Going Native? Deciding the Optimal App Approach for Smartphone eCOA

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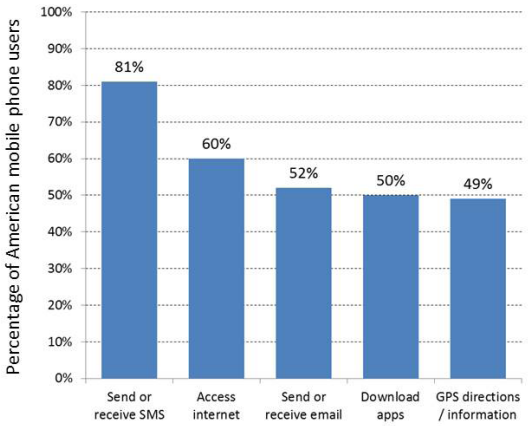
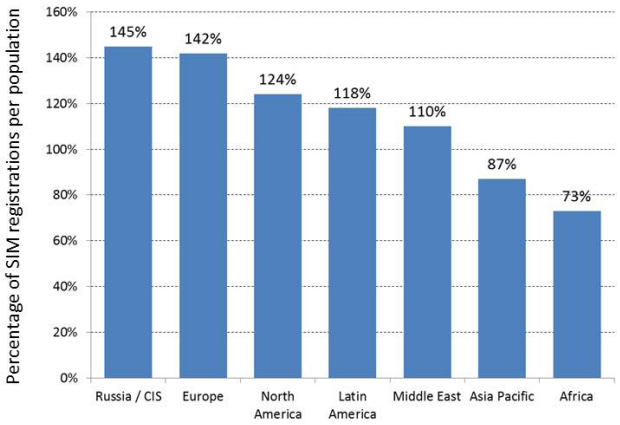
Introduction

Global mobile penetration has enabled a great opportunity for interacting with consumers of all types in different ways. The app phenomenon underlines the impact of mobiles on the consumer market. The free game, Flappy Bird, for example, was downloaded by over 50 million Android users in only a few months, and topped the Apple download charts at the start of this year, before being withdrawn as it was felt too addictive[1]. Ninety-one per cent of American adults own a mobile phone, with 55 per cent having a smartphone[2]. Eighty-one per cent of American mobile phone users regularly use them to send or receive SMS text messages, 60 % to access the internet, 52 % to send or receive email, 50 % to download apps, and 49 % to get directions or information based on location[3]. It is also estimated that over half of the global population owns a mobile phone[4]. The percentage of SIM card registrations per total population exceeds 100 per cent in most regions (many people have more than one device), including Europe, North America, Russia, Latin America and the Middle East; with 87 per cent and 73 per cent penetration in Asia Pacific and Africa respectively[4]. There are 680 million active mobile users of Facebook each month, and 120 million using Twitter on their mobile phones[4]. Considering the high level of mobile use and penetration, the opportunity to touch the patient in healthcare and clinical research is large.

Regular mobile phone usage



Global SIM registrations per total population



Reference: Pew Internet (3,4)

This article will explore different ways in which functionality can be delivered to mobile devices, and the benefits and limitations of each when applied to the collection of eCOA (electronic clinical outcomes assessments) in clinical trials.

To frame the discussion, we will define the following terms: native app, web app and mobile website.

Native Apps

A native app is a software application that is downloaded and installed to run on the mobile phone's operating system. It is usually accessed via an icon on the device home screen, and once downloaded can be used without requiring a mobile or internet connection.

Mobile Websites

A mobile website is a website that has been optimised for use on a device with a smaller screen such as a smartphone or tablet. A mobile website displays information for a user to read and browse, but doesn't typically provide functionality for a user to "do" something.

Web Apps

Web apps are websites that look and feel like native apps. They are accessed via a browser, and contain functionality for users to perform tasks or activities, as opposed to only accessing information. Examples include games or apps to access and manage email. Home screen shortcuts can be used as a convenient way of launching mobile apps.

For the purposes of this article, we will consider only native and web apps. Because they can look and feel very similar, we will explore some basic app properties and the advantages and limitations of each approach.

1. Using Native Smartphone Functionality

Web apps are increasingly able to access certain mobile-specific functions, such as click-to-call, SMS and integrated GPS. However, web apps are unable to access many other native smartphone or tablet features, such as the in-built camera and the ability to connect with remote devices using short-range radio technology such as Bluetooth. Popular apps, such as barcode readers, utilise the smartphone's camera feature and are difficult to deliver without a native app approach. Devices such as activity trackers (e.g. Fitbit) can use Bluetooth to download and synchronise activity data

collected with a native smartphone app, which can provide tracking interfaces for the user. In general, if an application requires access to any native phone or tablet feature, it will need to be developed as a downloadable native app.

2. Universal Accessibility

When you compare Apple and Android app stores, you will see that some apps are available in one and not the other, and within a store certain apps require a minimum version of the corresponding operating system to run (e.g. Honeycomb (3.2), Ice Cream Sandwich (4.0), Jelly Bean (4.1-4.3) or KitKat (4.4) on Android). This adds a level of complexity for native app development to be used across multiple platforms and devices. A web app does not need to download and be made compatible with multiple operating systems, as it is accessed simply via the browser within the mobile device but runs remotely. Web apps may provide greater speed to market when operation across multiple device types is needed.

3. Sending and Receiving High Quantities of Data

A native app will generally work faster than a web app as it does not rely as heavily on internet connectivity speed to serve up and process information. If an app is required to take in and process a lot of data – perhaps performing complex calculations, or producing charts and reports (such as banking or investment apps) – the performance may be superior using a native app. The same is true for gaming apps, such as Angry Birds, which are highly interactive and present rich graphical content. These are much better suited to using the device's processing power as a native app than relying on internet connectivity and network speed as a web app. That said, many apps do not require complex graphics or large amounts of data. As a result, there should not be a significant difference between approaches.

4. Frequent Updates

Native apps require additional downloads to implement software updates. Whilst these are straightforward technically, commercial app developers have additional hurdles, such as receiving app store approval before updates can be made available. Web apps enable updates to be implemented rapidly across the user base without additional downloads or activity. When a live app requires frequent updates, it is simpler to manage via a web app.

5. Offline Usage

For apps to work offline without a mobile connection, they must be developed as native apps. These apps can work in full without a mobile connection. Where they are used to collect information, data can be stored locally within the app until the device establishes a connection, at which point the information can be transmitted. Traditionally, web apps have been available only when a mobile connection is in place. The new HTML5, however, has the ability to cache and retain updated local copies of a web application so that the app can be used without a web connection. HTML5 has not been on the market long enough to fully assess these capabilities and evaluate the security of information held in this way.

6. Security

There has been considerable recent discussion about native app security, particularly as it relates to the collection of personal and health-related data. Kevin Johnson, CEO of network security consulting firm Secure Ideas, has stated that native app security is a concern when these apps contain personal health information[5]. His concern is that many native apps will not encrypt data to prevent any local data store from being accessed through a backend route. In addition, if not developed with adequate encryption and security, apps may not prevent other apps from accessing the data they contain. As we consider eCOA, these are important considerations. These issues are not limitations with the native app approach, but app developers need to ensure security and encryption features are addressed in the way their apps are developed

and configured. This is particularly important in the "bring your own device" (BYOD) area, as eCOA providers have less control over the devices being used.

Application to eCOA

Considering the six properties listed above, we can explore how these might affect app methodology choice for delivery of clinical assessments in clinical trials and peri-approval studies (Table 1).

While both approaches are typically considered to be satisfactory, there are a few specific instances where one approach is preferable. In studies where we wish to use some native phone features, whether the patient's own phone or one provided for the study, a locally-installed native app is required. Most commonly, this would include the use of Bluetooth connectivity when the patient is also collecting data using peripheral devices such as spirometers, glucose meters, activity meters and the like. Bodies such as the Continua Health Alliance are helping to define important standards to improve the interoperability of sensors and devices used in healthcare. If we wish to combine the objective assessment data collected with these sorts of devices along with additional patient-reported outcomes (PROs), then the solution must be developed as a native app.

In addition, native apps would be favoured if the study is being conducted in geographies where mobile connectivity may be unreliable. In this case, a native app would be expected to store data locally until a connection is made to enable secure data transfer. Native apps will need to maintain sufficient capacity on the device to ensure eCOA data can always be stored when needed. This applies particularly in a BYOD setting.

Web apps, however, offer ease of universal accessibility across multiple devices and operating systems, that is important if the patient's own device is to be used in the study. As described above, whilst native apps can be developed for BYOD settings, it is easier to develop a web app because there is no requirement to produce multiple app versions to operate on different platforms and their operating systems, such as iOS, Android and Windows Mobile platforms. As we consider BYOD in ePRO, we also need to be aware of current regulatory thinking and guidance around PRO validation[6]. Validation requirements for installed software are different to those for software accessed via a browser. Alan Yeomans of the Pharma Consulting Group describes this in his recent article [7]. Software installed on multiple devices and operating systems will likely need to be validated on each type of device / operating system to ensure correct operation. For web apps, the validation question becomes largely a display validation question, as opposed to device validation. Can the instrument or diary be displayed in a way that will not affect patient understanding or response across multiple devices? In his discussion, Yeomans proposes some principles for effective BYOD implementation for web apps, including:

1. Use devices with comparable capabilities – for example, similar screen sizes, graphics resolutions and colour palettes. (Implicit in this requirement is the ability to prohibit access from incompatible devices.)
2. Deliver the PRO instrument using a common graphical denominator that makes it appear the same on all devices – e.g. all answer choices are shown without the need to scroll. Larger screens, such as tablets / phablets would utilise the same limited display area as a smartphone – ensuring comparability in appearance of the diary or instrument across devices.

More specifically, by designing to a minimum device specification (screen size, screen resolution, colour palette, graphical capabilities, browser type and version) it should be technically possible to ensure that instruments used are displayed identically across devices of that screen size and higher. If ePRO assessments are delivered in this manner, then it would seem logically only a small step to provide the level of comfort that different devices are not affecting patient responses. When using different screen sizes in the way described above, there may be no difference in appearance, instructions, layout or font size. Alternatively, moving between screen sizes may reflect a "minor" change in appearance as specified by the ISPOR recommendations for ePRO validation[8].

Implementing in this manner will require the ability to exert some controls over the way a web app is displayed, as opposed to allowing the device to pick its perceived optimal display. BYOD will also require mobile platforms to be able to detect device characteristics, specifications and orientations so that devices not meeting minimum technical requirements can be blocked.

eCOA solutions must also adhere to the level of security expected with any solution recording personal and health-related data. Whilst web app entry usually means that a secure log-in exists, passwords can be checked and data is entered over a secure connection straight into the database; native apps require certain properties to be built in to ensure they comply with data security requirements. In his blog,[9] Dale Jessop, Chief Technology Officer at Exco InTouch, explains how native apps can be developed to ensure a level of security appropriate for clinical trials and the collection of patient outcomes data. Specifically:

- Apps should explicitly set the privileges of data files so they are all private to the app, ensuring that other apps installed on the device can't access or modify them.
- The contents of an app's data files should be encrypted to prevent their access or via rooting (gaining privileged access to the system).
- Data transmission via HTPPS ensuring the data is secure in transit between the app and the main server.
- Standard two-token authentication (username and password) to gain access to the app (as required for eCOA web apps).

Whilst this is not a limitation for the use of native apps in eCOA, it is important that they are developed to ensure the above requirements are met.

Table 1. eCOA considerations relating to native and web app properties

App property	eCOA considerations	Conclusion
1. Using native smartphone functionality	• Some eCOA applications require Bluetooth connectivity to collect data from devices such as spirometers. • Camera capabilities can be used in dermatology, wound healing and photographing medication usage.	Where native phone capabilities are required, a native app approach should be used.
2. Universal accessibility	• Studies where the patient's own device will be used (BYOD).* • Late-phase studies where it is desirable to allow patients access to an application via multiple means – e.g. PC when at home, smartphone when out of the house.	Web apps provide the degree of flexibility needed.
3. Sending and receiving high quantities of data	• Unlikely to apply to eCOA – interfaces are generally simple and the quantity of data collected minimal.	There is no advantage for either approach.
4. Frequent updates	• It is a requirement to be able to execute mid-study updates, although these will not be regular.	Easier to administer with a web app, but as frequent updates are unlikely to be common and can be achieved effectively with a native app approach, this is unlikely to represent an advantage or disadvantage for either approach.
5. Offline usage	• Diaries and instruments need completion on schedule, independent of whether a mobile connection exists.	Native apps have the advantage here, especially in geographies where connectivity may be unreliable.
6. Security	• Patient personal and health information needs to be securely stored and transmitted. • Access to apps needs to be controlled by username and password, with appropriate account locking and password expiry functionality.	There is no advantage for either approach. Sponsors should ensure that native apps have inbuilt the correct level of security to meet requirements.

* Subject to satisfying any regulatory concerns around display validation on multiple devices

Conclusions

There is little doubt that mobile solutions offer tremendous opportunity to interact with the patient throughout the course of a clinical trial. Aside from special cases (e.g. Bluetooth connectivity needed), the choice between native and web apps is not enormously important.

Perhaps one deciding factor is around the ability to use the instrument without connectivity for certain geographies. This will undoubtedly change as we become more comfortable with the reliability of mobile data networks globally.

Reflecting on the phases that EDC has gone through within our industry, we recall that initially, many systems were developed as hybrid (online/offline) systems to ensure that data could be captured if web connections were not available. Now, we trust internet availability, and all EDC systems are deployed in a pure-web mode in which the system is accessed exclusively over the internet. We see the same changes in mobile networks and connectivity. Soon our level of comfort with network availability will lead to fewer concerns about developing native apps simply to enable offline use. As described above, HTML5 may also accelerate this with its ability to store web apps for local use, although the security of data stored in this way will need to adhere to the same requirements described for the development of native apps.
Mobile is an enduring phenomenon, and the pharmaceutical industry is beginning to leverage its power within the strict regulations that exist, to improve clinical trials, ultimately making them more efficient and easier for all participants involved.

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