RCH SOLUTIONS

EBOOK

How Cloud Computing Puts Precision Medicine R&D Within Reach for Biopharma Start-Ups

Exploring the advantages of the cloud and best practices for implementation.

Open-source medical data drives innovations within precision medicine, unlocking the ability to create personalized treatments for each patient based on their lifestyle, environment, and genes. These technologies can illuminate the causes of illness and predict positive effects and adverse reactions to available treatments. While insights in this arena were previously limited to large labs and research facilities, cloud computing has put the necessary processing technology in the hands of agile biopharma start-ups and labs.

To understand just how big of an impact cloud computing has on emerging biopharma organizations, consider the classic big data example of the human genome mapping project. As reported by Forbes, the initial mapping of the human genome cost $1 billion and took ten years to achieve in 2003. Thanks to cloud computing capabilities, small labs can now map individual genes in around six hours at the cost of about $1,000. In this guide, explore the possibilities created in the cloud computing space, along with implementation strategies for your start-up.

Section 1

Why is the cloud so critical for precision medicine?

Eventually, health care providers will be able to recommend specific treatments for acute and chronic diseases based on the patient's complete personal and medical history, eliminating the need to take a trial-and-error approach in medicine. For example, researchers from the University of California San Francisco theorize that within a few years, a provider will be able to match a patient with type 2 diabetes with the right medication based on how long they've had the disease, their sex, their age, their ethnic background, and their genetic makeup. The cloud provides the necessary processing power and storage space to develop precision treatments derived from massive volumes of patient and genome data, removing one of the largest barriers to widespread adoption of the personalized approach.

The Cancer Research Data Commons, a project by the National Cancer Institute (NCI), epitomizes the energizing impact of the cloud on precision medicine. On this NCI Cloud Resources platform, cancer research labs from around the world can share, evaluate, and analyze data within this expansive ecosystem designed to power meaningful advances in cancer research and development.

The platform consists of several cloud engines, including the Cancer Genomics Cloud (CGC), which itself is comprised of the data from the Clinical Proteomic Tumor Analysis Consortium (CPTAC) and the Cancer Genome Atlas (TCGA), along with hundreds of tools and workflows to facilitate massive, complex calculations. Any cancer lab that taps into the platform can access these resources and data sets for R&D.

Seamless collaboration

New innovations in precision medicine require the central data repository provided by cloud platforms. Transitioning from local servers to the cloud allows organizations to tap into its wealth of open, aggregated information, including data from electronic health records, genetic tests, patient feedback, wearable health devices, existing clinical trials, and countless other sources.

The cloud effectively erases the data silos that have historically prevented emerging labs from competing with big pharma in the precision medicine space. Now, researchers and patients around the world contribute to this ever-evolving body of information that drives the development of increasingly targeted treatments, all within the cloud environment.

Cloud platforms can also streamline the research pipeline by extracting, cleaning, and formatting discrete data sets so they can be aggregated into a single repository.

> This technology represents significant time and cost savings, as scientists no longer have to manually perform these steps before beginning analysis.

Superior security measures

According to researchers from the Stanford Healthcare Innovation Lab, data on local servers simply isn't as safe as data stored and managed in the cloud. This is a critical point when it comes to the personally identifiable health information that comprises the foundation for precision medicine, but many researchers who don't interact with the cloud environment don't understand how secure it actually is.

Despite this misconception, using a reputable cloud provider gives your organization access to privacy and security measures that would otherwise be too expensive to implement at an emerging company. Cloud platforms copy information to multiple centers, which protects your research from the profound impact of data loss. They also have full-time teams dispatched to find and fix security flaws, so you don't need to worry about patching your own server system.

Conversely, most on-premise servers only have a single replication, and both these machines are at risk if a network-wide outage or natural disaster such as a fire occurs. Your company also doesn't need to worry about physical security when it comes to the cloud, removing the cost and effort of preventing on-site server theft.

The segmented cloud environment limits the impact of viruses and attacks. While these issues may affect one section of the cloud platform, the rest of it remains secure.

Support for predictive models and machine learning applications

Precision medicine research benefits from predictive models that determine personalized treatment choices based on the available data ecosystem, which encompasses various workflow data sets. Within the cloud, researchers can apply the predictive analytic frameworks to the appropriate sets to explore and innovate potential treatment approaches within personalized medicine. Artificial intelligence can rapidly detect trends and patterns in a cloud-stored dataset to inform precision treatments.

Cloud platforms also have the capability to build predictive disease models by integrating literature with patient data. This approach allows scientists to see how various factors interact with and relate to one another. For example, your teams can create and view simulations that reveal underlying causes of disease by visualizing the impact of overexpressing or removing certain genes.

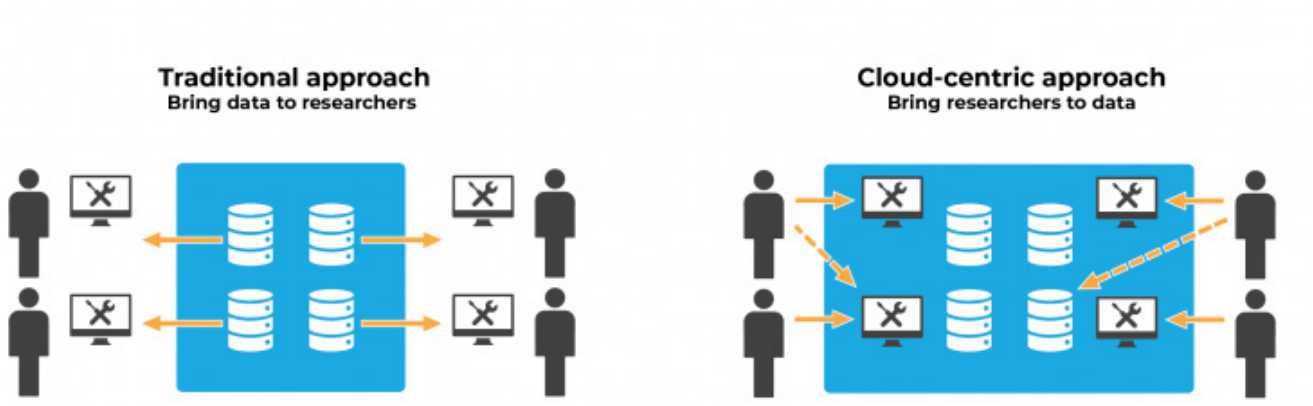
With these tools, precision medicine can potentially help address health disparities, particularly among racial and ethnic populations who have historically been underserved by the healthcare system. Big data within the cloud also helps expand the currently limited available clinical data for adults ages 75 and older.

USCF reports that about 86% of Asian Americans have a hypersensitivity to the

common blood pressure drug warfarin, which may increase the rate of uncontrolled bleeding as a side effect of this medication. In another example, the most commonly prescribed asthma drug, albuterol, does not work as effectively in African American and Puerto Rican individuals. These groups have the highest rates of pediatric asthma in the U.S.

Scalable for future growth

The cloud's framework facilitates expansion as your emerging organization grows in mission and scope. If you need more storage space or additional processing capacity, you can access these resources without implementing a new hardware or software system. The platform can also expand as needed to foster cross-department or organization collaboration without introducing issues with speed, security, or access. It also prevents the version control issues that occur when researchers in various locations have to download the same data set to a local server rather than collaborating on the cloud in real-time (Figure 1).



Enhanced user experience

Most cloud platforms are designed to provide a user-friendly experience, allowing researchers to work with data sets even when they have limited knowledge of the underlying technological innovations. Integrated workflows accelerate common analysis processes in areas such as imaging, epigenetics, proteomics, single-cell analysis, mutation analysis, and RNA sequencing without sacrificing best practices. Some cloud systems even include access to expert technical support and user guides that estimate the time and cost of a particular calculation so researchers can focus on innovation rather than reinventing the wheel by rebuilding existing data models.

Section 2

What do biopharma start-ups need to know before adopting cloud technology?

Digital transformation typically requires a significant financial investment, especially for emerging organizations. Cost remains a primary consideration for most small labs. The National Cancer Institute's Center for Biomedical Informatics and Information Technology recommends evaluating your research in terms of four cloud cost categories:

- Cloud computing, comprising the software and hardware your teams need for effective research and development. Cost increases in this category with increased platform customization, configuration, features, and virtual technology. Many cloud providers also charge for time spent performing data analysis, with premiums paid for on-demand access compared to more flexible scheduling.
- Cloud data transfer costs, including moving data between different regions of the cloud, as well as uploading and downloading information.
- Cloud storage, which increases in tandem with the amount of data, as well as with the necessary storage retrieval times. In other words, the more data you have and the faster your teams need access, the more you'll pay in this category for cloud services.
- Cloud technology, with costs increasing as the required build increases in complexity. Some of the more expensive features include artificial intelligence capabilities, data visualization and analytics, and natural language processing.

Don't forget to budget for expert staff and training, as cloud-based R&D requires the ability to adapt along with the accelerated flow of available services, apps, and platforms.

Although the cloud environment offers increased security compared to on-premise servers, you'll still need to invest in a few measures to optimize data safety. Make sure you choose a provider with features such as IP-limited access, the ability to make your own encryption keys, and support for multi-factor authentication. Comprehensively assess these areas to help ensure a successful cloud migration for your biopharma start-up.

> Labs are increasingly hiring biomedical scientists who are adept at managing and interpreting multidisciplinary research data.

Section 3

What do experts predict for the future of precision medicine?

Despite the dramatic advances in precision medicine capabilities over the past decade, science has only scratched the surface of the cloud's potential to harness and use big data to develop personalized treatments. Key areas for expansion in the coming months and years include:

- New ways to aggregate phenotypic and genotypic data along with international collaboration with these data sets, resulting in new insights about genetic disease factors
- Population sequencing studies to inform understanding of the impact of genes on disease development and presentation
- Rapid translation of safe, effective study results into practice driven by the alignment of patients, health care providers, and research teams
- Targeted medications and dosage recommendations based on individual genetic factors
- Advances in radiogenomics, the use of certain biomarkers on imaging studies to predict response to cancer treatment
- Stratifying patients based on comorbidity risk by evaluating factors such as organ function, age, and other existing health issues

Precision medicine also provides an opportunity to integrate the spectrum of social determinants of

health, including not only personal health history and biomarker data but also environmental exposures, employment status, socioeconomic status, and behavioral and lifestyle factors. A study published by Health Affairs suggests that SDOH make up as much as 60% of our personal disease risk, with 30% comprised of our genetics and just 10% determined by our personal health history.

It would be difficult to overemphasize the importance of the cloud in the advent of precision medicine. Moving forward with biopharma research outside of the cloud environment can put emerging organizations in this sector at a significant disadvantage. Partnering with an experienced provider can help your start-up develop, implement, and maintain a cloud environment that lets your lab keep pace with the rapid revolution of precision medicine.

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