A Valued Perspective

The implementation of mHealth technologies within clinical trials looks to accelerate R&D. Such advancements hope to create the capability to improve practices and explore new markets

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Acceleration of the integration of mobile health (mHealth) technologies into clinical trial operations is expected to be the catalyst for the adoption of disruptive research platforms with capabilities to overcome barriers in both clinically mature and emerging markets. While mHealth applications of smart devices, wearable biometric sensors, and telemedicine enable health monitoring, data collection, and patient communications have been around for some time. Despite this, their widespread use in clinical research should still be considered in its infancy. We continue to see the fast development of integrated mHealth platforms that have the potential to turn the traditional research model on its head – taking studies to patients rather than bringing patients into site-based studies. Powered by Big Data and connected across patients, researchers, and caregivers, emerging mHealth platforms will expand research participation, reduce costs, and integrate research with treatment in new models of personalised medicine based on real-world evidence.

The mHealth Disruption

Four foundational trends are driving 21st century biomedical research:

- Globalisation is expanding drug development into the emerging markets of Africa, Asia, and Latin America
- Big Data is being harnessed to understand disease impacts at the population level and support evidence-based medical practice
- Real-world evaluation is extending the continuum from traditional randomised clinical trials to new research models that assess real-world outcomes
- Personalised medicine is advancing with targeted therapies tailored to smaller populations and the growth of patient-centric research

mHealth technologies now provide the means to advance medicine on all fronts. Mobile smart devices, wearable biometric sensors, and telemedicine facilitate the remote collection of real-world, real-time data in study designs that take research to the patient, rather than bringing patients onto clinical study sites.

State of the Art

Consumerism continues to fuel the rapid growth of mHealth technologies. One industry report estimates that mHealth wearable devices will account for more than 60 million shipments in 2017, with a market value of $23 billion and a projected annual growth rate of 35% (1).

In the research sector, development of medical-grade biometric sensors and smart devices is advancing at a blistering pace. Medical-grade devices now support care and diagnostics in chronic diseases, from cancer and heart disease to diabetes and asthma. mHealth platforms are also well-suited to most therapeutic areas, delivering not just biometrics on heart rate, blood pressure, ECG, respiration, etc, but at the same time, the use of patient convenience applications continues to drive greater levels of patient engagement, retention, and compliance. Widely used mHealth technologies include smartphone image transmission systems for diagnosis and portable telemedicine units linked to computer servers to conduct video consultations (2). Numerous providers are working with sponsors and CROs to develop dedicated mobile devices designed for specific clinical trials (3).

Growing experience and adoption confirms the potential of mHealth technologies to advance clinical trial operations and reduce costs by conducting studies remotely. Drug developers have piloted essential elements of the mHealth toolbox to validate the accuracy and security of remote operations; social media-based patient recruitment, screening, and enrolment; electronic informed consent; and electronic patient-reported outcomes. The milestone 2015 virtual trial, VERKKO, demonstrated mHealth's capabilities to improve patient engagement and data collection in a randomised clinical trial.

Results reported in 2016 demonstrated the benefits of the mHealth platform. Compared to a site-based comparator study, the mHealth model improved protocol compliance by 18%, increased patients' glucose profiling time by 22%, and reduced the site's time spent on coordination activities by 66%. In a post-study survey, patient satisfaction scored high – 4.5 points out of a possible 5 – which emphasises the benefits remote research has in improving patient experience, engagement, and retention (4).

Driving Integrated Platforms

Drug developers, care providers, and regulators have been busy piloting and applying mHealth tools and approaches one by one. The next giant step in the mHealth revolution is to integrate the nebulous suite of mobile devices into mainstream, remote operations platforms.

Integrated mHealth research platforms are poised to disrupt the last 30 years of clinical trial management. mHealth-based virtual trails will take research to the patients instead of bringing patients into clinical sites. The benefits of this reversal are invaluable. Remote operations will free clinical studies from the limits of geography and the scientific constraints of the clinic. They will expand access to patients, improve research efficiencies, and combine research and treatment in new models of personalised therapeutics based on real-world evidence.

One predominant driver of mHealth platform development is the increasingly urgent need to reach and engage patients in clinical trials. mHealth-enabled studies offer solutions to the major problems facing drug development research in both mature and emerging markets.

Improving Patient Access

The insufficient number of participants who are biologically naïve is a critical barrier to servicing clinically mature markets. Engaging, recruiting, and retaining qualified patients in this crowded, competitive clinical trials landscape is a challenge and falls on the CRO or drug developer to create ever-increasing value propositions to both instigators and study participants.

Remote conduct of studies dramatically grows the pool of qualified patients, as they can participate in mHealth-based trials regardless of their location. The convenience of in-home research operations is a strong attraction for participants. Patients and families are not required to travel to study sites, miss work or school, or deal with potentially stressful clinical settings. Telemedicine provides in-home consultation and training, and mobile devices take measurements in the course of daily activities.

In rare disease research – one of drug development's fastest growing segments – remote trials offer unprecedented opportunities for drug evaluation. Small populations of widely dispersed rare disease patients make it unfeasible – and, in some cases, impossible – to conduct traditional site-based trials. Integrated mHealth platforms can identify and recruit patients worldwide from online communities and collect data remotely without burdening patients with stressful travel or absence from their home-based support and care networks. Virtual rare disease trials are beginning to meet enrolment targets with record speed. One virtual site reports it enrolled 30% of a trial's subjects 20 times faster than the rate anticipated for enrolment by the 60 traditional sites conducting the study (5).

Providing Infrastructure

In emerging clinical trial markets, a critical limitation is insufficient medical and research infrastructure to support the ever-increasing number of study patients who, through GDP growth in their regions, are now being subjected to non-communicable diseases not previously predominant in their areas. This gives rise to the opposite problem experienced by clinically mature markets – too few studies to support large patient populations. mHealth's digital infrastructure has the potential to circumvent the slow, costly development of traditional clinical site capabilities and accelerate delivery of clinical trials to underserved populations in Africa, Asia, and Latin America.

In Africa – which represents 15% of the world's population, but less than 1% of the world's clinical trials – mHealth platforms can support enormous research advances (6). Africa's rising incidence of non-communicable diseases, its unmet needs for effective infectious and parasitic disease therapies, and the risks to world populations from diseases like HIV and Ebola that are prevalent in the country, underscore the value of mHealth-enabled clinical trials across its least developed regions. For the biopharmaceutical industry, expanding research will support Africa's growing pharmaceutical market – projected to be worth as much as $60 billion by 2020 (7).

Early strategies propose mHealth frameworks to manage trials from a single, research-capable site with necessary electrical power, internet connectivity, and data security. Capabilities for remote data collection are growing rapidly as Africa's 500 million mobile service subscribers move to mobile broadband networks, with smartphone connections expected to triple, from 226 million in 2015 to 720 million by 2020.

Patient-Centricity

Traditional clinical trials begin with the potential solution – a therapeutic agent. A study is designed to determine safety and effectiveness; then patients are enlisted to test drug effects. In the new mHealth-enabled model, the research process will begin with patient profiles built from real-world, data-defining health needs; then a trial will be designed specifically for the identified patient cohort.

Platform Integration

As mHealth technologies move from add-ons to integrated elements of digital research platforms, each technology will inform and enhance the entire operational network. The key elements will be:

- Data-driven patient profiles integrated with social media recruitment. Rather than recruiting patients from traditional social media sites, mHealth platforms will use Big Data to build a social media outreach for patients based on biometrics that define a given health problem. Study participants will be drawn from this identified patient community with invitations to join a trial "specifically designed for your profile." Early approaches using disease-based online communities to pre-identify study subjects include the Scleroderma Patient-centered Intervention Network (SPIN) Cohort. SPIN is developing an online research structure in which scleroderma patients join the cohort of potential subjects and consent to participate in various ongoing evaluations

- ePRO integration with wearable sensors. Patients' subjective electronic diary reports on symptoms and quality of life will be compared to objective measurements transmitted by mobile sensors. Researchers, caregivers, and patients will be able to link behaviours to outcomes and develop interventions including behaviour modification and patient self-care regimens (9)
- Mobile device tracking for medication adherence. Smart devices, such as the currently available ingestible trackers, will be integrated into mHealth monitoring platforms to transmit time of dose. Patient prompts will ensure protocol compliance, and dose delays or omissions can be recorded. Combined with data from integrated ePRO diaries and wearable sensors, dose tracking data can be used to understand dosage impact on symptoms and adverse events. Applications in the care setting will provide evidence to tailor dose for the needs of an individual patient
- Integrated prompts and proactive notifications. Platform integration of smart devices and digital tools like eConsent will enable prompts and alerts to enhance patient safety and data quality and proactive electronic notifications to improve operational efficiencies. Ongoing mHealth-based patient communications are well-recognised aides to improve patient engagement and compliance. Smart devices will prompt patients to take measurements at specified times and alert monitors to safety signals. Integrated data – from ePRO diaries, for example – will trigger notifications to investigators, patients and research teams that re-consent will be required for a given patient

Emerging Capabilities

The benefits of mHealth-enabled research are becoming clearer as more mobile technologies are applied in clinical research and patient care. A recent report estimates that by the end of 2017, mHealth could account for as much as US$370 billion in annual healthcare cost savings worldwide (1).

Integrated mHealth platforms will generate insights based not on a single data point, but on a continuous flow of multiple data elements in real time. In this context, a physician uses real-time data to diagnose and prescribe treatment; a researcher views a display built from the biometric measurements that is transmitted to the study database and integrated with other data streams to identify a possible adverse drug effect and to inform dosing decisions; and a patient sees his medical readings, understands, and complies with treatment as ongoing displays show improvement.

New research and care capabilities on the mHealth horizon include tiered dosing and trial matching. With continuous mHealth biometric data to track the peaks and valleys of drug effects in real time, dosing will progress from one-size-fits-all regimens to personalised dosing schedules supported by prompts and reminders. Trial matching envisions the use of data mined on social media to build health profiles that will guide trial design and shape research tools.

The present mHealth ecosystem is focused on advancing mobile technologies and their regulation. Technology companies are driving mHealth capabilities with innovative mobile devices, data storage platforms, and analytics, and regulators are developing standards and guidance to incorporate mHealth tools into digital health platforms.

The future mHealth research platform puts patients at the centre of biomedical inquiry. mHealth technologies will capture and integrate continuous, objective biometric data to elucidate patient health status and therapeutic responses in real-world experience, with knowledge that will drive personalised medicine.

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About the author

David Blackman has responsibility for aligning technology strategies and innovations with PPD's evolving business needs. Within his role, David is responsible for creating and developing differentiating business capabilities together with partners and clients to accelerate clinical trial research. He has a strong passion for the design and implementation of mobile health and digital technologies solutions within clinical research. A graduate of the University of Johannesburg, South Africa, he combines more than 20 years of technological experience in development, process, and technology innovations with his commitment to implementing cutting-edge technologies as a platform to advance innovative technology solutions in clinical trials worldwide. He holds two patents and two patent applications for technology innovations.

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