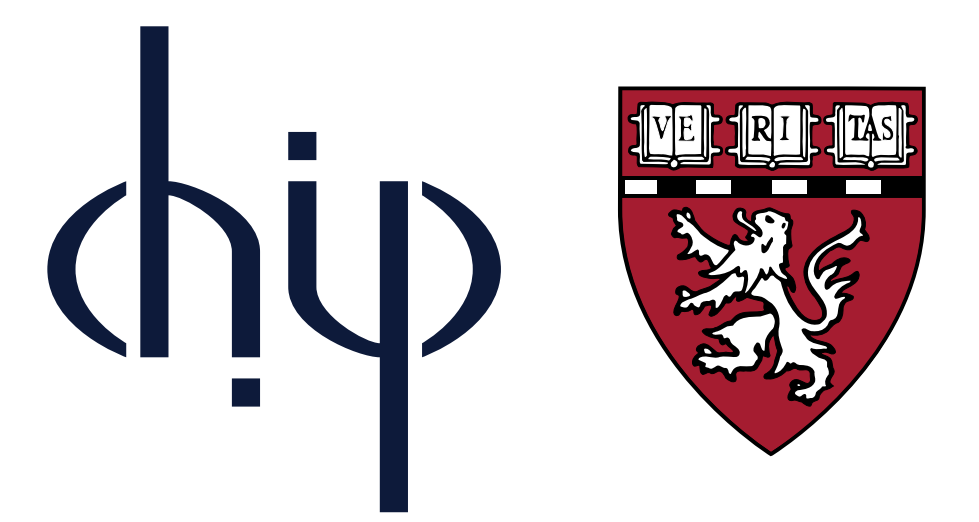


# C3-PRO

## Enhancing ResearchKit for iPhone Apps with FHIR



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Smartphones have become an interesting tool for patients to participate in a clinical trial from the comfort of their homes.

A year ago, Apple Inc. announced **ResearchKit**, an open source programming framework that greatly simplifies creation of iPhone research apps. This first iteration of ResearchKit helps guiding participants through a straightforward **consent** process, collecting their signature on-screen; administers **surveys** for patient-reported outcome (PRO) collection; and collects data from the phone's built-in **sensors** and the **HealthKit** health data storage.

### Aims

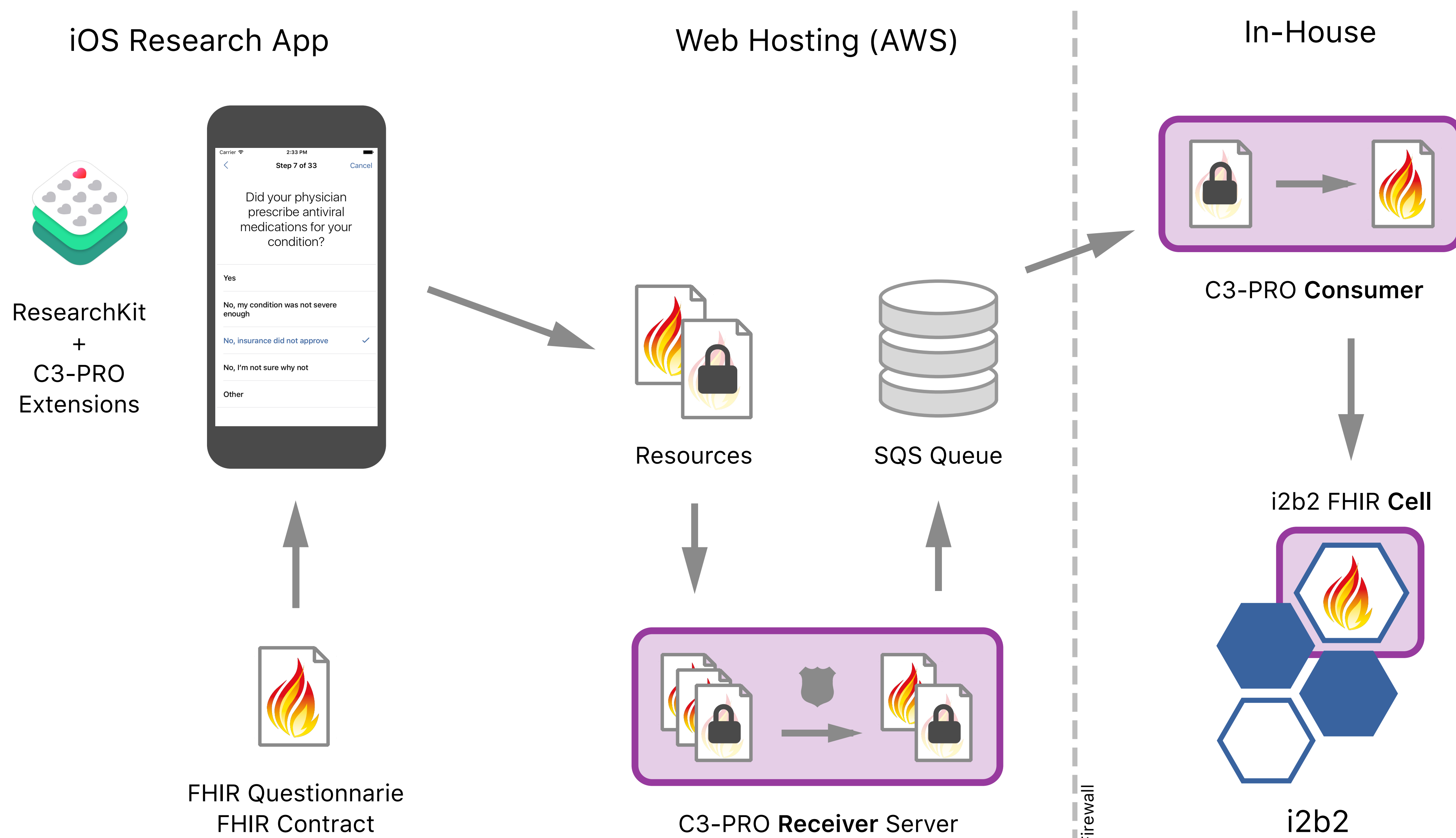
We intended to collect research data from subjects' iOS-based smartphones and deliver this data to our research infrastructure. For this purpose we extended ResearchKit with C3-PRO: the **Consent, Contact, and Community framework for Patient Reported Outcomes**, a set of tools that leverage open health data standards, thus support any type of health data and can connect any ResearchKit app to compliant research databases.

### Methods

First, we chose the **Fast Healthcare Interoperability Resources** (FHIR: /faɪər/) standard as data format. Data transmission to the server was to be encrypted using public-key cryptography.

Second, we built three server-side tools that

- A) accept incoming data via the internet ("receiver"),
- B) decrypt incoming data and forwards to ("consumer")
- C) a FHIR adapter to the i2b2 research database ("cell").



### Results

With our additions, ResearchKit can display interactive **informed consent** and research **surveys** by reading data from file. Survey responses are complemented by **activity data**, obtained from devices' built-in sensors. Converted to the FHIR format and encrypted using public key cryptography, research data is securely sent to the research backend, which merely needs to support FHIR.

### Conclusions

For researchers wanting to use ResearchKit as part of a clinical trial, C3-PRO provides a secure, open source, end-to-end solution.