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REDCAP AND SQLITE: A POWERFUL COMBINATION FOR STREAMLINING METADATA CAPTURE IN DEEP BRAIN STIMULATION RESEARCH

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The field of Neurosciences research faces significant challenges in managing heterogeneous data types. While the Brain Imaging Data Structure (BIDS) offers a standardized format for brain imaging data organization, its limitations in capturing detailed clinical metadata, such as longitudinal clinical scores or demographic information become apparent in data analysis pipelines. To address this critical limitation, this work proposes a framework for enhanced metadata capture based on the example of Deep Brain Stimulation (DBS). It leverages BIDS with Research Electronic Data Capture (REDCap), a secure web-based platform designed for validated data collection, and SQLite, a lightweight relational database management system capable of storing structured metadata. BIDS offers organization of data in neuroscience research, and RedCap user-friendly clinical data entry for clinicians. Patient-related metadata (e.g. demographics, medication, neurological assessments) is collected via structured forms within REDCap. Medical image data, originating from Brainlab Elements neurosurgical planning station, is stored and transferred in the anonymized DICOMDIR format. To ensure

BIDS compliance, a custom Python script extracts relevant information from the DICOMDIR data. This extracted data is converted into the Neuroimaging Informatics Technology Initiative (NIfTI) format, and the resulting files are stored in a BIDS-compliant directory structure. Additionally, image references are established within the SQLite database, which also serves as repository for metadata extracted from REDCap. To validate the proposed framework, data was collected and analyzed from two medical institutions: the University Hospitals Basel and Clermont-Ferrand. Our framework has successfully captured data for 107 patients, with an average of 35 imaging files including MRI and CT scans and labeled anatomical structures. This data is stored and managed within the patient-centric SQLite database. The database schema comprises 28 tables, 230 data fields (e.g. patient ID, age, implanted position, image file path) and 33 established relationships between these tables. The advantages of using such a system can be particularly appreciated in the use-case of group-level analysis. The system design facilitates efficient retrieval of structured clinical data. Furthermore, the framework effectively handles and stores files generated during post-processing steps, ensuring data integrity and traceability. This work demonstrates the successful integration of a translational tool for streamlining data collection and organization between clinics and research institutes. Our framework captures both standardized imaging data and comprehensive patient-metadata within a unified system. This enables researchers not only in the field of DBS but from the Neurosciences in general to leverage the richness of both types of data, potentially leading to improved clinical decision-making and ultimately, better patient outcomes.

Keywords: Neuroscience data; Data management system; Brain Imaging Data Structure (BIDS).

Session(s): Neuroscience and neuroengineering [main track]

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