Accelerating Clinical Trials with Digital Health

Get your innovative drugs to market faster through digital patient recruitment and retention, enhanced real-world data capture and automated insights.

BrightInsight

A Flex Company

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Purpose of White Paper

Digital technologies present a huge opportunity for biopharmaceutical companies to transform their clinical trials. In an industry where getting novel therapies to market ahead of the competition is paramount, companies are constantly looking for ways to accelerate clinical trials in safe, costeffective ways. This white paper explores the ways in which digital health can accelerate clinical trials, reduce costs and improve data collection and analysis through richer data sets and machine learning. Readers will learn the opportunities that exist as well as strategies on how to begin implementing digital in trials today.

Today, it costs around two billion dollars and ten years to discover, develop and launch a new drug.[1] Biopharma's traditional model of investing heavily in R&D is leading to diminishing returns.[2] The industry is seeing that investing billions towards future products that most often don't make it to market is not sustainable.

> **Faced with long drug development cycles and diminishing rates of return on their R&D investments, biopharma companies are looking to digital and machine learning technologies to improve the efficiency and the effectiveness of drug development.**

Understanding the Digital Health Opportunities in Clinical Trials

Digital health solutions can accelerate clinical trials, reduce costs and improve data collection and analysis through richer data sets and machine learning.

Accelerate Clinical Trials

Digital technology can accelerate clinical trials by enabling biopharma companies to do more faster, which can translate to significant revenue. Every day that a drug is not in the market because of development or regulatory delays costs a biopharma company between $600,000 in lost revenue for niche products to an average of $8 million for blockbuster drugs.[3] From accelerating the recruitment and retention of patients, to remote data capture from connected medical devices and wearables to automated insight generation through advanced machine learning capabilities, digital is poised to transform – and drastically speed up – clinical trials.

Reduce Clinical Trial Costs

A 2014 study showed that drug development costs had increased 145% since 2003 . The average cost of a Phase 2 clinical trial ranges from $7.0 million to $19.6 million, while the average cost of a phase 3 clinical trial ranges from $11.5 million to $52.9 million.[5] Recruitment, retention and monitoring account for approximately thirty percent of the average clinical trial cost, and this number approaches fifty percent when the physician and Registered Nurse (RN) or Clinical Research Associate are included. Biopharma companies can use connected medical devices and clinician portals to enable remote patient monitoring to reduce the required number of in-person visits as well as costs associated with researchers and clinicians to manually monitor and interpret patient data.

[1] https://www.fool.com/investing/2016/07/31/12-big-pharma-stats-that-will-blow-you-away.aspx
[2] https://endpts.com/pharmas-broken-business-model-an-industry-on-the-brink-of-terminal-decline/
[3] "Accelerating Clinical Trials: Budgets, Patient Recruitment and Productivity," Cutting Edge Information, 2005, https://www.prnewswire.com/news-releases/clinical-trial-delays-costpharmaceutical-companies-55044607.html Accessed December 2017.
[4] https://cen.acs.org/articles/92/web/2014/11/Tufts-Study-Finds-Big-Rise.html
[5] https://www.centerpointclinicalservices.com/blog-posts/driving-drive-drug-innovation-andmarket-access-part-1-clinical-trial-cost-breakdown/

Improve Patient Recruitment and Retention

Patient recruitment and retention are other major factors in determining the speed and duration of a clinical trial. Patient recruitment consumes thirty percent of the overall clinical trial process[6] and four-out-of-five clinical trials fail to meet original recruitment targets,[7] which is causing biopharma companies to consider digital platforms to more quickly recruit patients for trials. Poor participant retention forces biopharma companies to re-recruit, leading to extended trials. According to Forte Research, the average dropout rate across all clinical trials is thirty percent.[8] Patient dropout is often tied to inconvenience – such as long commutes to a study site, multiple visits that conflict with their daily schedule and more. By providing patients with mobile apps and connected medical devices, trial sites can alleviate the patient's burden of manually tracking their outcomes data, reduce the number of in-person visits the patient has to travel to, and provide them with a frictionless user experience that consumers have come to expect. One particularly interesting area where digital is being applied is the passive collection of data and the application of algorithms to predict patient behavior and personalize patient content to improve engagement.

Expand Data Collection

According to research, the global Internet of Things (IoT) market in healthcare is expected to grow to reach ~$405 billion by 2026[9]. With the introduction of more and more connected healthcare "things", such as wearables and medical devices, biopharma companies are able to passively collect a wealth of data they have not had access to previously. One major opportunity is surrounding the capture of secondary or exploratory study endpoints - endpoints that are analyzed after the trial for which the trial may not be powered nor randomized. This data may yield insights in how to better manage a particular therapy in-trial and in-market, as well as reveal alternate uses for a particular therapy. More and more we will see companies leveraging the robust data sets from wearables and connected medical devices to develop algorithms that show statistically significant data to support primary study endpoints. These digital health technologies will enable biopharma companies to discover new uses for therapies.

Enhance Data Analysis and Predictive Algorithms

The McKinsey Global Institute estimates that applying big-data strategies to better inform decision making could generate up to $100 billion in value annually across the US health-care system - and improving the efficiency of research and clinical trials is one of the key areas of opportunity the study identified.[10] Biopharma companies are beginning to leverage machine learning to develop algorithms to enable real-time remote patient monitoring as well as yield insights that influence adherence and patient engagement methods (e.g., reminders, gamification, incentives). These engagement methods can also be applied post-trial to encourage medication adherence and timely refills. Demonstrating improved outcomes and patient experiences using companion digital therapies will allow companies to submit their proprietary algorithms to a formal trial and through regulatory approval.

As the population continues to age globally and healthcare costs continue to rise, the industry is transitioning from traditional high-touch, face-to-face visits between clinicians and patients to high-tech, remote patient monitoring models. Digital technologies are powering these remote care models, which are enabling the capture and analysis of patient data on a continuous basis to provide clinicians with a more accurate and holistic view of a patient's health. The value of having this holistic patient view with seamless, more accurate data capture presents a huge opportunity for clinical trials.

Digital health companion apps or connected medical devices provide continuous visibility into a biopharma company's patient population, enabling ongoing improvement of algorithms that can engage patients in remote care models that are more effective, personalized and predictive.

[6] https://social.eyeforpharma.com/uncategorised/accelerating-clinical-trials-strategies-improve-efficiency
[7] https://social.eyeforpharma.com/clinical/future-clinical-trials-0
[8] https://www.centerwatch.com/news-online/2016/06/27/issue-patient-retention-clinical-trials/
[9] https://www.wiseguyreports.com/reports/3068773-iot-healthcare-global-market-outlook-2017-2026
[10] https://www.mckinsey.com/industries/pharmaceuticals-and-medical-products/our-insights/how-big-data-can-revolutionize-pharmaceutical-r-and-d

Overview of Digital Health Technologies for Clinical Trials

It is clear that digital health technologies can streamline trial efficiencies, reduce costs and improve data capture and analysis. The next step in building out your digital health strategy for clinical trials is understanding the different types of technologies that can be leveraged.

Here are some examples of digital health technologies that can be integrated into a clinical trial, all of which provide benefits of more frequent, accurate and robust collection of data:

Connected Regulated Drug Delivery Devices
Smart devices such as injector pens and inhalers can be used to capture device usage to monitor medication adherence, manufacturing lot, dose, date and time. This data can be used by a biopharma company to optimize its therapies or can be shared with caregivers or clinicians to support remote monitoring or care coordination use cases.

Connected Wearables and Consumer-Grade Devices
Non-regulated connected devices such as activity trackers, weight scales, sleep monitors, air quality monitors, blood pressure cuffs and heart monitors are being used in trials to transmit patient vitals to provide more context around their health status. The smartphone itself can also be used to capture patient vitals through the accelerometer, GPS, touch screen, microphone, and camera technology on the phone. One example is tracking the activity of patients with COPD (Chronic Obstructive Pulmonary Disease) in a clinical trial to understand how their outcomes may be affected by the patient's activity.

Audio-based Technologies
There are a number of audio-based technologies that seamlessly integrate into patient's daily lives. A recent study showed that audio-based approaches can be used to monitor inhaler adherence in clinical practice . In fact, the study actually uncovered insights beyond adherence, with the acoustic evidence revealing that 17% of the patients were using the inhaler incorrectly. The most common error made by patients was exhaling into the inhaler after the lever had been deployed to activate the drug. This error reduces the quantity of drug inhaled and negatively affects outcomes. Companies are also exploring how to leverage the home assistant platforms, such as Google Home, that consumers have adopted to contextualize healthcare data with lifestyle data to deliver improved medication reminders or instructions on how to use a certain therapy.

Companion Apps
Smartphone apps can be used in clinical trials to deliver validated instruments for capturing patient reported outcomes. They can facilitate therapy schedules, educational content, reminders, interventions and remote consults. These apps can also be consumer or medical grade, such as Software as a Medical Device, (SaMD).

How to Get Started with Digital Health

Determining which technologies and where to begin when implementing digital health in clinical trials can be overwhelming. In this section of the white paper, we outline the main considerations to keep top of mind when digitizing your drug development process.

01 Capture data

The first step is to begin capturing data. You can do this through companion apps, biometric sensors, wearables, connected drug delivery devices or combination products.

▸ **Companion apps:** Companion apps can be used to collect patient reported outcomes, deliver instructional or educational content, provide feedback and streamline patient and clinician communication.

▸ **Biometric sensors or wearables:** BBiometric sensors or wearables are now mainstream for consumers. In fact, Apple Watch outsold the entire Swiss watch industry last quarter,[12] and with the advent of 5G we will continue to see connected devices proliferate. There is a big opportunity for biopharma companies to begin capturing data from consumer's biometric sensors or wearable devices to enhance data capture in clinical trials.

▸ **Connect your drug delivery devices or combination products:** Connecting your devices should be priority number one. In order to see the full value of investing in digital health technologies, you need access to data from the drug delivery device or combination product. When determining the type of connectivity module and sensor you need to integrate, it's important to consider the end user and their level of comfort using a smartphone, pairing devices and more. Biopharma companies should aim to make the connectivity as seamless as possible, such as having a fully integrated inhaler or injector pen versus one that requires an add on connectivity sensor. Removing friction and making patients' lives easier should be the aim.

02 Analyze the data and develop algorithms

Once you have access to new, real-world data that you have not previously had access to, you can begin to analyze it to uncover new insights and develop predictive algorithms that can help diagnose and better treat your patient segment. These real-world insights become your intellectual property and can be used to inform your research and marketing strategies and support value-based health care business models.

03 Leverage the data and insights to improve your drug development process

Armed with this new data and insights around patients, adherence, outcomes and more, biopharma companies can begin to make enhancements to their clinical trials.

[12] https://www.businessinsider.com/apple-outsold-the-entire-swiss-watch-industry-in-2017-2018-2

Future-Proof your Digital Health Platform with BrightInsight, a Flex Company

BrightInsight, a Flex Company, provides the leading global regulated digital health platform for biopharma and medtech. Our medical-grade Internet of Things (IoT) platform is built under a Quality Management System to support and optimize regulated drugs, devices and software through integrated data and actionable insights to enable customers to drive increased patient adherence and engagement.

Our mission is to make digital health innovation easy for our customers through our end-to-end digital health capabilities and scalable, medical-grade platform. Together, our leadership team brings over 85 years of combined digital health experience in the biopharma and medtech industries, bringing deep operational expertise having successfully deployed in their careers over 20 regulated digital health solutions globally to support chronic conditions including diabetes, cardiovascular disease and respiratory disease. Our engineering team has deep experience in building software solutions in highly regulated medical environments, balancing the need to iterate rapidly while operating under a robust Quality Management System.

Our parent company, Flex, helps their customers transform ideas into intelligent products for a connected world. With approximately 200,000 employees in thirty countries, Flex provides innovative design, engineering, manufacturing, supply chain insights, and logistics services to a global customer base across every major industry, including healthcare. For over 30 years Flex has worked with leading healthcare companies deploying over 100 regulated hardware and software medical products worldwide.

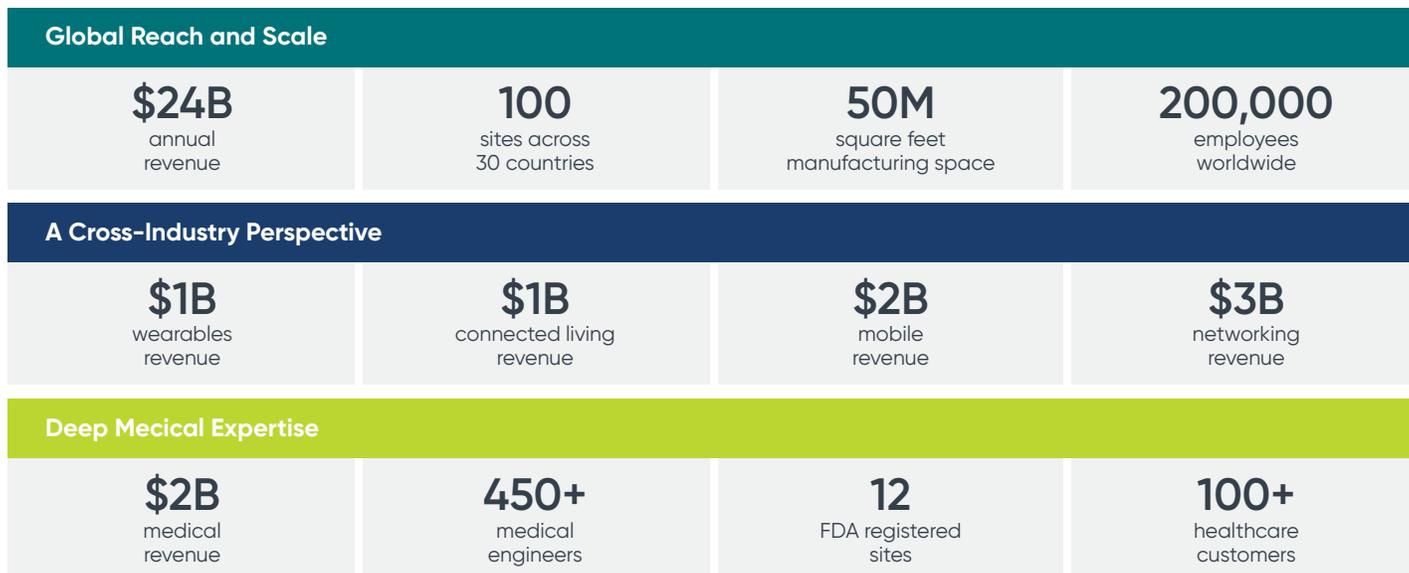| Global Reach and Scale			
$24B annual revenue	**100** sites across 30 countries	**50M** square feet manufacturing space	**200,000** employees worldwide
A Cross-Industry Perspective			
$1B wearables revenue	**$1B** connected living revenue	**$2B** mobile revenue	**$3B** networking revenue
Deep Mecical Expertise			
$2B medical revenue	**450+** medical engineers	**12** FDA registered sites	**100+** healthcare customers

Figure 1: Flex Overview

Flex's Sketch-to-Scale™ capabilities can support our biopharma customers from human factors testing, to product concept, to development and industrialization, to mass production, to app design, build, maintenance and iteration, to app optimization through our robust intelligent cloud-based digital health platform.

Our end-to-end digital health capabilities support customers from the design, build and maintenance of front-end patient or clinician facing apps, to the foundational, fully-managed medical-grade infrastructure, to the ongoing iteration and optimization of our customer's solution through real-time generation of insights.

Whether you're connecting a medical device or combination product, developing a companion app or deploying a smart algorithm, we make digital transformation easy while accelerating your time to market, minimizing your risk and future-proofing your digital health offerings.
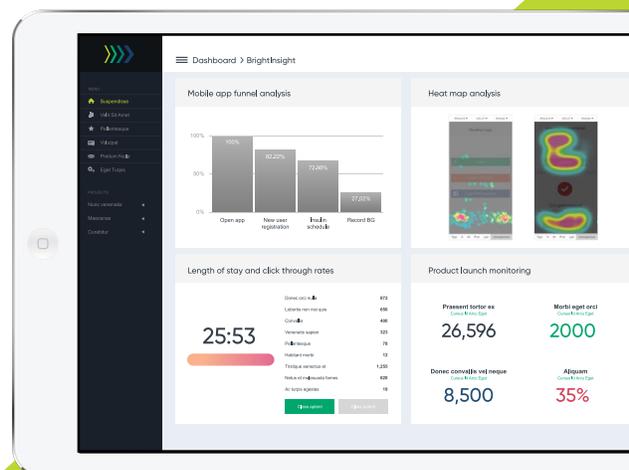
The BrightInsight™ Platform

BrightInsight is a medical-grade platform that uses software and services to enable customers to capture, transmit and analyze data from connected medical devices, combination products, apps and Software as a Medical Device, in a regulatory-compliant manner. Going beyond simple Medical Device Data System (MDDS) solutions in the market today, the BrightInsight platform was built from the ground up to support CE-marked and FDA-regulated Class I, II and III medical device, combination product and Software as a Medical Device requirements.

Connectivity
BrightInsight offers connectivity and management for regulated apps, algorithms, devices or combination products.

Data Management
BrightInsight can aggregate data from multiple sources and can integrate with EMRs and other IT systems.

Analytics and Insights
Clinical, operations and patient engagement dashboards provide valuable insights in real-time.

Figure 2: The BrightInsight Platform

Deployed as a managed service, the platform accelerates the time to market for biopharma and medtech companies, reduces the cost of implementation and maintenance versus a custom solution, and scales across products and global markets.

- In clinical trials, BrightInsight can be used to collect real world evidence that can be used to support your trial reporting requirements, support a regulated companion app, and enable the reuse of assets, such as apps, devices, integrations and analytics in trials across your organization.

- The platform is device-agnostic and integrates directly with Class I, II, III medical devices (e.g., injectors, inhalers, CPAP machines, smart pill packaging) and Combination Products to capture passive data, such as injection start and end times, dose amount, medication temperature, schedule adherence and injection device data, automatically in the background. Other device data can include IoT and wellness devices such as weight scales, air quality monitors, sleep monitors, activity monitors, gait monitors, and more.

- Depending on your therapeutic area, you may consider capturing contextual data such as weather, pollen count, patient calendars and more. The BrightInsight Platform also facilitates the capture and management of active data, such as patient reported outcomes (PRO) via a mobile app or smart speaker, in a regulatory compliant manner.

- The platform is architected to integrate easily with your data warehouse, clinical trial management system or EMR (Electronic Medical Records) application using HL7 and FHIR compliant protocols.

- BrightInsight generates real-time insights from real-world drug and device data to enable our customers to investigate new exploratory endpoints. The platform's robust machine learning capabilities and out-of-the-box customizable dashboards include:

  ▸ **Patient Engagement Dashboard:** analytics and insights to provide trial sponsors and device manufacturers with insight into app engagement, patient behavior and more.

  ▸ **Clinical Dashboard:** analytics and insights that provide real-world evidence of drug adherence, patient reported outcomes (PROs), real-time drug and device utilization data, and measurement and analysis of intervention effectiveness.

  ▸ **Operational Dashboard:** analytics and insights to provide trial sponsors with insight into segment adherence, intervention effectiveness, and more.

The BrightInsight Platform allows biopharma companies to apply machine learning algorithms to discover new hypothesis from their data that can lead to regulated algorithms that become intellectual property. These regulated algorithms can be deployed on our platform in a commercial setting to predict, diagnose and make clinical recommendations that can lead to improved outcomes, reduced costs as well as brand recognition and competitive advantages.

Starter Assets

Beyond our core BrightInsight Platform, we also offer Starter Apps to accelerate our customer's drug development process.

> **To meet our customer's remote patient monitoring clinical trial needs, we have a starter Clinician Portal and Patient App that customers can license and then customize to save up to 75% of the overall Portal and App development effort when compared to developing a Portal and App from scratch.**

• Our Clinician Portal provides Clinicians with insight into patient adherence, trends, alerts, and more. Our core BrightInsight platform can transmit data from connected medical devices to the Clinician Portal to alert Clinicians of adverse events for early intervention, or to investigate new biometric indicators to discover better predictors of adverse events. This data can also be provided for stakeholders in their applications of choice, such as clinical trial management systems or Electronic Medical Records, to increase value and adoption.

• Our Patient App provides participants with insight into their therapy, support for their condition, communications with their providers and more. Our patient app offers several capabilities to improve retention of clinical trial participants:

  » Custom user experience personalized for the participant, therapeutic and trial

  » Multimedia content delivered at the right time along the patient's journey to inform and educate the patient

  » PRO questions and surveys delivered according to rules to capture additional data

  » Non-adherence detection and intelligent interventions (e.g., reminders, phone calls)

  » Scheduling for site visits

  » Actionable insights delivered to the patient

  » Consent management and data sharing

Medical Director View

Patient App View

Trial Clinician View
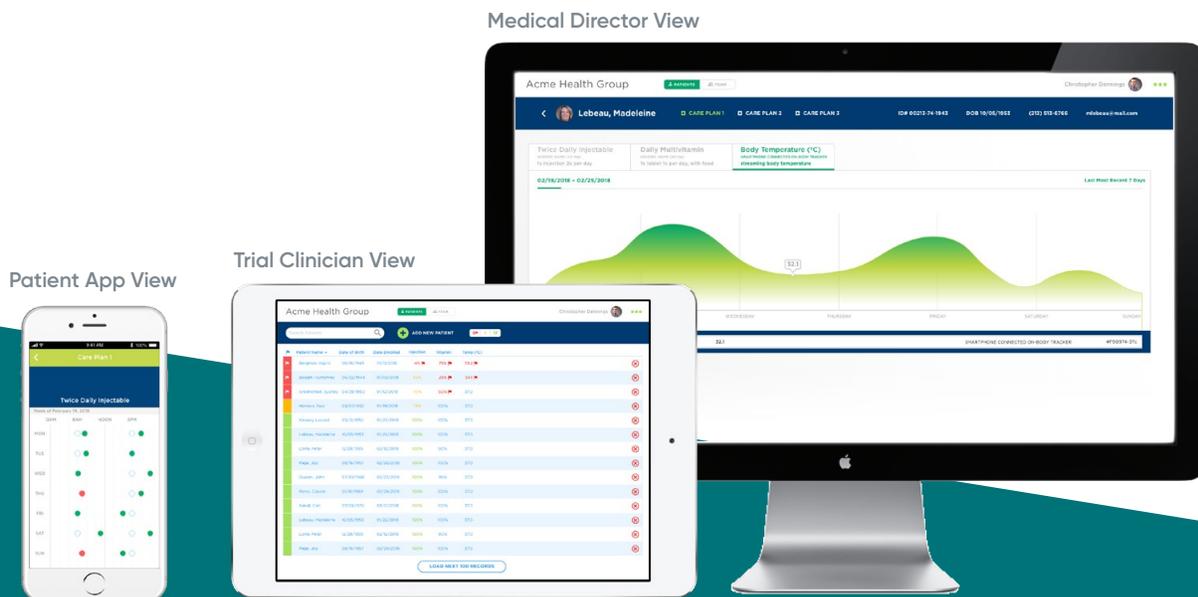
Conclusion

Digital technologies present a huge opportunity for biopharma companies to transform their drug development to accelerate clinical trials, reduce costs and improve data collection and analysis. Leveraging our decades of experience in the industry, BrightInsight is in a unique position to partner with biopharma companies on this transformational journey. With our pre-built medical-grade IoT platform and Starter Apps, our team can enable biopharma companies to quickly begin capturing and analyzing real-world data in trials.

For more information on the BrightInsight Platform, email contact@brightinsight.com or visit Brightinsight.com.