



Introduction to series on technology-based HIV prevention and care interventions for youth

The *iTech* Center for Innovative Technology across the Prevention and Care Continuum is a collaborative center developed under the National Institute of Child Health and Human Development (NICHD)-funded, Adolescent Trials Network for HIV Interventions (ATN). *iTech* currently supports the implementation of ten (two completed, eight in progress) randomized controlled trials (RCTs) testing innovative technology-delivered interventions to address the HIV prevention and care continuum among youth in the United States (US) (1). Since 2018, nearly 1,700 youth have been enrolled across the US in either the formative intervention development phases or within the RCTs. *iTech* relies on a team science approach and the belief that substantial benefits can be gained by disseminating both the challenges and successes that have informed our collective experiences. The 11 articles included in this series of the journal explore an array of interconnected themes and provide a unique perspective on the development, implementation, evaluation and dissemination of technology-based interventions across the HIV prevention and care continuum.

Youth in the US, particularly Black and Latina/o/x sexual and gender minority (SGM) youth are disproportionately impacted by HIV (2). In their narrative review, Allan-Blitz *et al.*, provide an overview of the HIV epidemic among youth using a developmental lens to highlight individual and structural drivers of HIV transmission and acquisition risk. Within this context, they present challenges and opportunities for new and innovative biobehavioral prevention and treatment interventions. As noted in their review, and in line with previous research, multiple intersecting forms of stigma and discrimination related to sex, gender, HIV, and race/ethnicity challenge HIV prevention and treatment service utilization, particularly among youth (3,4). In their paper, Mulawa *et al.* review mobile health (mHealth) interventions that aim to reduce stigma as a way to improve HIV-related outcomes for youth. While the authors identified mHealth interventions that engage youth to reduce stigma, they contend that further efforts are needed, specifically calling for the development of theoretically-grounded, multi-level interventions that not only measure HIV-related outcomes but also prioritize and measure changes in stigma and differentiate mechanisms through which various forms of stigma operate (5).

Sullivan *et al.* discusses how mobile applications (apps) and other mHealth tools fit into the current landscape of efficacious HIV prevention options for youth, highlighting both the unique strengths and limitations of what technology can do. Digital health interventions that are developmentally tailored to meet the needs of youth are highlighted as having the potential to increase uptake of prevention services including HIV and sexually transmitted infection (STI) testing. Biello *et al.* provide additional support for the utility of mobile apps to increase HIV and STI testing rates among youth, specifically among young gay, bisexual, and other men who have sex with men (YGBMSM). In their paper, the authors present the results from two pilot RCTs that were completed in *iTech*, each demonstrating that the distribution of HIV self-testing and STI self-collection kits was a feasible and acceptable strategy among YGBMSM.

Both the Sullivan and Biello papers emphasize the importance of conducting formative work to understand user characteristics and preferences when developing or adapting mHealth interventions for youth. This topic is explored further in the paper by Giovenco *et al.* which describes the results from a cross-cutting analysis of formative end-user research conducted with five samples of SGM youth living with or at-risk for HIV within *iTech*. Overall, feedback on preferred features and functions was consistent across the five interventions, and in line with prior research (6). Divergence, however, was seen in terms of content needs which varied based on the intervention's priority population, indicating that community-centered, cross-disciplinary, formative work should be conducted to ensure interventions are serving the diverse needs of SGM youth (7). This conclusion is reinforced in the paper by Skeen *et al.* which reviewed existing mobile technologies that were tailored exclusively for transgender and gender-expansive populations and incorporated gender-affirming features. Novel content and features that supported self-validation and promoted physical safety and emotional well-being were observed within platforms primarily originating outside the field of HIV prevention. These findings underscore the importance of harnessing gender-affirming cross-disciplinary innovations to advance the field.

Three studies focus on technology-driven methodologies that engage youth to support intervention development, implementation and evaluation. Gamarel *et al.*, describe innovative approaches for online collection of formative qualitative

data and discuss the relative advantages and disadvantages compared to face-to-face data collection methods. Virtual qualitative data collection allows for engagement of youth whose participation might be otherwise limited by structural barriers (e.g., lack of transportation, inconvenient timing) or a reluctance to participate due to stigma or discomfort with group settings. These methodologies may prove even more valuable given the impacts of the COVID-19 pandemic on research and health services delivery and requirements for physical distancing (8). Engaging youth to participate in mHealth studies also presents challenges. Lessons learned from recruitment of youth into four ongoing RCTs of mHealth HIV prevention interventions within *iTech* are described in the paper by Zlotorzynska *et al.* In addition to providing metrics of success based on advertising and screening metrics, the authors also provide a framework for evaluation of data from future online recruitment efforts across platforms and geographic areas. Once enrolled, poor engagement can also limit the effectiveness of mHealth interventions for youth. In the paper authored by Hightow-Weidman *et al.*, the author's discuss promising intervention strategies and features being employed within five ongoing *iTech* RCTs to enhance youth mHealth engagement, ensure its monitoring and reporting throughout the trial, and evaluate its impact on trial outcomes. A discussion of measurement approaches and metrics of success based on the engagement features embedded in the technology, key mechanisms of behavior change, and trial outcomes is provided.

The final two papers offer insights for both researchers new to the field wishing to create novel mHealth interventions, as well as for seasoned investigators wishing to scale-up established technology-based solutions. Siegler *et al.* provides a guide on how to maximize the opportunities mHealth tools and interventions afford, while avoiding salient pitfalls in mobile health app research and development. A critical issue is the mismatch between technology product development and research funding, both in terms of NIH budgets and timelines; the result of which is a manifested by a paucity of publicly available, “post-research” apps. Sharing and disseminating best-practices and leveraging collective experiences in multiple mHealth interventions, as is being done within *iTech*, may bring promising interventions to scale more quickly. Paul *et al.* discuss this topic further using as an example the app P3 (Prepared, Protected, em-Powered), an mHealth intervention to increase PrEP adherence among YGBMSM and young transgender women who have sex with men (9). The authors illustrate best practices and lessons learned for scale-up of mHealth interventions including the involvement of key stakeholders—particularly community members, potential implementers, and end-users—during initial planning, trials, analysis and dissemination. Capacity building (e.g., provision of staff training and technical assistance with deployment and evaluation) to support implementation of mHealth interventions by public health and community-based organizations is recommended.

The articles included in this series of the journal highlight the depth and breadth of youth-focused, mHealth intervention research that is being conducted both within *iTech* and in the broader research community. Ending the HIV epidemic among youth in the US will require an intentional, integrated and personalized approach that includes both behavioral and biomedical components and addresses the multi-level risk factors and barriers youth face. Technology-based platforms offer a potential way to deliver these integrated strategies in an engaging and impactful way and will assuredly play a key role in reducing HIV incidence and improving health outcomes among youth.

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Lisa Hightow-Weidman

Lisa Hightow-Weidman, MD, MPH

Professor of Medicine and Health Behavior;

Institute for Global Health and Infectious Diseases,

University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

(Email: Lisa_hightow@med.unc.edu)

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