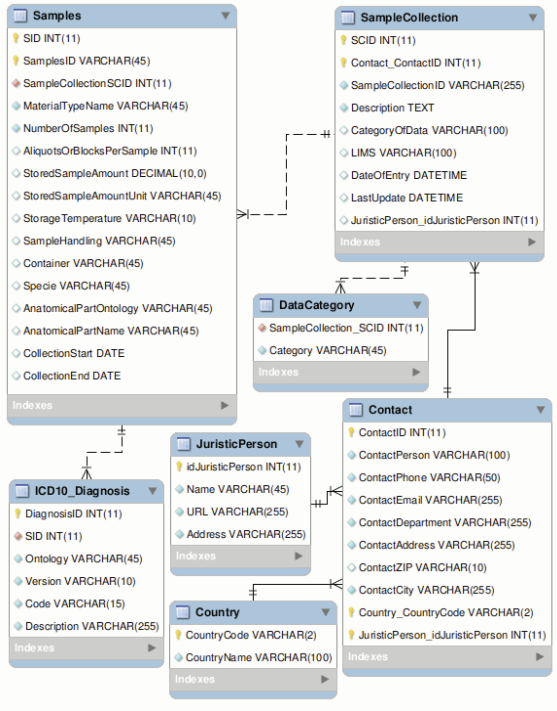

Figure 2. E/R model of the extended MIABIS database schema

Use case a) implies that the system performs a search based on material type values within the body fluid domain (serum, blood, plasma, ascites, etc.). Therefore, information about the material type must be stored for each sample collection.

To fulfil use case b), the register needs to hold information about the disease code and material type of each collection. For use case c), the system performs a search based on the number of samples contained in the collections and a specific department name. To fulfil use case d), the system requires information about the anatomical position and the material type of the sample collections.

2.3. MIABIS based data model

A department-wide biobank register with shared access to uniform biosample collection information requires a set of common description elements. Such a "minimum dataset" was developed during the preparatory phase of the BBMRI[3] project and includes 21 meta-level attributes. MIABIS has emerged as an enhanced version of the BBMRI Minimum dataset during implementation of the Swedish biobank register [7]. Tables from the MIABIS database schema have been adapted and extended with a set of attributes describing common properties of all sample collections (Figure 2).

[3] Biobanking and Biomolecular Resources Research Infrastructure

2.4. Requirement specifications of a MIABIS based biosample register

A document with all functional, non-functional and technical requirements was created based on the IT-analysis and the user needs that were collected during interviews with department members. An interface between the LIMS and the register will allow for automated updates of aggregated sample collection data. Since there will be no donor information stored in the biosample register there is no concern about donor privacy.

3. Discussion

A biosample register should enable an easy and quick access for researchers to aggregated data about existing biosample collections. Privacy issues are addressed by the anonymization during the aggregation of the data. The usage of MIABIS will enable international access to the register. However some limitations in the level of detail of the register data must be considered: For instance, as a consequence of data aggregation, no detailed information about individual samples or clinical data associated is available. This information is currently kept in the local department databases and the hospital information system (HIS) and it is not planned to be integrated in the biosample register without a formalized access policy. Possibly, the detailed data will be managed by a hospital-wide LIMS in the near future.
Currently the prototype implementation of the biosample register based on the requirements specification document is running. Further activities will concentrate on the integration of a BBMRI.AT interface (Figure 1) and the full ICD-10 disease catalogue [8].

Acknowledgements

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