

CHALLENGE PROJECT REPORT



**AHRQ Step Up
App Challenge**

Advancing Care Through
Patient Self-Assessments



CHALLENGE PROJECT REPORT: AHRQ STEP UP APP CHALLENGE

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EXECUTIVE SUMMARY

In 2018, the Agency for Healthcare Research and Quality (AHRQ) contracted Sensis to design, manage, promote, and execute a multi-phase innovation prize challenge with the goal of crowdsourcing user-friendly digital solutions to advance the collection and use of standardized patient-reported outcomes (PROs) data related to physical function in ambulatory care settings. Challenge participants were required to use the Fast Healthcare Interoperability Resources® (FHIR) technical specifications provided by AHRQ in developing the mobile applications. Sensis implemented the challenge using a multi-stage approach to advance participants through proposal development and application development—all of which culminated in the selection of a grand prize winner who pilot-tested their mobile application in nine MedStar Health clinics.

To launch the challenge, Sensis helped AHRQ design the competition strategy, develop challenge branding and communication assets, and create content for webpages on challenge.gov and a microsite within AHRQ's web infrastructure. More than 150 participants registered for the challenge after launch. Phase 1 yielded 54 submissions, from which AHRQ selected the best 10 teams and awarded each of them \$12,500 as the financial resources to develop functioning prototypes in Phase 2. At the end of Phase 2, three winners were selected based on their submitted documentation and product demonstration videos. The grand prize winner received \$35,000; the 2nd place winner received \$30,000; and the 3rd place winner received \$25,000. PRISM, the grand prize winner, was advanced into Phase 3 - pilot testing. After the successful implementation of a pilot test, PRISM received an additional \$40,000.

The challenge successfully spurred the creation and production of multiple mobile applications that advance the state of PRO data use, while leveraging FHIR specifications. Grand prize winner, PRISM, produced a mobile application that re-envisioned patient-centered engagement with a highly useable and intuitive product capable of collecting and communicating PRO data in a digestible format, while providing patients personalized information resources.

BUILDING THE COMPETITION STRATEGY, DESIGN, AND INFRASTRUCTURE

A. Problem Statement Definition

Patient-reported outcomes (PROs) are vital to understanding the complex needs of a patient. For this challenge, PRO data are defined as “any report of the status of a patient’s health condition that comes directly from the patient, without interpretation of the patient’s response by a clinician or other medical expert.” In other words, PRO data come from patient self-assessments and look beyond the clinical data to assess how a patient feels about his or her health.

While PRO data have proven useful to healthcare providers, they are not widely used in clinical settings. Recently, some digital tools have been developed to streamline the collection of PRO data. However, those digital tools are not widely adopted due to challenges related to clinician workflow and patient ease with the tools. Also, researchers who want to analyze PRO data across different practices or health systems often encounter the issue that data are not collected in a standardized manner. Creating a digital tool to efficiently collect, aggregate, and share PRO data is critical to advancing the quality of care.

B. Intellectual Property and Environmental Scanning

Sensis conducted an intellectual property (IP) and environmental scan to understand the current trends, players, patents, and practices in the PRO environment to guide the evaluation of Phases 1 and 2 submissions.

Environmental Scanning Process: The scanning process involved three steps. The first step was to identify notable players in PRO data collection, best-in-class health applications, PRO reports and resources, and IP related to PRO. Sensis also leveraged search terms such as “digital patient-reported outcomes app” and “ePRO companies” to source a list of firms and players in the environment. Sensis identified electronic PRO (ePro) application vendors and the International Consortium for Health Outcomes Measurement, an ePRO vendor marketplace.

The second step was to analyze company characteristics, product use cases, positioning, best practices, success stories, and IP rights. The third step was to synthesize information into key findings, trends, and an overall picture of the competitive and technical landscape.

The environmental scan identified the following key insights for successful electronic PRO applications:

- 1. Clarify the Benefit Immediately.** Providers and patients have a limited amount of time to dedicate to PRO data collection, reporting, and insights. The direct benefits, both immediate and long-term, must be apparent from the outset.
- 2. Make the Process Fast and Engaging.** More questions are not better. Use as few questions as possible to keep the time burden low. Implement interactive technology, visualizations, and innovative forms of data entry to keep patients engaged.
- 3. Make Insights Actionable.** Insights from data must be relevant to actions the provider and patient can take. Responses need to be incorporated into electronic health records (EHRs) to provide better care, so the PRO data must be relevant to provider-patient decisions.

Additional findings from the environmental scan showed:

- Most patents related to PRO instruments are disease-specific (e.g., a tool used to assess patient outcomes for a given condition such as dysphagia, celiac disease, or endometriosis).
- Patented technical systems and methods broadly touch on a variety of data collection techniques, of which PROs are only one data element within a larger system.
- No patents were identified related to measuring physical function outcomes.
- One design existed for a PRO mobile application. The PRO patent was for a mobile software that collects information from patients who have or are suspected of having dysphagia with eosinophilic esophagitis.

C. Stakeholder Interviews

Prior to launch of the challenge, Sensis conducted in-depth interviews (IDIs) with medical and open innovation stakeholders. The objective of these interviews was to glean insights and recommendations to guide the creation of the challenge rules and requirements as well as evaluation criteria. The interviews focused on the overview of the challenge structure, the submission requirements, the workflow of each challenge phase, the evaluation criteria, the weights of the evaluation criteria, and any other advice the interviewees thought important for the execution of the challenge.

The project team conducted four IDIs with the following stakeholders:

Table 1.

Name	Title	Affiliation and Expertise	Background
DerShung Yang	CEO, BrightOutcome	Industry	Dr. Yang is the Founder and President of BrightOutcome Inc., a healthcare technology company that specializes in innovative PRO solutions to promote symptom self-management and improve patient outcomes. BrightOutcome has been in collaboration with more than a dozen top-rated research and patient-care institutions in product development and validation endeavors. In particular, BrightOutcome has worked closely with the NIH Patient-Reported Outcomes Measurement Information System (PROMIS®) project to incorporate their adaptive PRO questionnaires into their PRO products.
Sandeep Patel	Open Innovation Manager, U.S. Department of Health & Human Services (HHS)	Federal Government	Sandeep Patel is the Open Innovation Manager at the U.S. Department of Health & Human Services, helping HHS develop prizes, crowdsourcing, accelerators, and other open innovation tools to spur innovation in healthcare. Dr. Patel is a PhD nanotechnologist by training and has built his career around understanding and guiding scientific and technological insights to building products and services that ultimately improve lives on a global scale.
Sunit Jariwala	Associate Professor and Clinician, Albert Einstein College of Medicine	Academic	Dr. Sunit P. Jariwala is the Director of Clinical & Research Innovation of the Department of Medicine at the Albert Einstein College of Medicine and Montefiore Medical Center. He also serves as the Director of Allergy/Immunology Research for the Division of Allergy/Immunology and Co-Director of the Montefiore Asthma Center. Dr. Jariwala has a long-standing interest in quality improvement and medical informatics, especially regarding asthma care delivery. He developed and pilot tested an adult version of the ASTHMAXcel mobile intervention for severe asthma patients.
Michael Bass	Research Assistant Professor, Northwestern University	Academic	Michael Bass is an expert in software/system architecture, programming, and strategic leadership in technical matters related to information systems and EHR integration. He has significant experience in web-based applications, as well as other electronic data capture methods. He is the principal architect/programmer of the PROMIS Assessment Center, an online research management tool that enables researchers to create study-specific websites for capturing participant data securely.

Each interview lasted 45-60 minutes, was facilitated by Sensis' open innovation strategist, and was divided into five sections. Sections one and two lasted the first 10 minutes and included an introduction, a warm-up, and a briefing on each interviewee's area of expertise. Sections three and four lasted 30 minutes (15 minutes per section), and focused on the challenge rules and requirements, as well as the evaluation criteria. Section five allotted 5 minutes to glean additional stakeholder insights and recommendations.

Analysis of the qualitative data yielded key considerations and recommendations including:

1. Ensure promotion of the challenge uses the new announcement template and is compliant with HHS standards by posting content to an HHS.gov web entity (for example: the challenge microsite, AHRQ webpage, or Challenge.gov.)
2. Develop an approach to handle the scenario where an existing in-market product pivots into the competition and, in some sense, has an unfair advantage and/or exists in an area where the solution may not be considered "original."
3. Ensure participants can easily and quickly learn more about the designated PRO instrument for the competition, NIH's Patient-Reported Outcomes Measurement Information System (PROMIS), as well as be given access to the actual questionnaire content that will be incorporated into the application (e.g., how to download the measures from the PROMIS website.) This information should be posted on both the microsite and Challenge.gov challenge page.
4. Involve stakeholders from the selected healthcare system where the winning application pilot test will occur as soon as possible (either as a judge or a mentor in Phase 1 or 2).
5. For challenge communication assets (e.g., microsite, Challenge.gov page), include more details about the current state of PROs with a market overview, describing how the current in-market solutions are not meeting patients and provider's needs, thus, shaping the problem statement and the need for innovative solutions.

D. Branding & Innovator Communications Outreach

To create an identity for the PRO challenge, Sensis helped develop a challenge graphic design element (Figure 1) and challenge name, "AHRQ Step Up App Challenge." The ascending arrow design of the graphic reflects the challenge's aim to develop an application that advances data collection and, ultimately, improves patient outcomes

and quality of care. The graphic's ascending arrow imagery also connotes the multi-phase structure of the challenge.

Figure 1.



The communications goal was to effectively publicize the competition and drive relevant solvers and stakeholders to register for the challenge.

For each stage of the challenge, the communication objectives were as follows:

1. Phase 1 (Challenge Launch): Target and reach potential challenge participants with compelling informative content and drive qualified participants to register for the challenge.
2. Phase 2 (Challenge Promotion): Announce challenge winners and promote partnership/ collaboration opportunities specific to the challenge.
3. Phase 3 (Challenge Results and Post Challenge): Showcase winning solutions and grand prize winner's progress, while seeking further collaboration opportunities for the winners.

As the Phase 1 (Challenge Launch) objective states, it is critical to the success of the challenge to target and reach potential participants with compelling content to drive registrations. To deliver targeted outreach, the challenge team first identified potential challenge participants.

The group includes professionals in the following categories: mobile technology, healthcare, research, and information technology (IT).

Target Technology Solvers:

- Software developers
- Data scientists
- Tech meetup groups
- Database coders
- User experience experts
- Web/mobile developers
 - Secondary Audience (to help spread the word): Technology education groups like Galvanize, General Assembly, and Code Academy

Target Healthcare Solvers:

- Healthcare researchers
- Graduate or PhD students in the healthcare field
- Healthcare IT professionals

Target Health IT Community Solvers:

- Hospital chief technical officers
- Health IT experts (health information exchange, EHR)
- Health IT research organizations
- Healthcare provider networks
- Local and community hospitals

To kick off the challenge launch, the AHRQ Director promoted the challenge at the Blue Button 2.0 developer's conference. This launch was augmented with an AHRQ microsite, Challenge.gov notice, AHRQ press release and blog post, social media, and email blasts pushed out through HHS channels, and listservs.

Phase I communications yielded a total of 98,200 views from 19 coverage pieces published on traditional media outlets, such as *Politico Health*, *FedHealthIT.com*, *Health IT & CIO Report*, and *Healthcare IT News*. After the challenge achieved considerable media attention, challenge registrations spiked to over 150 challenge registrants.

E. Competition Platform Design & Maintenance

The AHRQ Step Up App Challenge leveraged Challenge.gov as the competition platform for collecting submissions. Sensis also helped AHRQ set up a customized microsite in AHRQ's web infrastructure to serve as the primary education and awareness destination for the challenge. Sensis delivered navigational and content recommendations to AHRQ in the development of the site.

This resulted in the home page layout shown in Figure 2:

Figure 2.



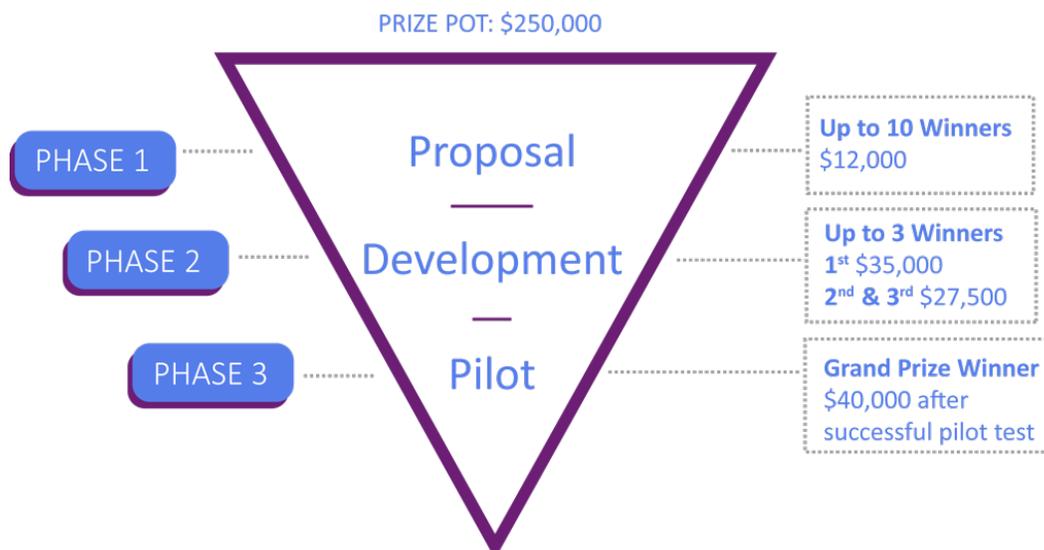
Throughout the competition, Sensis provided AHRQ content to update and maintain the web platform. This included new language related to the updated winners, rules and requirements, and promotional content.

F. Multi-Phase Incentive Structure

The ultimate multi-phase structure was designed to provide participants the time and resources to develop their solutions over the course of 6 months.

The final winner would then be equipped with a fully functioning mobile application and ready to pilot test its product in nine practices affiliated with MedStar Health in the Washington, DC/Maryland/Virginia area.

Figure 3.



The down-select, pay-for-performance incentive model increases capital for awardees, as the final product is validated and iteratively developed through prototyping and pilot testing.

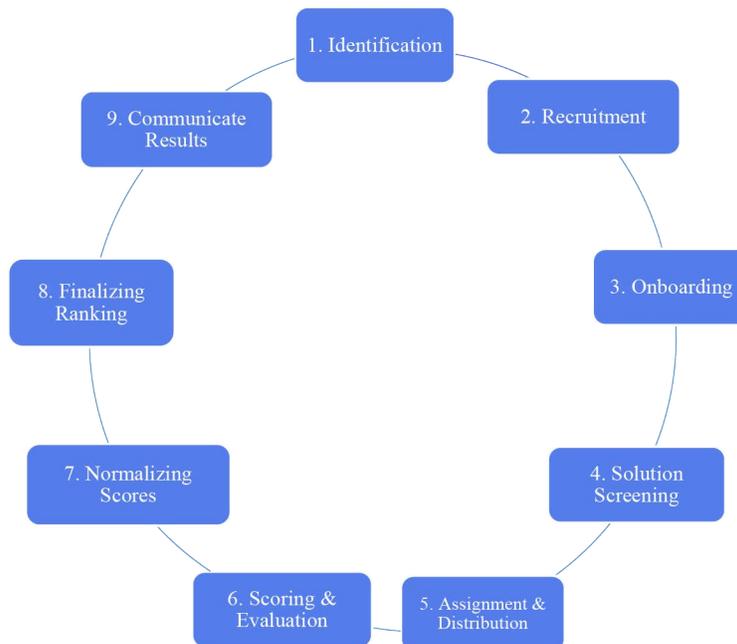
The total prize pot (shown in Figure 3) was \$250,000, which was split between the three phases: each of the 10 Phase 1 winners received \$12,000; the three Phase 2 winners earned \$35,000, \$30,000, and \$25,000, respectively. Upon the successful pilot of its mobile application, PRISM (the grand prize winner) was awarded \$40,000.

G. Judging Management

A critical part of executing a prize challenge is to implement a robust and comprehensive judging system. The AHRQ Step Up App Challenge recruited judges who had expertise in digital product design, PRO implementation, health IT research, and clinical practice.

Sensis helped AHRQ execute the judging process lifecycle, as displayed in Figure 4.

Figure 4.



The lifecycle included identifying and recruiting judges, onboarding judges to the evaluation criteria and scorecard via webinar, screening submissions, assigning judges to a number of applications, aggregating and normalizing scores, finalizing the ranking, and communicating the results to all challenge participants.

In the AHRQ Step Up App Challenge, six judges were recruited (refer to Table 1). Judges included an HHS open innovation specialist, the principal architect of PROMIS, a clinical informatics developer, a patient-centered outcomes researcher, and two senior advisors for health information technology.

The judges delivered their scores and comments, helping AHRQ select the submissions that warranted advancement into the later stages of the competition. This judge panel offered invaluable insights in evaluating submissions.

PHASE 1: PROPOSAL

A. Phase Objective

The proposal phase reached and activated potential participants within the mobile application innovation community, prompting the target audience to register for the challenge and to present plans and frameworks that demonstrated how they planned to execute their mobile application development. Ultimately, the Phase 1 objective was to drive as many qualified submissions as possible for AHRQ to select the best 10 teams as top candidates for advancing into the next phase of the competition.

Participants were asked to describe the team capabilities as well as the feasibility, originality, and impact of their mobile application development approaches.

B. Strategic Approach

After the challenge launch, a variety of communication channels were leveraged, including earned media, social media, the Blue Button 2.0 Developer's Conference announcement, a Challenge.gov notice, and HHS listserv email blasts. These communications asked participants to register for an informational webinar. The webinar created the first quantifiable metric of predicted participation rates. Over 150 attendees registered and attended the informational webinar. Sensis delivered presentation slides and managed the execution of the webinar.

Through consistent communications (e.g., using a central challenge email account to gather and relay questions and answers) with participants and judges, Sensis helped AHRQ implement the first challenge phase, successfully driving submissions and engaging the mobile application community. Participants were asked to submit a plan, explaining the technical, operational, and financial aspects of their proposed solutions.

C. Tasks & Deliverables

Prior to challenge launch and during Phase 1 implementation, Sensis delivered the following tasks and deliverables: a project work plan, microsite development plan, Challenge.gov content, and a challenge announcement.

As part of the challenge design and strategy, Sensis supported AHRQ in developing rules and requirements documentation, IP & eligibility structure, evaluation criteria, stakeholder analysis, and judge recruitment and management.

To execute the challenge launch and competition promotion, Sensis developed a comprehensive communications plan, and executed various design and communication tasks including creating a challenge graphic and name, developing various promotional materials (e.g., one-pagers, social media posts, press releases), and implementing an informational webinar.

D. Success Metrics

Using a success metrics funnel that included awareness, consideration, participation, and selection, we measured how marketing and communication activities translated into Phase 1 submissions and winners (as shown in Table 2).

Table 2.

Success Funnel Phase	Metric
Awareness	98,200 coverage views
Consideration	150 webinar registrants
Participation	54 Phase 1 submissions (key success metric)
Selection	10 Phase 1 winners

The 10 Phase 1 winners moved on to Phase 2 and each was awarded \$12,000 based on the merits of their proposals. Seven judges who were experts in digital healthcare solutions scored the 54 submissions. These judges evaluated submissions with a scorecard, using the following criteria:

- Team/Participant Capabilities (20%)
- Impact (30%)
- Feasibility (30%)
- Originality (20%)

Each submission was scored by three judges. The scores were then normalized using MIT’s Fairness Algorithm¹. Judge score normalization is a critical step in the prize challenge evaluation process, as it ensures all scores are viewed on the same objective, fair, and debiased scale. Each judge is unique; therefore, each judge has a different scoring scale, or score spread. Some judges are generous and provide a higher score distribution, while other judges provide lower-than-average scores. Additionally, judges only score a sample of all submissions, which creates risk. For example, a strong submission can “fall through the cracks” if only the more critical judges evaluate the submission and give lower-than-average scores, compared to the

total judge population. For this reason, normalization ensures fairness in the submission selection process.

After scores were normalized and the top 10 teams were identified, Sensis employed an eligibility scan to determine whether participants were eligible for a prize award.

¹ <http://2017.mitinclusiveinnovation.com/#fairness>

PHASE 2: DEVELOPMENT

A. Phase Objective

The Phase 2 mobile application development objectives primarily focused on providing the resources and information required to help participants develop a patient-facing mobile application compliant with the FHIR technical specifications and PROMIS physical functioning measures provided by AHRQ. Mobile applications must be designed to encourage and engage patients in the collection of PRO data, while leveraging computer adaptive testing (CAT) functionality and employing FHIR standards. CATs are a type of measure in which the questions a person answers are tailored to that person. Each response is used to further refine a person's score. CATs are shorter and more precise, and can cover a wide range of PRO domains.

B. Strategic Approach

Sensis checked in with participants periodically and helped host three technically-focused webinars to aid participants in the development of the mobile applications.

To ensure mobile applications were ready to be pilot tested, applicants were required to develop pilot-ready mobile applications capable of exporting and integrating data into an EHR or another IT system for clinical and research purposes. The mobile application needed to be able to perform CAT on various devices such as mobile phones and tablets.

C. Tasks & Deliverables

Sensis implemented various individual technical check-ins with each of the teams on multiple occasions. These sessions focused on helping participants understand the technical requirements, identifying major issues or barriers the team faced, and resolving issues as the challenge progressed. These sessions also gave Sensis and AHRQ insight into the development of the mobile applications, and the user experience wireframes, mock-ups, and clickable prototypes being developed.

In addition, Sensis implemented three technical webinars that provided overviews on the PROMIS instrument, FHIR standards, and CAT functionality.

Sensis synthesized the findings from the technical check-ins into an interim check-in report, which was delivered to AHRQ.

D. Success Metrics

Based on the three informational webinars and calls with the teams, Sensis reported the following success metrics:

- 111 questions asked and answered
- 7 Phase 2 submissions (two teams dropped out, one unsuccessful team)

This resulted in three Phase 2 winners – 1st place (PRISM, \$35,000), 2nd place (PEER Technologies, \$30,000), and 3rd place (cliexa, \$25,000).

The grand prize winner, PRISM, was invited to pilot test their mobile application in nine practices affiliated with MedStar Health to receive the final \$40,000 allocated in the challenge.

Sensis also conducted a participant survey to gauge strengths and weaknesses in the competition execution and overall participant satisfaction with the process.

This yielded the following participant feedback and satisfaction:

- Time spent developing mobile applications varied widely, with the lowest being less than 150 hours and highest being more than 900 hours.
- 80% of participants felt the evaluation criteria were fair.
- A majority (80%) found the webinars very helpful or extremely helpful.
- 75% of teams felt the challenge structure aided in refining their mobile application.
- When asked to rate their overall experience, participants answered with an average score of 7 out of 10 (0 being extremely negative and 10 being extremely positive).
- When asked about future competitions, 75% of participants responded that they would compete in future challenges.

PHASE 3: PILOT

A. Phase Objective

The ultimate objective in Phase 3 was to help PRISM implement a successful pilot test. In addition, Sensis worked toward helping the top three teams achieve business sustainability by leveraging the VatorX platform to provide teams with exposure to potential investors.

B. Strategic Approach

Sensis set up monthly calls with PRISM to help coordinate the execution of pilot testing the mobile application. This involved careful coordination between MedStar, PRISM, and AHRQ.

C. Tasks & Deliverables

Sensis performed tasks such as providing monthly reporting updates and developing the challenge summary report and an in-depth challenge project report. Additionally, to support the sustainability of winning solutions, the challenge team set up an exclusive VatorX page with information about the Phase 2 winners that can be accessed by health technology investors.

D. Success Metrics

Key milestones were reached and the grand prize winner (PRISM) received the remaining \$40,000 of prize awards, after a successful pilot.

E. PRISM Pilot Test and Results

The PRISM team was tasked with pilot testing their mobile application in nine primary and specialty care practices affiliated with MedStar Health in Washington, DC; Maryland; and Virginia. The team worked with MedStar's technical staff, legal and compliance office, and patients and providers to successfully implement the mobile application. Although FHIR standards allowed the PRISM application to easily connect to a FHIR server that served as a middle layer to bridge the mobile application and two different EHRs, there were still challenges and technical barriers. In particular, setting up a compliant Amazon Web Services instance was resource intensive and time consuming.

When working with practices, the PRISM team found a tight-knit teamworking system essential to successfully implementing the application. They also found that the availability of Wi-Fi and cellular service was critical to adoption and sustained use of this technology. This can be particularly challenging for clinics in rural areas with poor cellular service, or individual practices with specific architectural or physical constraints (e.g., lead walls installed for protection from nuclear medicine).

In general, patients found the PRISM application to be usable and easy to navigate for completion of the PROMIS survey. The application facilitated efficient survey completion (74 seconds on average), highlighting the potential for this technology to be scaled for a large battery of clinically relevant PROs. Password issues when registering an account or downloading from the App Store or Google Play were a common challenge for many patients attempting to engage with the application. Security and privacy concerns remain paramount for many patients and would likely impact their willingness to continuously use this type of technology to collect PROs.

Providers play a key role in patients' willingness to use PRO applications to collect data, as patients were more willing to use the application if they knew the provider was looking at their data. The PRISM team found that surfacing PRO data via a dynamic template in the EHR proved to be a viable solution allowing providers to easily access and consume the PRO data in the EHR. However, some providers still expressed hesitation about interpreting the data because it ultimately represented a patient's perception, rather than an objective physiological measure.

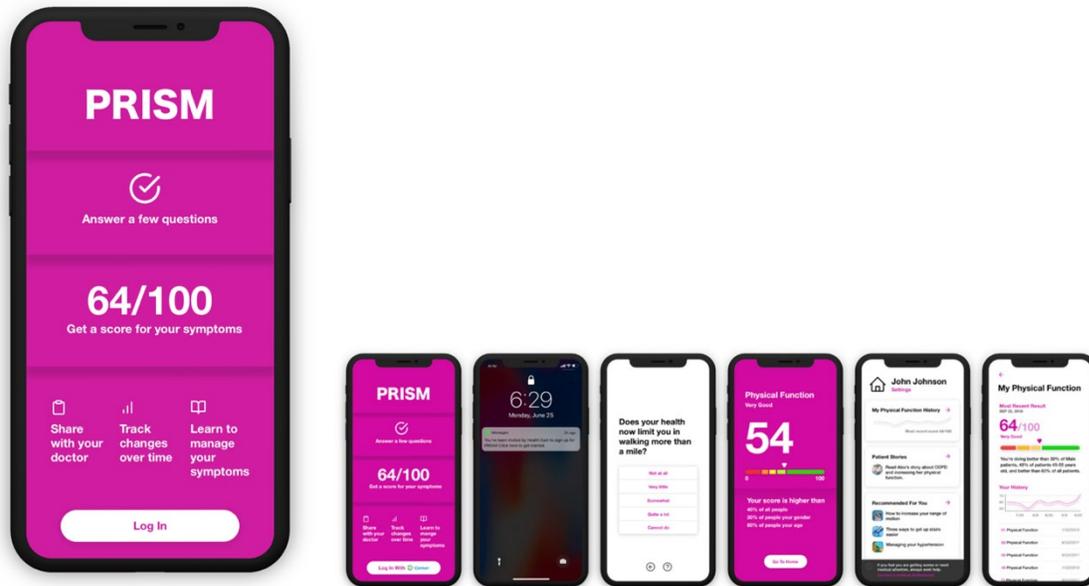
This pilot study was an important step toward testing the technical specifications for PRO development, and a demonstration of the various factors critical to successful adoption, potential scaling, and sustained use of this technology in ambulatory settings. The PRISM application pilot test successfully demonstrated the model for a healthcare institution using a PRO application by leveraging the modern standards of SMART on FHIR to implement a patient-facing application and an EHR-based provider-facing application.

CHALLENGE PERFORMANCE

A. Key Success Indicators & Outcomes

The primary success indicator for the Step Up App Challenge was the successful design and production of multiple mobile applications (as shown in Figure 5) that advance the state of PRO data collection and use. PRISM's mobile application, in particular, re-envisioned patient-centered engagement with its highly useable and intuitive product, capable of communicating PRO data in a digestible format. It also provides actionable and personalized information resources for patients.

Figure 5.



An additional primary success indicator was the challenge’s high number of submissions. The challenge incentivized a large community of mobile application developers (54 teams) to develop products using FHIR standards. This supports AHRQ’s goal of further propelling data interoperability in America’s healthcare industry. When surveyed, all Phase 2 participants indicated they have plans to bring their mobile applications to market. By running the Step Up App Challenge, the PRO data collection mobile application market was stimulated, creating more innovative players, potentially bringing more diverse products to the market.

B. Strengths & Weaknesses

Strengths:

- The multi-phase challenge competition structure was successful, advancing participants’ ideas into full-fledged digital products.
- The Step Up App Challenge was the first challenge that AHRQ hosted. It created a blueprint for future challenge competitions, including helping AHRQ set up challenge microsites and employ best practices in the administration of prize challenges.
- The prize allocation was efficient and provided enough resources for the teams to build functioning prototypes

- Participants had a great experience overall with the challenge. Four out of five participants felt evaluation criteria were fair.
- Participants were able to meet their goal of enhancing brand exposure and improving their mobile applications.

Weaknesses:

- The greatest challenge for participants was understanding and incorporating the evolving technical requirements. Due to the tight project timeline, AHRQ had to work with other entities to modify the technical specifications during the course of the challenge. This created confusion for the participants regarding the technical requirements that they should follow.
- A lack of a common space/platform where participants can submit and see all questions and answers at their convenience was a challenge weakness.

C. Lessons Learned

- Identify all key technical requirements for each phase before launch to decrease participants' confusion and frustration over the course of the challenge.
- Use an in-person event (e.g., conference, workshop) to launch the challenge to maximize promotion so that the target innovator community becomes aware of the challenge.
- Learn from the most common questions and comments from the challenge participants to understand their perspectives and concerns. This will help define the key areas that participant communications should focus on.
- In Phase 2, two teams decided not to continue with their mobile application development. Challenge managers should be prepared for some participant dropout in later phases. Some companies take on a high level of risk to compete and in some circumstances are unable to continue based on their unique business dynamics and the opportunity costs the firms incur to build out solutions.
- A majority of participants felt the challenge met its goal of simplifying the process of collecting, interpreting, aggregating, and sharing PRO data.

D. Opportunities for Improvement

- Provide up-front and clear technical requirements from the beginning of the challenge. This will make it easier to work from concept to development to implementation. For example, some participants felt the FHIR specifications were somewhat unclear.
- Add more interactive or face-to-face communications, such as an in-person product demonstration day, a virtual “Slack channel” or a similar collaborative messaging platform. A live demonstration would allow participants to interact more with the judges and experts.
- Create a SharePoint folder or collaborative workspace such as Atlassian’s Confluence to store all new information, webinars, and resources, which makes critical information more accessible for participants.