

The Alzheimer's Disease Neuroimaging Initiative informatics core: A decade in review

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Abstract

The Informatics Core of the Alzheimer's Disease Neuroimaging Initiative has coordinated data integration and dissemination for a continually growing and complex data set in which both data contributors and recipients span institutions, scientific disciplines, and geographic boundaries. This article provides an update on the accomplishments and future plans.

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1. Introduction

Informatics and data management solutions in multisite efforts are essential for success. There are many aspects to this including, data ingestion, meta-data tagging, provenance, logging, sophisticated query, data interrogation, tightly coupled analytics and visualization, data format flexibility, data distribution and transmission, data integrity and safety, and data use policies.

The degree to which the high quality data is efficiently ingested into databases along with comprehensive meta-data and usable provenance determines its value. How easily can data be found and queried by anyone who is provided access further enhanced its usefulness. The ever increasing rate of utilization seen in Alzheimer's Disease Neuroimaging Initiative (ADNI) and other efforts has been driven largely by the creation and adoption of successful informatics solutions along with the demand for multiscale, multimodal, large N data in the investigation of fundamental disease processes [1]; the necessity of applying methodologies and insights from multiple disciplines to adequately integrate, query, analyze, and interpret the data [2]; and the movement of science in general toward freely and openly available in-

formation [3]. We have reached a point in biomedical science where the electronic collection, organization, annotation, storage, and distribution of data are essential activities in most translational discovery processes.

1.1. Overview

Multidisciplinary scientific collaboration has expedited discovery and understanding of complex problems, with benefits amplified through the application of generous data sharing practices. Although this potential was recognized over a decade ago, only recently has the sociology of scientific communities become accepting and even welcoming of the sharing model building on participation and contributions across disciplines, institutions, laboratories, and investigators [4–6]. The ADNI study unites the expertise and efforts of scientists from multiple disciplines and organizations working toward improving our understanding of Alzheimer's disease. Eight cores participate in the ongoing conduct of the ADNI study, each using distinct systems that contribute toward a complex flow of data between systems, individuals, and institutions (Fig. 1).

ADNI has set the standard for informatics solutions that facilitate open sharing with a broad data sharing philosophy embodied in the study's subject consent language, data use agreement, and publication policies. This philosophy has been translated into practice with widespread data

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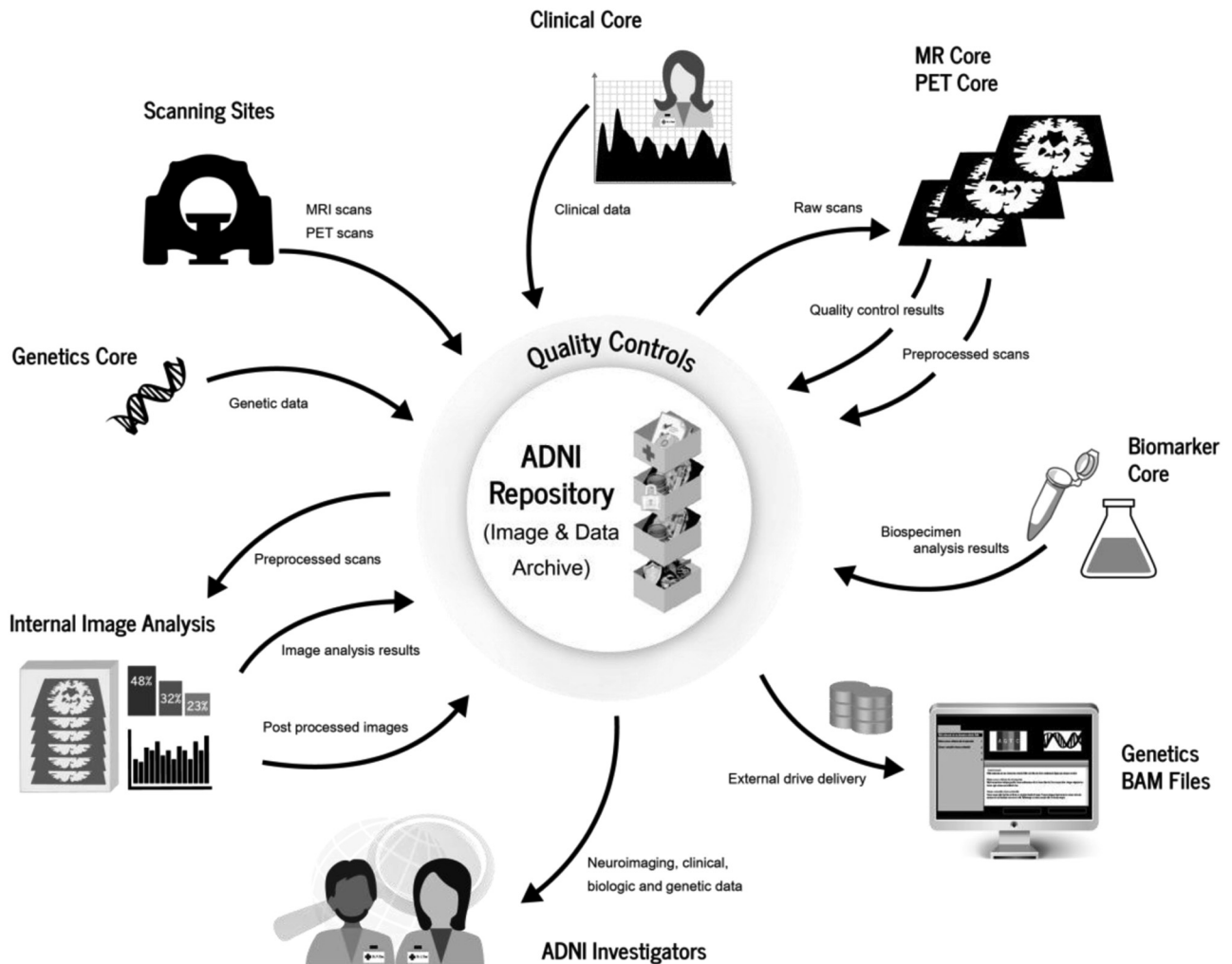


Fig. 1. Alzheimer's Disease Neurological Initiative (ADNI) Data Flow Data flows from the participating sites and between the ADNI cores is carefully choreographed.

sharing and data reuse evident in the number of investigators using ADNI data in their research and the number of ADNI-related publications submitted and published to date. All ADNI data collected and generated through the oversight and efforts of the eight cores are ultimately deposited into the ADNI data repository (Image and Data Archive [IDA], Laboratory of Neuro Imaging, University of Southern California) and data passing quality control checks are made available to the scientific community without embargo, generally within days of collection. The primary goals of the ADNI informatics core are to build and sustain a data repository and information infrastructure that facilitates data integration and sharing for the diverse and growing ADNI scientific community.

The ADNI Informatics Core developed the infrastructure and has played a central role in managing and integrating data collected and analyzed at each of the participating centers, generated by the other ADNI cores and contributed by external investigators since the study began in 2005. The informatics core disseminates ADNI data to a continually

growing number of investigators who have written hundreds of scientific papers based on ADNI data. Research using ADNI data crosses many scientific disciplines, geographic regions, and includes computer scientists interested in developing and testing machine learning and classification algorithms, neuroscientists interested in developing and testing models of disease progression, radiologists, geneticists, and many others seeking to expand the boundaries of scientific knowledge. ADNI has been a global resource of scientific discovery for a decade. Here we report on the efforts of the informatics core in managing and disseminating these valuable data.

1.1.1. Background

The ongoing and long-term collection of varied and expanding longitudinal data has produced an accumulation of data that are heterogeneous, complex, and large. From the earliest ADNI phase (ADNI-1), different study cohorts (healthy control, mild cognitive impaired [MCI], and Alzheimer's disease [AD] subjects) followed different

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