

# The global cost of visual impairment

250 million people suffer from visual impairment at a global cost of \$3 trillion, Translational Imaging Innovations explain



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Did you know that 250 million people suffer from visual impairment at a global cost of \$3 trillion? This number is expected to double by 2050. Clinicians and researchers monitor the health of our eyes through imaging and interpreting quantitative signatures of disease, called biomarkers. The development of biomarkers in ophthalmology is a challenging endeavour. Clinical data management tools are not well-suited to the data access needs of biomarker research. Translational Imaging Innovations (TII) is addressing the challenge of biomarker development with an integrated online platform. TII’s mission is to make data more accessible and actionable for investigators, empowering images to accelerate innovations in eye care. By unleashing the power of the eye, we can transform medicine.

The eye is the window to our soul and our health. Like a digital camera, the

eye captures images of the world by focusing light through our lens at the front of the eye to our sensor, the retina, at the back of the eye. We regularly capture photographs of the retina with sophisticated cameras and use these photos to assess the health of our eyes. Retinal photos can tell us about early-stage degenerative eye diseases so that we can treat patients early. Not only can retinal photos tell us about the overall health of our eyes, but they can also tell us about diseases we do not normally associate with vision, including diabetes and neuromuscular disease. Research is rapidly advancing on techniques for diagnosing multiple sclerosis and Alzheimer’s disease using eye imaging. Our eyes communicate to us using their own language – biomarkers.

Biomarkers are quantitative signatures of disease that clinicians and scientists rely on for patient care and the

development of new treatments. Imaging-biomarkers are a particularly important class of signatures because of available, non-invasive imaging technologies. Biomarkers are disease-specific and must be sensitive enough to detect early changes in eye health and track pathology. To discover and validate new biomarkers, scientists need access to tremendous volumes of images and data. Managing big data comes with significant challenges that are unique to the field of ophthalmology.

Among the challenges in conducting image-driven biomarker research is the lack of standardisation in the field of ophthalmology. Research requires FAIR data – data that is Findable, Accessible, Interoperable, and Reusable. Researchers cannot find images associated with medical records. They do not have access to clinical records that have protected patient health information. Images

and data from various instruments are not considered to be interoperable for biomarker applications due to proprietary data formats. Researchers are struggling to curate a single large data set. Curating multiple large data sets that can be replicated, shared, and reused in a different context seems unfeasible and is a challenge that has not yet been met.

Managing images for research and development is quite a bit different than managing images in the clinic. In the research context, the objective is to collect and analyse large amounts of images and metadata – data about the images and the patient population – and transform this raw information into actionable insights that apply to specific diseases, therapies and patient groups. Clinical image management systems are not designed for this task.

The depth of this problem is acknowledged in the U.S. by the National Eye Institute (NEI) of the National Institutes of Health (NIH), the Association for Research in Vision and Ophthalmology (ARVO) and the U.S. Food and Drug Administration (FDA). These organisations are actively promoting standardisation across the ophthalmic imaging space. It is up to industry to drive the development and adoption of standards. Government agencies and professional societies must promote and incentivise the adoption of standards to accelerate clinical research, robust diagnostics and effective treatments for eye disease.

Translational Imaging Innovations (TII) is on a mission to accelerate biomarker discovery by enabling FAIR data management. TII provides a suite

of software to drive ophthalmic research forward. Researchers can track clinical research projects from data collection through analysis in an online portal, Lattice©. Lattice provides electronic record-keeping of research subjects, encounters and exams that are tied to ethics protocols. Lattice allows investigators to monitor the progress of multi-site collaborations. All source data and medical records are captured and encapsulated with ocuVault™. ocuVault is a unique data transport and storage system for the secure transfer of images and data. ocuVault maintains data provenance and security, ensuring accessible, actionable and auditable data throughout a project lifecycle. ocuLink™ is the data visualisation application that allows investigators to curate and annotate multimodal image collections during biomarker exploration. Curated and annotated collections are analysed in Mosaic, a computational environment for systematic biomarker development. Lattice, ocuVault, ocuLink and Mosaic are the basis for Integrated Translational Imaging™.

The Integrated Translational Imaging suite is built on a common data model – the TII Data Genome©. The Data Genome is a standards-driven ontology for defining the data elements required to curate images and data for collaborative research. The Data Genome relies on standardised libraries and templates including Logical Observation Identifiers Names and Codes (LOINC), Systemized Nomenclature of Medicine (SNOMED), the Global Medical Device Nomenclature (GMDN) and Digital Imaging and Communications in Medicine (DICOM) to ensure an extensible, scalable, and FAIR data structure.

The ophthalmic research community invests heavily in developing therapeutic innovations to slow the progression of degenerative eye disease and reverse blindness. Their efforts merit a better set of tools to conduct this research. Imaging of the eye and the generation of robust biomarkers from images is critical to the development of early diagnostics and new treatments. Significant challenges in data management and data standardisation constrain the pace of innovation. Translational Imaging Innovations is addressing the needs of the ophthalmic research community with an integrated suite of software solutions, enabling FAIR data management, improved collaborations, and accelerated development of imaging biomarkers essential to the development of new therapies. TII's goal is to enable ophthalmic investigators to develop better diagnostics and better therapies, with more predictable benefits – faster, at a lower cost and with less frustration.



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