Data Warehouse to Support Clinical Trials in Dentistry

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Data Warehouse to Support Clinical Trials in Dentistry

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Abstract. The increasing digitalization of clinical research requires infrastructure capable of integrating and quality-checking large volumes of data. In this study, we present the design of a relational data warehouse (DW) for collecting periodontal clinical data. The core of the DW is the 'Patient' table, with all other clinical information stored in related tables linked to it through appropriate relationships. The effectiveness of the DW was assessed using 95 real-world records (47 subjects with periodontitis and 48 controls) collected during the Gum-Gut Project.

Keywords. Data Warehouse, Data Quality, Trial Data Management, Dentistry.

1. Introduction

The increasing digitalization of clinical research has led to a dramatic growth in the amount and complexity of health data to be collected, stored, and properly managed. In this framework, the adoption of electronic tools for clinical data collection has expanded rapidly [1]. A Data Warehouse (DW) is a "subject-oriented, integrated, time-variant, and nonvolatile collection of data in support of management's decision making process" [2]. Unlike traditional databases, specifically designed to store transactional data and support day-to-day clinical operations, DW integrates data from multiple sources to enable retrospective and longitudinal analyses [3]. These characteristics make DWs one of the most suitable tools for the data management of clinical trials as well as to support retrospective and prospective analyses over long periods of time. The aim of this preliminary work is to present the design of a relational DW for periodontal clinical data, able to store data from periodontal charts collected by the Section of Periodontology of the Dental School in Turin, during the trial associated with project "The microbiome along the gum-gut axis: biobank creation, multiOMICS phenotyping and effect of periodontal treatment (the Gum-Gut Project)" (Bando PRIN 2022 PNRR).

2. Data warehouse design

DW design was performed according to the DW definition reported by Inmon [2]. The DW was organized around a central **Patient** table, with all clinical information stored in

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corollary tables linked through explicit relationships. The system was implemented as a relational MySQL database, whose Entity-Relationship (ER) diagram is shown in Figure 1. The DW consists of 9 tables: Patient, Comorbidities, Clinical Trial, Examination, Mouth, Tooth, Implant, Site and Clinical trial. The **Patient** table contains demographic and lifestyle data, along with the identifiers, serving as the hub for all other entities. Patients can be linked to multiple **Clinical Trials** (N:N), enabling scalability. Each patient can have multiple **Examinations** (1:N), each linked 1:1 to a **Mouth** record summarizing disease stage, grade, number of teeth and other data (e.g., full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS)). From the mouth level, several **Tooth** and **Implant** records (1:N) describe local parameters such as mobility, furcation, and implant type, while each tooth connects to multiple **Site** entries (1:N) reporting measurements related to each of the six sites of the tooth (e.g., probing pocket depth (PPD), clinical attachment level (CAL), bleeding on probing (BoP), etc.). The integration of additional entities (such as **Comorbidities** and **Therapy**) into the DW enables clinical data to be stored, too. The explicit definition of data types and admissible values enabled preliminary automated screening of data-entry errors during the collection of **95 real-world clinical records** (47 subjects with periodontitis and 48 controls) from the **GUM-GUT Project**, confirming the suitability of the proposed DW schema for clinical data management.

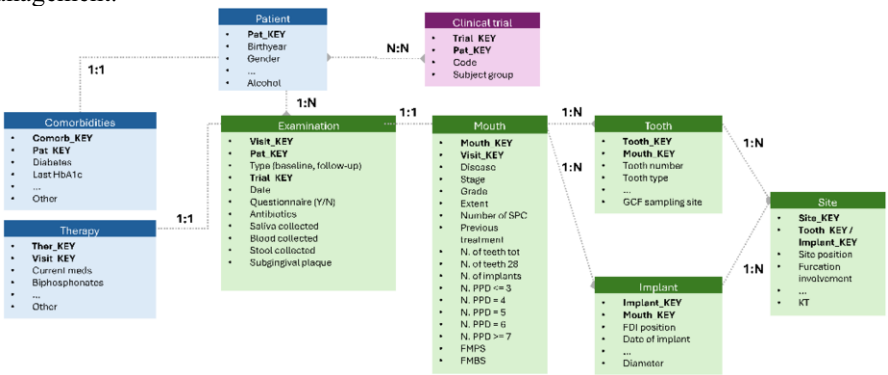

Figure 1. Entity-Relationship (ER) diagram of the DW designed for collecting periodontal data.

3. Conclusions

This preliminary work describes the design of a **relational data warehouse for periodontal clinical data**, developed to support the structured storage of information collected from periodontal charts. Such a framework enables an effortless flow of data from clinical collection to reliable prospective and retrospective analysis.

References

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