Bill & Melinda Gates Foundation's UNITY Project *Democratizes Brain Imaging Research* Around the Globe

When it comes to conducting large-scale medical imaging studies, researchers need to ensure data collection and analysis are as equitable across all collection sites as possible. Only then can they get reliable, actionable results that can affect real change.

The Bill & Melinda Gates Foundation is in the midst of doing just that with its project UNITY, which stands for Ultra-Low Neuroimaging In The Young. Led by King's College London, the project has enabled research teams around the globe to collect pediatric MRIs using low-field scalable imaging tools that can be operated by most people.

The goal is to look beyond typical markers of childhood development, such as height and weight, and investigate the effects of issues such as malnutrition and birth complications on the brain. They're accomplishing this by collecting and comparing pediatric MRIs between high-income countries (HICs) and low-middle-income countries (LMICs), where these issues are more prevalent.

> "Our bet has really been on looking more closely at the brain," explains Sean Deoni, Ph.D., senior program officer, Bill & Melinda Gates Foundation. "When we think about all those amazing behavioral and cognitive changes that occur across the first two to three years of life, they are mirrored by substantial changes and amazing changes within that child's brain."

Their mission is to minimize the impact of these issues and help children everywhere reach their highest potential and live their best possible lives. It's a massive and worthy undertaking, and one that Flywheel is proud to be an integral part of.

The Challenge

In order for UNITY to accomplish its goals, project directors needed to enable their researchers to collect, process, and curate their own data.

“When we talk about imaging data, not only do you need experts in terms of acquiring the data, but you need a tremendous amount of expertise in analyzing that data,” Deoni says.

The technology required

In addition to building knowledge and capabilities across research sites, they needed a way for researchers to upload and process data in a consistent and automated way. With a centralized imaging platform in place, each team could spend more time analyzing their data, rather than managing it.

Researchers across all sites required secure data-sharing capabilities, with proper access management controls. They also needed to be able to establish common workflows with provenance so that projects within UNITY would be consistent and reproducible, empowering local teams to publish their own papers based on their studies.

The challenge for UNITY was to build both the computing infrastructure and knowledge base for them to do more of that imaging analysis on their own while creating common workflows and protocols to retain consistency across the project.

The Solution

To help achieve their vision, UNITY selected Flywheel to serve as one singular platform for data ingestion and management, computation, and algorithm development. Flywheel served as a centralized hub for the diverse range of researchers associated with the project.

> **“This is really where the relationship with Flywheel came from,” Deoni explains. “Rather than trying to set up these large-scale image processing laboratories and do all the capacity building in terms of the infrastructure as well as training, we could instead offload a lot of that to Flywheel to act as our cloud-based image curation and analysis suite.”**

By choosing Flywheel, UNITY’s researchers in sub-Saharan Africa, India, Bangladesh, and Pakistan could upload their data while collecting input from leaders in academia, clinical practice and industry partners across the U.S., Canada, Europe, and the U.K. No matter where they were located, those involved could access the same data in one, centralized location, while lowering the barrier of entry so anyone could start looking at data, conducting quality control, and running analytical processes on them.

> **“Flywheel really acted as a nice, direct, easy way to integrate across all these sites, have a singular place where we can bring that data together, ensure that it’s searchable and sharable across our network, and also harmonize data processing pipelines so that we know everyone’s doing the same thing,” Deoni says.**

With Flywheel handling data capture and data management, UNITY’s team could then focus their time on training personnel in data and image processing and manipulation, as well as building their own processing tools. With the right knowledge base in place, UNITY could subsequently focus on creating the computing infrastructure necessary for investigators to complete their own analyses.

> “Flywheel was the only tool available on the market that brought all these components together in a lightweight platform that could be deployed anywhere,” Deoni says.

The Results

With Flywheel in place, researchers on site have been able to upload their scans directly to the platform and manually curate and visualize their data as they go, saving time and improving the quality of data collected. Scans can be uploaded to a central location from studies across several sites at once, meaning there’s more time to process and analyze that data.

Scans can be uploaded and automatically classified by acquisition type and converted from DICOM to NIfTI. Quality control can be run from anywhere on these scans through a web browser, which allows for collaborator input.

There’s also provenance of data and processes within Flywheel. This makes it possible for all parties to run the same workflows across different sites in a reproducible and scalable way.

> “Flywheel has been a great way to connect everybody through one, central platform,” says Niall Bourke, Ph.D., research fellow, King’s College London.

By the Numbers

Flywheel helps UNITY get more from (and give more back to) its research sites

48 researchers on 2 Flywheel instances

12 LMIC/HIC sites

110K+ algorithms run by researchers to date

5,000+ sessions uploaded over 1.5 years

9 gears created and running, with more under construction

25+ machines across UNITY enterprise

Fueling innovation

Within UNITY's work, disparate areas of interest occur, depending on the research site. One site might be interested in maternal anemia, another in nutrition, and another in encephalopathy. Each site is set up to have control over its own research within Flywheel. The site can then control who has access to a particular project and what analysis gets run on their data.

Because existing pipelines weren't optimized for working with data involving children, they needed to create new analysis workflows. With Flywheel, they've been able to create these in Flywheel Gears, or containerized algorithms that can be easily deployed at scale on the platform. Some of the new gears they developed cover isotropic reconstruction, N4 bias correction, fetal brain segmentation, and more.

Each gear can be run automatically after the previous step, significantly speeding up processing time. Gears can also be selected ad hoc, depending on the specific project's needs, such as high-field fetal image segmentation or conversion of reconstructed images to DICOM for PACs upload. The output of this processing is standardized across projects, helping researchers aggregate data to address global health concerns as well as enable future collaboration.

> "Getting everyone to have the same analytical pipeline really adds value when you want to scale, incorporate data, and compare different regions, conditions, and environmental issues," says Steve Williams, Ph.D., professor, King's College London.

Enabling local publication and working to improve outcomes

When a group gets to a point where they want to share their data more widely, they can move their data into a collection that can be further analyzed by others involved in UNITY. One local team using Flywheel has already published a paper and made their data available to the wider UNITY consortium. That data could also be published to the wider Flywheel community through Flywheel Exchange, if they so choose, thereby giving access to important data to the greater neuroimaging community.

Ultimately, Flywheel has been able to provide an infrastructure to collect and harmonize data so the researchers can better work toward their collective ultimate goal: optimizing children's health around the globe.

> "If we've helped save a few more lives in one of those settings, then this will have been a huge success," Williams says.

*Visit **flywheel.io** for more on how Flywheel is enabling research in high gear.*