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FROM THE FIELD

Innovating Maternal and Child Health: Incentive Prizes to Improve Early Childhood Development

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Abstract

Purpose Protecting and advancing maternal and child health is a critical goal to both society and to the economy, given that their health is a predictor of the next generation's health. Yet despite this recognition, many of the communities aiming to improve maternal and child health still problem-solve in silos: age silos, disease silos, organizational silos, disciplinary silos, data silos, and communication silos, often created or exacerbated by the disconnected approaches to research, funding, and reporting. These silos limit discovery and spread of new solutions to important maternal and child health problems.

Description In this paper, we will discuss federal incentive prizes as a tool to break down silos and to engineer cognitive diversity and transdisciplinary collaboration.

Assessment In 2018, the United States Health Resources and Services Administration, Maternal and Child Health Bureau (HRSA MCHB) launched the "Maternal and Child Health Bureau Grand Challenges," a suite of four prize competitions totaling $1.5 million addressing critical issues in maternal and child health. These included federal challenges designed to (1) prevent childhood obesity in low-income communities, (2) improve the remote monitoring of pregnancy, (3) improve care coordination and planning for children with special health care needs, and (4) prevent opioid misuse among pregnant women and new mothers.

Conclusion The ability to incentivize innovation to address critical public health issues cannot rest in the private sector alone. Complementing other investments, the Challenge mechanism's power to catalyze the rapid development of innovative solutions can improve how we address barriers to achieve optimal maternal and child health for the families that we serve.

Keywords Prize challenge · Maternal child health · Innovation · Public private partnership

Significance

What is already known? Since the middle of the twentieth century, the primary strategy of U.S. research and science policy has been to fund competitive grants and contracts to address specific themes or needs in research. This approach has enabled unprecedented scientific and technological advancements. However, in today's innovation ecosystem in which communication, manufacturing, and computation are not just found in universities or in labs, it is increasingly

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difficult to predict where important contributions might originate.

What this Study Adds? This case study offers an example of how incentive prizes allow for fast-paced development and testing iterations for continuous improvement while breaking down unnecessary barriers between funder and innovator.

Introduction and Purpose: Challenges as an Innovation Tool

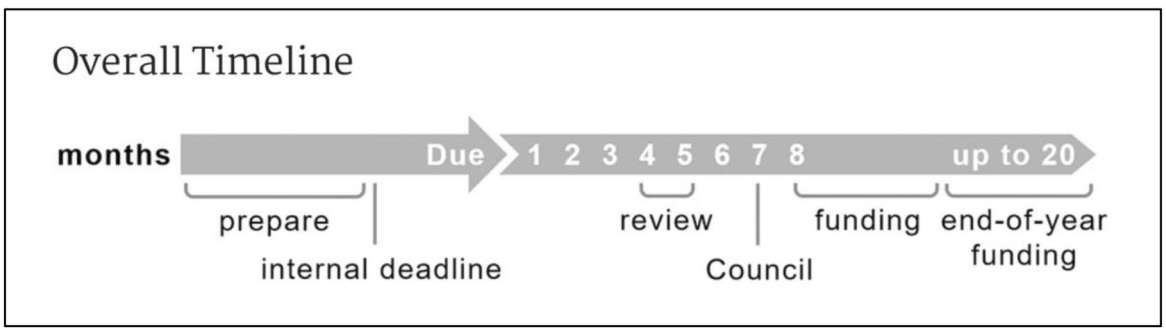
The history of incentive prizes to drive innovation dates back to the 1714 Longitude Prize launched to consider multiple approaches to develop an accurate measurement of marine longitude ("A Guide to Historical Challenge Prizes," n.d.). This prize, established by the British government, set a precedent for engaging the public and unexpected solvers in finding creative solutions to longstanding issues.

Since the middle of the twentieth century, the primary strategy of U.S. research and science policy has been to fund competitive grants and contracts to address specific themes or needs in research. This approach has enabled unprecedented scientific and technological advancements across a range of fields and industries. However, in today's innovation ecosystem, in which communication, manufacturing, and computation are not just found in universities or labs, it is increasingly difficult to predict where important contributions might originate. To provide an example, consider the timeline of federal competitive grants, which includes multiple layers of review after submission. The U.S. government advises that timeline total from planning to award can take up to two years, and longer should a resubmission be necessary. If funded, the study or design would take place afterwards, with final dissemination up to five years later:

Overall NIH R01 grant timeline. Source: U.S. National Institutes of Health, National Institute of Allergies and Infectious Diseases.

In response, federal agencies like the U.S. Department of Health & Human Services (HHS) have looked for new ways to support ecosystems of innovation capable of effectively responding to our most important and complex societal problems. One component of that strategy is the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act of 2010, or America COMPETES Act, signed into law by President Barack Obama. The law authorized every Federal agency to "award prizes competitively to stimulate innovation that has the potential to advance the mission of the respective agency." A central federal challenge site was created (Challenge.gov), and as of March 2019, challenge.gov had more than 1000 challenges posted, offering awards exceeding $250 million.

The HHS and other federal agencies have increasingly turned again to prize challenges as a tool to reach broad audiences, accelerate development, and create more collaborative problem–solving environments. The growing use of incentive prizes as an integral part of federal research and development—and as a complement to grants—is redefining who and how participants can meaningfully contribute to the development of solutions for public benefit. Incentive prizes allow for fast-paced development and testing iterations for continuous improvement while breaking down unnecessary barriers between funder and innovator. Consider, for example, the timeline for the Challenge mechanism, which has three phases, each with iterations of review and coaching. The phases can be as short or as long as the federal agency deems necessary (e.g., six months). Reviews and feedback are embedded in each phase and the final study or design is delivered upon conclusion of the Challenge itself. Reflecting its competition style, there are also multiple solution outcomes ready for scale:



Federal Challenge Overview. Source: U.S. Health Resources and Services Administration.

Assessment

Case Example: HHS MCHB

For more than a century, the Maternal and Child Health Bureau (MCHB) has been working to give every child and family, regardless of circumstances, a fair shot at reaching their fullest potential. Recognizing that early language ability is one of the best predictors of school readiness and later achievement (Burchinal et al., 2016; Hoff, 2013), the Bureau decided to take on the "Word Gap": the inequality in child-directed language between higher and lower-income households. From Hart and Risley's (1995) original data collection, they extrapolated that by the age of three, children in lower-income households were exposed to 30 million fewer words than children in more affluent families. More recent findings have linked socioeconomic status (SES) differences in child-directed speech to disparities in language and cognitive outcomes (Fernald et al., 2013). Subsequent studies have demonstrated that the quality of the early home language environment, independent of SES, is vital to the development of language skills (Melvin et al., 2017), and may indicate a window of opportunity for intervention.

There has been a great debate in the fields of education, linguistics, psychology, and others surrounding the construct of the word gap and how language ideologies play a role in SES related findings (e.g., Keys Adair et al., 2017; Golinkoff et al., 2019; Kuchirko, 2018; Sperry et al., 2018). However, recent studies have demonstrated links between conversational turns, the back-and-forth synchronicity of a caregiver and child during an interaction, and neural language processing, independent of SES or IQ (e.g., Rowe, 2018; Romeo et al., 2018). This research shows how critical it is that interdisciplinary researchers come together to examine how to maximize all children's early learning environments and support academic readiness.

In 2014, HRSA's Maternal and Child Health Bureau (MCHB) announced two major funding initiatives: (1) the creation of a national research network to be charged with assessing the current state of the science on evidence-based interventions addressing early language disparities, and (2) the launch of a new Bridging the Word Gap Challenge, a three-phase prize competition designed to spur innovative, technology-based solutions to help solve this issue by directly targeting parents and encouraging high-quality, verbal interactions with young children (see Fig. 1).

A major appeal to the challenge mechanism was the ability to generate new solutions, from ideation to development, in a relatively short time frame. The challenge was structured in a three-phase design that covered 14 months. Another key incentive was the opportunity for teams, through their continuous user testing and adjustment, to iterate better versions of their prototype, resulting in the most thoughtful and tested final solutions. This iterative process ensured that the final products would be sustainable with families, or "sticky": e.g., that they would appeal to parents and caregivers, fit easily into daily life, and be engaging over a long timeframe.

The first stage of the prize competition aimed to attract a large array of ideas and innovators, with a low threshold for participation. Applicants were asked to submit, in five pages or less, a description of their idea for an innovation, including the evidence behind *why* this idea would have an impact on the target population, and an explanation of how the proposed innovation would be accessible across diverse backgrounds and easily implemented by users. The ten most promising ideas were selected by a panel of Expert Advisors, who signed on to help design the challenge and mentor the Phase 1 teams, and Federal Judges, representing expertise in early childhood development, technology, and early childhood interventions and programs. The winners each received a cash award of $10,000 seed funding and advanced to the second stage of the challenge. Using support from the Phase I prize funding, the teams were required to prototype their proposed innovation, and to test its efficacy on end users (parents and caregivers of young children). The team of Expert Advisors served as mentors and were available to

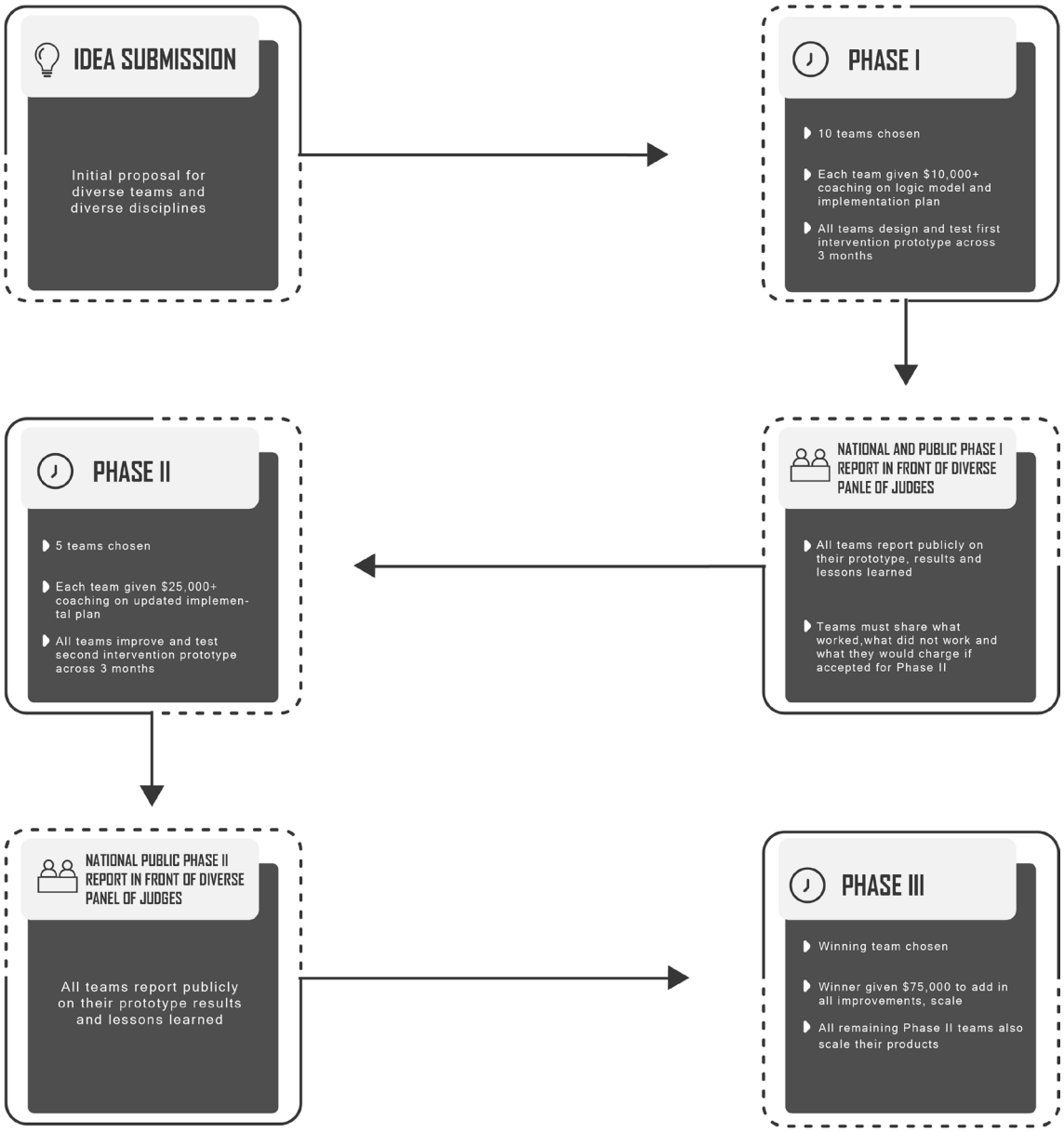


Fig. 1 Three-Phase Structure of HRSA's Challenge Mechanism

help design appropriate testing methodologies and provide information about early language and literacy.

At the end of Phase 2, MCHB hosted a live, in-person "Demo Day" where the nine teams traveled to pitch their interventions "Shark Tank-style" for the opportunity to advance to the final phase of the competition. At the conclusion, the five Phase 2 winning teams each received a cash award of $25,000, and advanced to the final phase of the Challenge, which required testing the innovations at greater scale, and developing a plan for sustainability and widespread adoption by target end-users. The final winner was awarded the grand prize of $75,000.

The design of the challenge was successful in incentivizing the right problem solvers. Applicants included diverse teams and individuals, such as community-based organizations, academics, non-profit organizations, students, and even a group of farmers.

To exemplify how the three-phase accelerator was experienced from the team perspective, the specific steps of the winning team, Háblame Bebé, are provided below.

a. *Phase I* In the first phase, the Háblame Bebé team proposed to create the first mobile application that promotes Spanish–English bilingualism and quality language interactions within the home for low-income Hispanic

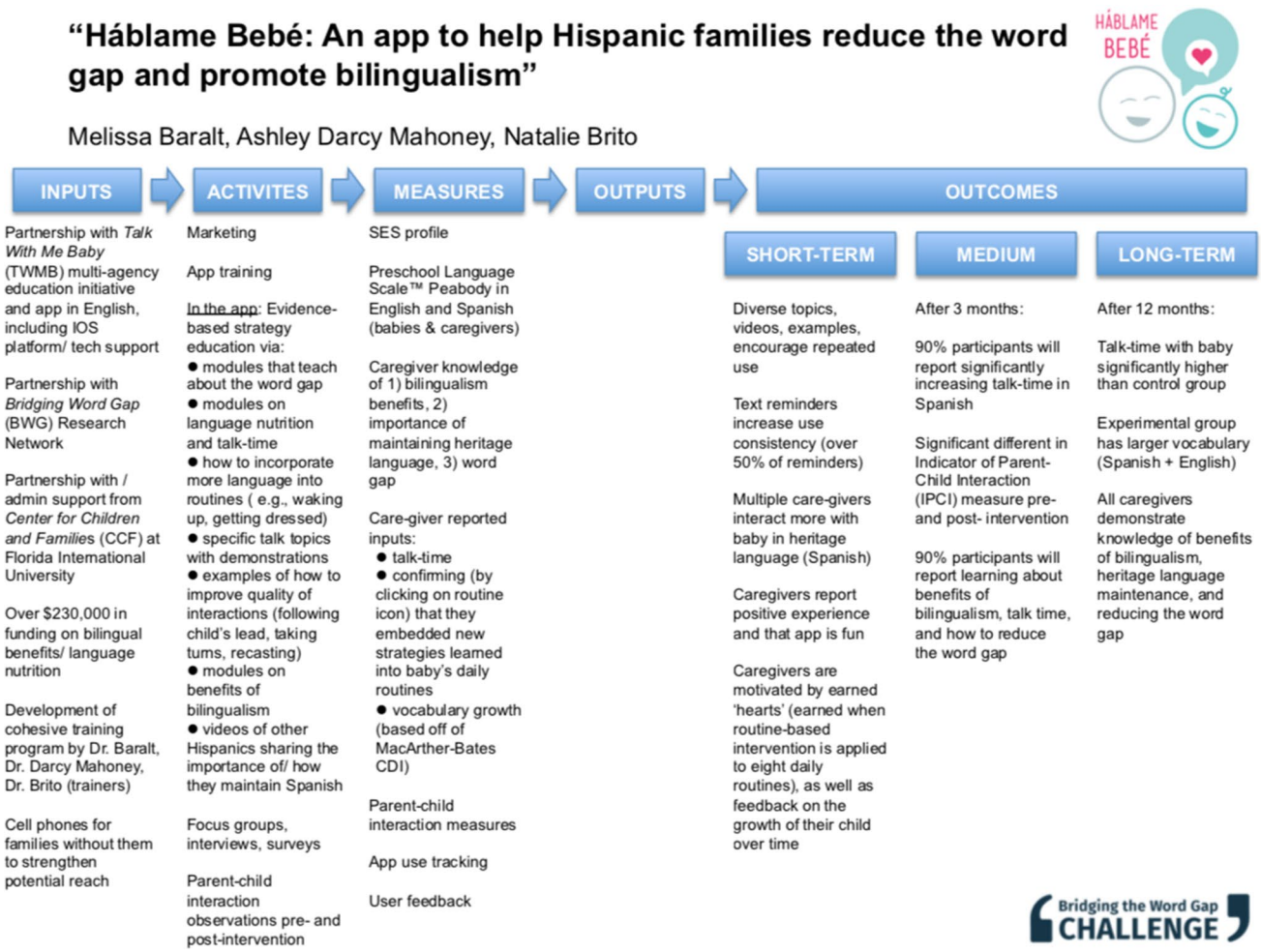


Fig. 2 Háblame Bebé's logic model

families.[1]HRSA asked all participants to provide a descriptive analysis of how they arrived at their ideas in addition to existing evidence and research that supports the efficacy of the intervention proposed.

b. *Phase II* Teams needed to: (1) obtain study approval from an Institutional Review Board (IRB) and to (2) develop a logic model and test plan. All ten Phase II teams were assigned a mentor and provided with training on the creation of a logic model and test plan. Teams were also tasked with seeking out partners and any additional funds outside of the Challenge. The Háblame Bebé team sought out and partnered with the state of Georgia's Talk With Me Baby program, the Bridging the Word Gap Research network, and Florida International University's Center for Children and Families. These partners and resources would serve as key additional inputs in their logic model. Teams also had to specify logic model inputs, activities to be conducted, measures and quantifiers to assess change, outputs, and outcomes. The first stage of feedback from mentors and from HRSA detailed both the strengths and weaknesses in each team's logic model (see Fig. 2).

These iterations of feedback not only served as learning points, but also ensured that the science and methodology behind the interventions was as strong as possible.

At Demo Day, teams reported on their beta prototype development, empirical studies conducted, results, what worked, and what did not work. The Háblame Bebé team reported on their Phase II study: mothers' back-and-forth conversations to their children *did* improve, but not at the level of significance and not always in their native Spanish. Information gathered from focus groups reported that every one of the families had experienced linguistic racism surrounding their use of Spanish with their infants. Instrumental to Háblame Bebé's success, the heart of their app needed to be focused on sociolinguistic pride, and changes were made prior to Phase III.

c. *Phase III* The additional funds from Phase III allowed teams to create a second and improved version of their prototype. Sociolinguistic pride was implemented

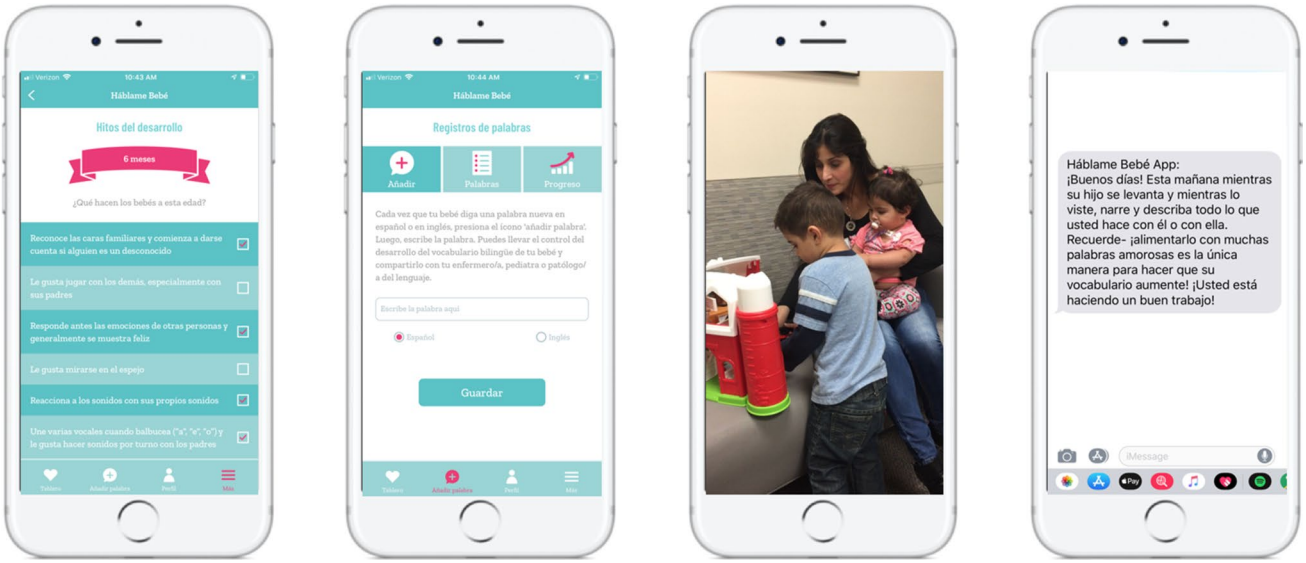


Fig. 3 Háblame Bebé's final outcome and prototype that is now available for free from Apple's iTunes and Google Play

through the app via videos of other Hispanic parents and caregivers narrating their experiences with linguistic racism, educational modules in the app, and text messaging content. A second empirical study commenced and the Háblame Bebé teamed up with Miami-Dade County Women, Infants, and Children (WIC) Clinics to collect data from twelve additional mothers, all who were living at or below the federal poverty line. Before and after the two-month intervention, mother–child interactions were assessed. This time, the Háblame Bebé team found that mothers' verbal interactions with their child significantly improved, and most importantly, mothers were using their native, maternal language to their infants. Mothers in their study reported feeling more empowered, more knowledgeable, and more equipped to handle language ideology and/or prejudice challenges. Upon conclusion of the Phase III study, the five teams had to report to HRSA once again, this time via a "Virtual Demo Day" online and fully accessible to the public. Háblame Bebé's final outcome and prototype that is now available for free from Apple's iTunes and Google Play (Fig. 3).

Conclusion: One Winner, But Lots of Innovation

While there was only one final winner, the challenge helped to proliferate multiple solutions to HRSA's goal: assist families in understanding better the primacy of quality language interactions with their children from birth, and their unique role in improving language and literacy outcomes. All interventions were supported to their final product stage and *all* are currently available to the public. The four additional teams included (1) Beginning with Babble: a mobile app that reminds caregivers to interact with their baby through a variety of developmentally-staged and individually tailored stimuli; (2) Starling: a wearable device that counts the number of words a child hears in real-time; (3) Talk around Town: a mobile app with geo-location technology that provides real-time, location-specific messages to parents aimed at promoting parent and child communication during community outings; and (4) The Word Gap App: a mobile app that offers parents and caregivers information on interacting with their baby through alerts, videos, and by tracking interaction.

Eliminating Silos: Evidence of the Impact of the Challenge Mechanism

As summarized in a 2015 federal report (OSTP, 2016), one of the greatest impacts from the Challenge mechanism has been the ability to discover solutions through a dramatically easier process, compared to traditional grant mechanisms. Leveraging this further, the U.S. Office of Science and Technology has created a "one-stop shop" website, www.Challenge.gov, where anyone—all citizen "solvers" without needing experience—can find a public prize Challenge and submit an idea.

Two additional benefits have been greater reach by a wider diversity of participants and disciplines, as well as accessibility to be able to participate. The report highlighted the Challenge's ability to reach "beyond the usual suspects to find innovative solutions" (p. 36), with participants from all

sectors of society. This increase in participation and in diversity has been facilitated with the need to apply only with an idea and a five-page concept white paper—clearly much more accessible than the traditional 200-page grant application that often requires entire university departments to facilitate the proposal submission process. Consequently, this substantially decreases the cost and effort needed to apply. For example, grant administrators, university overhead, and reviewers must be paid for their roles in submission and in review. On the other hand, the 2015 Challenge hosted by the U.S. Office of Management and Budget "utilized milestone-based prizes to pay only for success" (p. 36), spurring both innovation and efficacy at a much lower price point.

In 2018, HRSA launched the "Maternal and Child Health Bureau (MCHB) Grand Challenges," a suite of four more prize competitions with a $1.5 million prize purse addressing critical issues in maternal and child health. These include challenges designed to (1) prevent childhood obesity in low-income communities, (2) improve the remote monitoring of pregnancy for prenatal providers and pregnant women, (3) improve care coordination and planning for children with special health care needs, and (4) prevent opioid misuse among pregnant women and new mothers. The HRSA Maternal Child Health Bureau has supported additional innovations developed through the challenge mechanism to advance solutions to maternal and child issues. With the Care Coordination for Children with Special Health Care Needs Challenge, the prize mechanism led to the rapid development, testing, and implementing of the CareMap app; a software solution that helps families of CSHCN coordinate the care their children receive from a variety of health care professionals, including medical, behavioral, social, educational, and developmental specialists. The patient-facing mobile-app leverages open standards and has an associated Clinician Dashboard enabling communication with care team members across settings and over time. A unique team was formed to collaborate on this submission, representing Boston Children's Hospital, Family Voices, and Duke Health, with social workers, physicians, and parents providing input as the solution was developed.

Another example in partnership with USAID and others was the development of a rechargeable, locally sourced battery for critically needed electricity in health contexts. This solution is to maintain electricity supply for life-saving health services in Syria where humanitarian crises continue. The winner developed a: "new modular battery array which is low-cost, locally-sourced, mobile and plug-and-play. The innovation will be a casing for a battery module which, uniquely, can be opened and filled with locally sourced, refurbished car batteries. A module can hold four to eight car batteries and interlock with additional modules to increase capacity and will have simple charge and discharge ports" (Humanitarian Grand Challenge. https://humanitariangrandchallenge.org/10-bold-solutions-helping-syrians-a-decade-into-the-conflict/).

Limitations

These prize challenges still have limitations to address. The funding amount and the quick pace did not permit academic teams to 'buy out' their course time, nor did challenge funds pay any indirects to universities. This challenges the very fiscal fabric in which universities are able to sustain their research enterprises. This means that these innovations are very fast but may be considered in-kind work on top of one's own job in a university setting. It also challenges whether these types of "research dollars" are counted in the same way for tenure and promotion for academic scientists. However, the feedback, learning, and outcome makes it incredibly rewarding.

Additionally, several of the semi-finalists noted that the six-month timeline for Phases 2 and 3 was difficult. It required a significant workload that for most was added onto existing full-time positions. Building, testing, and scaling an intervention in such a short timeframe required a great amount of time and effort without the guarantee of additional funding, but it also facilitated expedited learning and feedback that was invaluable to the continued development of the innovations. While the case exemplar presented here was an app based technology, among the finalists there were others that had wearable devices that differed in their innovation.

The challenge mechanism offers unique opportunities outside the realm of traditional investments. One of the unique aspects of applying to a challenge is the capacity for the idea or product to be modified throughout the funding cycle. Most traditional grant mechanisms require researchers to have a full proposal, and in most instances, pilot data to support their hypotheses. Rarely do non-academics participate, and while Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) funding mechanisms specifically cater to business owners, it is rare to have non-siloed interaction amongst people from diverse backgrounds for the purpose of solving societal problems. Challenges are more flexible and encourage the use of feedback during the various funding stages to improve upon the final product; they also foster the participation of and interaction amongst people from a variety of industries. This results not only in ideas and solutions that are more creative and high-risk, but also high-reward.

Additionally, the portfolio of diverse approaches, perspectives, and backgrounds these initial winning teams brought to the challenge created a rich learning environment. Even though this was a competition, the opportunity

for different groups to learn from each other was another unforeseen benefit.

The ability to incentivize innovation to address critical public health issues cannot rest in the private sector alone. Complementing other investments, the Challenge mechanism's power to catalyze the rapid development of innovative solutions can improve how we address barriers to achieving optimal health and well-being for the families we serve.

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