Centering Equity in the Implementation of Emerging Digital Health Technologies

JOIE D. ACOSTA, DOUGLAS YEUNG, SANA ZAKARIA
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Digital health technologies were rapidly implemented and scaled as a result of the health care delivery challenges associated with the coronavirus disease 2019 (COVID-19).

Despite the unprecedented scaling of digital health technologies, many populations got sick or died at higher rates than others—bringing renewed attention to the importance of health equity (Crawford and Serhal, 2020). To address the persistent health inequities in the United States, it will be crucial to center health equity in the implementation of digital health technologies. As these two fields (health equity and digital equity) are finding their footing after rapid implementation and scale-up in the post-pandemic world, a focus on equitable implementation is particularly important to ensure that digital health technologies do not perpetuate or create new health inequities. However, to date, these fields have had a limited or siloed focus on implementation. To our knowledge, this paper will be the first to discuss what it would mean to center health equity in the implementation of digital health technologies. Specifically, we describe approaches to center health equity in the implementation of digital health technologies and provide examples of how leading implementation process and evaluation models can be adapted to support equitable implementation of digital health technologies and, ultimately, bridge the research-to-practice gap. The key terms we use in this paper are defined in the following box.
At the time of writing, efforts to identify the factors that lead to the successful use of digital health technologies to promote health equity are siloed. For example, although IS methodological frameworks have implicitly considered equity an objective, few of these conceptual and theoretical frameworks have systematically and explicitly emphasized the upstream social determinants or systemic or structural issues that historically have contributed to health inequities (Gallant et al., 2023; Nooraie et al., 2020). Similarly, only one methodological framework has explicitly considered the implementation of technologies within a health-related setting (e.g., Integrated Technology Implementation Model) (Gallant et al., 2023), but this methodological framework does not explicitly address equity (Schoville and Titler, 2015).

Equity has only been explicitly addressed in IS determinant frameworks that identify factors relevant to implementation in health promotion and care (e.g., health equity implementation framework, elements of equitable implementation). IS researchers have made few advances in developing integrated digital and health equity process models and evaluation frameworks to guide the implementation of digital health technologies (Brownson et al., 2021).

Process models and evaluation frameworks are needed to assess whether digital health technologies are implemented equitably and whether they are successful in addressing health inequities. Advancing understanding in these areas could also help to tell us whether there are gaps or erroneous concepts in IS determinant frameworks and provide needed methodological guidance to support equitable digital health technologies implementation and evaluation. Thus, IS can offer “an explicit response to the decades of scientific progress that generally have not translated into equitable improvements in population health” (Brownson et al., 2021) by applying equity and technology adoption lenses to advance the use of digital health technologies (Richardson et al., 2012). This paper proposes adaptations to an IS process model (Getting To Outcomes [GTO]) and IS evaluation framework (reach, effectiveness, adoption, implementation, and maintenance/sustainment [RE-AIM]) to demonstrate how to center health equity on the implementation of digital health technologies (Brownson et al., 2021). These model adaptations operationalize ways to leverage the intersection of IS, health equity, and digital equity (see the box on the following page).

In this paper, we first describe the persistent health inequities in the United States and how the rapid adoption of digital health technologies can perpetuate those inequities. Then we discuss challenges and limitations of IS in centering equity in the rapid adoption of digital health technologies and translating these technologies into equitable improvements in public health. Next, we provide examples of how IS process (i.e., GTO) and evaluation (i.e., the RE-AIM measures) frameworks can be adapted to focus on digital and health equity to leverage emerging health technologies to course correct and address inequitable health outcomes. Finally, we discuss how these adapted IS process and evaluation frameworks can be applied to address the pitfalls—and realize the promise—of three emerging fields at the intersection of racial and digital health equity: (1) genomic medicine, (2) artificial intelligence (AI) (specifically large language models [LLMs]), and (3) participatory digital media (e.g., blogs, digital stories).
Definitions of Key Terms

**Health equity** is defined by all people having a fair and just opportunity to be as healthy as possible (Braveman and Gruskin, 2003). To achieve health equity, the disparities in health and its determinants (e.g., quality education and housing, safe environments, health care) must be reduced.

**Digital equity** is “the capacity in which all individuals and communities have access to technologies needed to participate fully in society, politics, and economics” (Davenport Institute, 2023).

**Digital health equity** sits at the intersection of health equity and digital equity (Davenport Institute, 2023) and focuses on “the equitable opportunity for everyone to access, use, and benefit from digital health, to achieve their greatest standard of health and wellbeing” (Figueroa et al., 2022).

**Digital health technologies** include computing platforms, connectivity, software, and sensors for health care and related uses, such as mobile health, health information technology, wearable devices, telehealth and telemedicine, and personalized medicine.

**Implementation science** (IS) is a field dedicated to closing the research-to-practice gap by translating the conceptual, scientific, and health technology advancements from academic research to improve the front-line provision of services, programs, and other practices, thus ensuring that diverse populations across different settings benefit from scientific advancements (Brownson, Colditz, and Proctor, 2018). IS theories, models, and frameworks can be grouped into one of the three following categories based on the aims of that theory, model, or framework (Nilsen, 2020):

1. Process models describe or guide the process of translating research into practice, or both.
2. Determinant frameworks and implementation theories explain what influences implementation outcomes.
3. Evaluation frameworks provide guidance on evaluating implementation.
Health inequities in the United States are persistent.
Health inequities in the United States are greater than in other industrialized countries and have shown little improvement over the past 20 years. Health inequities are the differences in health status or in the distribution of health resources among different population groups, which arise from the social conditions in which people are born, grow, live, work, and age (World Health Organization, 2024). In 2019, U.S. life expectancy at birth was 77 years, three years younger than the Organisation for Economic Co-operation and Development (OECD) average of 80.4 years. Similar patterns repeat for death rates for avoidable or treatable conditions, maternal and infant mortality, and obesity rates (Table 1). Despite spending a greater percentage of the GDP on health care than other industrialized nations (17.8 percent compared with an OECD average of 9.6 percent), the United States ranks worse than other industrialized nations on many health indicators (Gunja, Gumas, and Williams, 2023). In addition to the almost 20 percent of GDP spent on health care alone is spending dedicated to a multitude of other factors that drive health outcomes (e.g., educational access, neighborhood, and the built environment), including efforts to promote digital equity.
To address health equity, public health experts, health advocates, and providers of health services need to be conscious of race and racism and take into account the requirements, culture, and historical context of populations and communities, as well as health system structures and policies and provider-level factors.

TABLE 1
Health Indicators for the U.S. Population Compared with Other Industrialized Countries (as of 2020)

<table>
<thead>
<tr>
<th>Health Indicator</th>
<th>U.S. Rate or Percentage</th>
<th>Average Rate or Percentage Across OECD Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of avoidable deaths per 100,000 persons</td>
<td>336</td>
<td>225</td>
</tr>
<tr>
<td>Rate of infant mortality per 100,000 persons</td>
<td>5.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Rate of maternal mortality per 100,000 persons</td>
<td>23.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Percentage of total population that is obese</td>
<td>42.8%</td>
<td>25.0%</td>
</tr>
</tbody>
</table>


NOTE: OECD countries include here are Australia, Canada, France, Germany, Japan, the Netherlands, New Zealand, Norway, South Korea, Sweden, Switzerland, and the United Kingdom. In the report cited, the term *avoidable deaths* refers to those that “are preventable and treatable”; *infant mortality rates* “reflect no minimum threshold or gestation period or birthweight”; and *obese* is defined as “a body-mass index of 30 kg/m² or more.”
In addition to these concerning health trends overall, significant health inequities also exist among populations in the United States. For example, life expectancy for Black Americans (74.8 years) and American Indians or Alaskan Natives (71.8 years) is lower than for White Americans (78.8 years). Maternal and infant mortality in the United States is also highest for Black American and immigrant mothers and infants (Dagher and Linares, 2022). Obesity disproportionately affects Black Americans—women in particular—regardless of socioeconomic status (Lofton et al., 2023). Over the past 20 years, obesity increased among U.S. adolescents, primarily because of increased rates among Black and Mexican American youth (Ogden et al., 2020).

Health inequities are not limited to race. Compared with U.S. citizens residing in urban centers, those living in rural areas are more likely to die of heart disease, stroke, cancer, and suicide, among other conditions (Miller and Vasan, 2021). Lesbian, gay, bisexual, and transgender people have worse mental and physical health than heterosexual and cisgender people (Medina-Martínez et al., 2021). Neighborhood or geography also contributes to health inequities: For example, a Black man in Baltimore, Maryland, is 50 percent more likely to die of diabetes than his White counterpart, whereas in Washington, D.C., that same Black man is 300 percent more likely to die of diabetes than his White counterpart (Tung et al., 2017). Often, these factors work together to create unique interactions between an individual and their environment that result in differential health outcomes.

Research has shown that health outcomes are influenced by a series of complex interactions among individuals, friends and families, schools and workplaces, systems of power, and their overall community environments (Peterson et al., 2020). Within these interactions, there are factors that are more relevant to understanding the promotion of health equity (National Institute on Minority Health and Health Disparities, undated); in the context of implementation health outcomes, these factors are often influenced by the following social characteristics: place of residence; race, ethnicity, culture, and language; occupation; gender and sex; religion; education; socioeconomic status; and social capital. Additionally, personal characteristics are also associated with discrimination, such as age, disability, sexual identity, and both lasting (e.g., parental) and time-dependent (e.g., hospital provider) relationships. Collectively, these factors are referred to as PROGRESS+ (O’Neill, 2014).

Research has shown that bias, prejudice, and stereotyping occur during the implementation of health services (Nelson, 2002). A 2018 analysis of health care quality measures found that Black, American Indian and Alaskan Native, and Native Hawaiian and Pacific Islander patients continue to receive poorer care than White patients on 40 percent of the study’s quality measures and that there has been little improvement over the past two decades (Agency for Healthcare Research and Quality, 2023). In addition to race, research has found that bias can lead to differential health care for individuals based on their weight, age, language, income, and insurance status (Smedley, Stith, and Nelson, 2003).

To address health equity, public health experts, health advocates, and providers of health services need to be conscious of race and racism and take into account the requirements, culture, and historical context of populations and communities, as well as health system structures and policies and provider-level factors, such as the
attitudes and knowledge that can contribute to health inequities (Raphael, 2000). As the enduring legacy of the COVID-19 pandemic illustrates, health care decision-making that can help protect populations from emerging health hazards is more important than ever.

**RAPID ADOPTION OF DIGITAL HEALTH TECHNOLOGIES CAN PERPETUATE HEALTH INEQUITIES**

The use of digital health technologies to help people avoid, recover from, or cope with disease or disability and improve the quality and safety of health care has been growing rapidly as internet-enabled technological advancements continue to emerge. In 2019, the United States invested $7.4 billion in digital health to build more than 300,000 health apps (Rodriguez, Clark, and Bates, 2020). Yet, in 2020, about 21 million people in the United States lacked the broadband access needed to use these innovations (Anderson, 2019). Some researchers have predicted that broadband access could become a social determinant of health (Benda et al., 2020), as the digital expansion of health technologies continues (Rodriguez, Clark, and Bates, 2020). Research has also found that many digital health technologies are not consistently usable for diverse populations (Sarkar et al., 2016), and uptake of existing health portals and mobile health apps has lagged among people of color, older adults, low literacy adults, and adults with limited English proficiency (Anthony, Campos-Castillo, and Lim, 2018).

The design, development, and evaluation of digital health technologies can reinforce health inequities. For example, smartwatches are less effective at monitoring heart rates of people with darker skin tones because they frequently use green light optical sensors, which are readily absorbed by melanin (Hailu, 2019; Costin and Hearing, 2007). This limitation resulted from people of color not being represented in the development and testing of these technologies, despite these technologies being marketed as democratizing health. Research has also found that there is a lack of mobile health interventions tailored to racially and ethnically diverse patients (Huh et al., 2018), again, because these technologies were developed without engaging diverse communities. Even digital health technologies that purport to address race (e.g., makers of atrial fibrillation–wearable technologies made a race-based correction to improve their accuracy), do not address race as a social construct—just as a biological one (Merid and Volpe, 2023). As previously mentioned, health outcomes are a result of the interaction of individuals and their environments—with the digital environment being a key factor in the use of digital health technologies. Factors within the digital environment that have been associated with digital health equity include individual factors (such as digital literacy and technology access), interpersonal factors (such as implicit technology bias of health providers that can limit their willingness to engage individuals in digital health technologies), community factors (including the norms and infrastructure to support technology), and societal factors (including policies, design standards, social norms, and algorithmic biases) (Richardson et al., 2022). Without active efforts to ensure that the needs of diverse groups are included in the design and implementation of digital health innovations, these technologies may not reach the populations who can most benefit from them or may create intervention-generated inequities (Veinot, Mitchell, and Ancker, 2018).
Research has found that it takes an average of 17 years for scientific innovations to be incorporated into routine health promotion and practice (Morris, Wooding, and Grant, 2011), and only about half of effective innovations ever reach widespread usage among their intended populations. IS was developed to address this research-to-practice gap, thereby improving the front-line provision of services, programs, and other practices to ensure that the public can benefit from scientific advancements across diverse settings and populations (Eccles and Mittman, 2006). Implementation evaluation and research studies focus on assessing the processes through which scientific innovations are developed, planned, and executed (Bauer et al., 2015). Implementation outcomes may be measured by the extent to which a scientific innovation has been adopted and sustained. Below, we discuss some challenges and gaps in current IS methodological frameworks that limit the field’s ability to translate new digital health technologies into equitable improvements in population health.

BIASED AND OPAQUE SCIENCE ON DIGITAL HEALTH TECHNOLOGIES

First, IS is focused on translating research into practice (using the aforementioned process models), but the scientific innovation research that serves as the basis of IS may be biased. Innovative practices or programs are
considered effective when rigorous research studies show that innovations have resulted in the expected health outcomes (e.g., such evidence is found in multiple randomized controlled trials) (Chambers and Norton, 2016). The authors published, populations included, and the settings involved in research studies of scientific innovations often lack diversity (Naik et al., 2019), thus resulting in scientific innovations that—although effective for the general population—could unintentionally exacerbate health inequities for some groups (Lorenc et al., 2013). For example, although tobacco smoking prevention effectively reduced smoking overall, anti-smoking interventions were less effective among less-educated populations. Although the adult smoking rate in the United States has dropped from 47 percent to 15 percent overall, it is only 4 percent among adults with graduate degrees and 34 percent for adults with a high-school degree, showing that health inequities are exacerbated by education levels (Veinot, Mitchell, and Ancker, 2018).

Additionally, scientific innovations that are designed with the general population in mind are often criticized as reductionist because they do not attend to the broader context or address upstream social and structural determinants of health. Scientific innovations that are designed with the general population in mind are often criticized as reductionist because they do not attend to the broader context or address upstream social and structural determinants of health.
efforts to use innovative digital health technologies have faced major data quality, privacy, and regulatory concerns (Sharma et al., 2018).

**LACK OF AN EXPLICIT FOCUS ON HEALTH OR DIGITAL EQUITY IN PROCESS AND EVALUATION FRAMEWORKS**

Second, to date, evolving approaches to IS processes and evaluation have had a limited explicit emphasis on equity or on technology adoption (Brownson et al., 2021). Loper, Woo, and Metz (2021) defined equitable implementation as “an explicit and intentional integration of implementation science and equity that attends to what is being delivered, for whom, and under what conditions; and how delivery should be tailored to best meet the needs of the focus population.” IS has made some progress adapting determinant frameworks (i.e., those that identify the factors that predict implementation success) to address health equity. The Health Equity Implementation Framework (Woodward et al., 2019), which combines the Integrated Promoting Action on Research Implementation in Health Services (Woodward et al., 2021) and Health Care Disparities Framework (Adler and Stewart, 2010), is one of the most well-established examples of a determinant framework that explains factors relevant to implementation and disparities in health care. Attending to these frameworks would result in successful implementation and health equity.

Technology adoption frameworks are primarily focused on determinants of technology adoption; they have not focused on implementation specifically and context more broadly. These frameworks have focused primarily on user interaction with the technology rather than the factors that could lead to inequitable access to the digital technology (such as broadband needed to use the innovation) or inequitable distribution of digital literacy needed to take full advantage of the technology. For example, the Technology Acceptance Model (Marangunić and Granić, 2015) is the most widely referenced adoption framework, which identifies individual-level determinants of technology acceptance—specifically ease of use and usefulness of the innovation. The Unified Theory of Acceptance and Use of Technology (Dwivedi et al., 2019; Williams, Rana, and Dwivedi, 2015) expands the Technology Acceptance Model by focusing on five determinants of technology adoption: (1) performance acceptancy (“the degree to which an individual believes that using the system will help him or her to attain gains in job performance”), (2) effort expectancy (the “degree of ease associated with the use of the innovation”), (3) facilitating conditions (“the degree to which an individual believes that an organization and technical infrastructure exists to support use of the innovation”), (4) social influence (“the degree to which an individual perceives that important others believe he or she should use the innovation”), and (5) behavioral intention (“the subjective probability that he or she will use the innovation”) (Venkatesh et al., 2003, p. 724). One exception has been the Integrated Technology Implementation Model, which identifies factors that affect technology implementation and use in a variety of health care settings (Schoville and Titler, 2015), including resource, ethical, governance, and digital literacy considerations (van Gemert-Pijnen, 2022). However, a 2020 study found that even this model lacked attention to implementation process—the sequence of activities and use of technology to achieve quality patient care—and did not reference digital or health equity as an explicit consideration (Schoville and Titler, 2020).
Several key changes to the ways in which digital health technologies are being planned and developed, executed, and evaluated are needed to center racial health equity in the implementation of these digital health technologies. The IS gaps and challenges to the equitable implementation of digital health technologies are not insurmountable: There are still opportunities for IS to contribute to centering racial health equity in the implementation of digital health technologies.

**Strategies to Center Health Equity in the Implementation of Digital Health Technology**

**Improve Transparency of Development Processes**

A critical first step to improving the equitable implementation of digital health technologies should be taken before a technology is even developed. First, the development processes of digital health technologies needs to be more transparent. For example, digital health technology developers need to document who contributes to the development of the technology, what they contribute, what populations are part of initial usability testing, and how well those populations correspond to the intended target populations.
IS can help to operationalize a transparent process or methodology for the design and development of digital health technologies by using process models. For example, implementation scientists can help to inform a standardized way for developers to document their processes and for journal peer reviewers and editors to critically appraise manuscripts (similar to Preferred Reporting Items for Systematic Reviews and Meta-Analyses, which is a standardized documentation for the minimum set of items reported in meta-analyses and systematic reviews). A standardized and required documentation about digital health innovation development and implementation practices could require transparency on issues that have been obfuscated in the current environment (e.g., data quality, privacy, regulatory concerns) (Sharma et al., 2018).

**Design with Implementation in Mind**
Second, digital health innovations should be developed with implementation in mind. This means designing the digital health technology so that it can be delivered most effectively to the population(s) that need it the most. For example, if the technology is for people with low literacy, a greater use of visual and auditory presentation styles may be needed in the information design, and the interface design may need to be linear (rather than hierarchical) to promote easier navigation (Veinot, Mitchell, and Ancker, 2018). Just because it is possible to digitally adapt an in-person health promotion approach does not mean that it is a good idea. During the design phase, technology developers should consider whether the digital platform brings an important advantage or addresses a key barrier to implementation. Developers will also need to determine how the technology will be transitioned to the population(s) that need it the most. These transition processes should be a key consideration during the development process rather than an afterthought once technology is designed. Involving affected populations in the design of digital health innovations through a user-centered process can lead to greater adoption. If these innovations are to reach the populations that need it the most, it is imperative to consider how to effectively reach those populations and match such considerations with the design of digital health innovations.

**Evaluate with More-Diverse Populations**
Third, the effectiveness of digital health technologies should be tested among the populations who can most benefit from them. For example, an innovative digital technology to improve the uptake of insurance should be tested with American Indian or Alaska Native, Hispanic, Black, and Native Hawaiian or Pacific Islander populations because these groups have persistently higher rates of uninsurance than other groups (Ndugga and Artiga, 2023). IS can guide a standardized process for reviewing sources of evidence for the effectiveness of digital health technologies that assesses the alignment of diverse populations and settings involved in generating the evidence with the populations who can most benefit from these technologies. Results of such a review process could be used to ascertain how effective certain digital health technologies are for a specific population (or population need); additionally, such results can be used to score digital health technologies on their equitable contribution to health outcomes across various populations. Results from these IS-informed review processes could be integrated into existing registries, databases, and online marketplaces where individuals and practitioners find relevant digital health technologies.
Improve Evaluation Design, Methods, and Dissemination

Fourth, developers of digital health technologies should consider how their technologies will be affected by and, in turn, affect the social and structural determinants of health outcomes, including structural racism, oppression, and discrimination. Evaluation methods and measures are needed to raise the visibility of equity in the implementation and adoption of digital health technologies, as well as in evaluation design, interpretation of evaluation data, and dissemination of evaluation findings (via the aforementioned evaluation models) (Thomas et al., 2018). IS can guide the development of evaluation methods and measures specific to health equity and digital health technology adoption (Shelton, Adsul, and Oh, 2021). These methods and measures are needed to capture the extent to which digital health technologies are implemented equitably (Brewer et al., 2020). Methods that center health equity should include explicit steps for evaluators to challenge and address biases in evaluation and work in partnership with practitioner partners involved in implementing the digital health technologies that are being evaluated (Dean-Coffey, 2018; Donaldson and Picciotto, 2016; Rogers, 2016).

ADAPTATIONS TO CENTER HEALTH EQUITY IN THE IMPLEMENTATION OF DIGITAL HEALTH TECHNOLOGY

Digital Health Technology Implementation Processes

GTO, which is a popular and evidence-based implementation process model, offers an opportunity to showcase how implementation processes might be adapted to center racial health equity in the development and use of digital health technologies. Specifically, this section provides some illustrative examples of how GTO can be adapted to support the cocreation of a tailored manual, tools, and training materials, as well as a tailored coaching process (meeting agendas, frequency, formats) with an explicit focus on digital and racial health equity.

The GTO intervention builds capacity for implementing evidence-based practices (EBPs) by strengthening the knowledge, attitudes, and skills needed to choose, plan, implement, evaluate, and sustain EBPs. GTO lays out ten key steps for obtaining positive results that compose GTO’s process model:

- GTO Steps 1–6 address planning programs.
- GTO Steps 7–8 involve process and outcome evaluation.
- GTO Steps 9–10 focus on the use of data to improve and sustain programs.

Three types of support are provided to help organizations progress through the ten steps: a manual that is specifically tailored to include EBPs focused on the outcomes of interest, face-to-face staff training, and onsite technical assistance (Wiseman et al., 2007). The goal is to help organizations integrate the practices that GTO targets into their routine operations. Several studies have demonstrated GTO’s effectiveness. Specifically, past research found that greater engagement with the GTO supports was associated with improvements in prevention capacity—i.e., knowledge (e.g., ease of completing various prevention tasks), attitudes (e.g., perceptions of EBPs), and skills (e.g., frequency of doing evaluation) (Chinman et al., 2008; Acosta et al., 2013). Also, there was evidence that organizations that implemented GTO performed better on a set of key programming tasks targeted by the GTO approach (e.g., goal setting, planning, evaluation [called GTO performance]).
(Chinman et al., 2008; Acosta et al., 2013; Chinman et al., 2009). Two cluster-randomized trials on GTO found that youth-serving organizations who received GTO support had higher ratings of fidelity and better youth outcomes compared with control sites (Chinman, Acosta, et al., 2018; Chinman, Ebener, et al., 2018).

To center health equity in the implementation process for digital health technologies, the GTO process would need to explicitly incorporate the essential elements of equitable implementation. Table 2 provides some examples of how the ten steps of GTO can be adapted through a community-based participatory implementation development process, with needed adjustments to specific GTO steps. These examples are intended to be illustrative rather than exhaustive and are aligned with the strategies to center health equity described above.

Using the community-led method to cocreate GTO manuals, tools, and trainings (e.g., community-based participatory research) will help support the selection of digital health technologies that are culturally grounded and based on the voices of those affected (Chinman et al., 2004). These methods will also help in the development, selection, adaptation, and evaluation of digital health technologies that focus on health equity. Few existing digital health technologies address the root causes of health inequity; therefore, it is imperative to cocreate processes that can mitigate the detrimental health effects of inequity.

**Evaluation of Digital Health Technology Implementation**

The RE-AIM evaluation model offers an opportunity to demonstrate ways to center health equity in implementation evaluation. Traditionally, RE-AIM outlines a series of implementation processes and outcomes at four specific levels—the individual (e.g., knowledge and skills), practitioner (e.g., health providers, community-based professionals, public health practitioners), organizational (e.g., schools, public health agencies, community-based organizations), and setting (e.g., multiple organizations working together to create an environment) levels. Table 3 adapts these processes and outcomes (left column) and the associated evaluation questions and measures to center health equity in the evaluation of digital health technology implementation. This adaptation reconceptualizes the processes and outcomes—as well as their evaluation questions and measures at each of the levels—to be intersectional rather than individual (see the box on p. 18).

Few existing digital health technologies address the root causes of health inequity; therefore, it is imperative to cocreate processes that can mitigate the detrimental health effects of inequity.
<table>
<thead>
<tr>
<th>GTO Steps</th>
<th>Adaptations Needed to GTO</th>
<th>What Adaptations Look Like in Practice</th>
</tr>
</thead>
</table>
| GTO Steps 1–6: Planning for a digital health technology | Revisit how digital health technologies are selected and prioritized by policymakers, implementation scientists, government regulatory bodies, etc. | • Clarify the role of PROGRESS+ factors in problems, goals, outcomes, and digital health technology identification.  
• Consider whether the digital health technology has been found to be effective among populations experiencing inequities and whether it explicitly addresses the social determinants of health. |
|           | Revisit what counts as evidence.                                                           | • Rely on best practices as determined by lived experience, not just academic literature. This process has been formalized as community-defined evidence, which is a set of practices that communities have used and found to yield positive results, as determined by community consensus over time (Callejas, Perez, and Limon, 2021). |
|           | Revisit how needs that drive decisionmaking about the use of digital health technologies are identified and prioritized. | • Include social determinants of equity and factors related to digital equity (e.g., broadband access) as part of a needs-based and resource-based assessment.  
• Prioritize needs that contribute to health equity. |
|           | Revisit how adaptations to digital health technologies are prioritized.                      | • Prioritize adaptations to digital health technologies that recognize local culture, history, community strengths and assets, as well as other PROGRESS+ factors. |
| GTO Steps 7–8: Evaluating a digital health technology | Revisit how the digital health technology process is evaluated.                             | • Capture common barriers and facilitators to equitable digital health technology implementation based on the Health Equity Implementation Framework (Woodward et al., 2019).  
• Consider a wider variety of critical approaches for assessing digital health technology outcomes.  
• Facilitate critical discussions about how to mitigate bias in digital health technology implementation and evaluation. |
### GTO Steps Adaptations Needed to GTO

**Support the cocreation of digital health technologies and their evaluation plans.**

- Coauthor the manuals, tools, and trainings using an iterative and participatory cycle of dialogue, decisionmaking, and continuous improvement to maximize GTO’s alignment with local culture, values, and context.
- Cocreate strategies to disseminate digital health technology evaluation data in ways that are maximally useful and empowering.

**Support data sovereignty across digital health technologies and evaluation.**

- Intentionally plan for community ownership and control of their digital health technology data to address historical and current mistrust.

**Revisit how evaluation findings are interpreted and applied for quality improvement.**

- Consider alternative explanations for digital health technology evaluation findings related to racism.

### TABLE 2—CONTINUED

<table>
<thead>
<tr>
<th>GTO Steps</th>
<th>Adaptations Needed to GTO</th>
<th>What Adaptations Look Like in Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTO Steps 9–10: Using data to improve and sustain the use of a digital health technology</td>
<td>Support data sovereignty across digital health technologies and evaluation.</td>
<td>• Intentionally plan for community ownership and control of their digital health technology data to address historical and current mistrust.</td>
</tr>
</tbody>
</table>
Evaluation of Intersectional Versus Individual Processes and Outcomes

*Intersectional evaluation* captures processes and outcomes at the intersection of the social categories (as defined in PROGRESS+) that predict health (Bauer et al., 2021). For example, instead of capturing reach and efficacy and effectiveness measures among all individuals that use a particular digital health technology and then examining differences in reach and efficacy and effectiveness separately by gender (e.g., male, female, transgender people) and then by race (e.g., Black, White), we have adapted RE-AIM to capture differences in reach and efficacy and effectiveness at the intersection of race and gender (e.g., Black men, Black women, Black transgender people, White men, White women, White transgender people), as well as at the intersection of other PROGRESS+ characteristics.
<table>
<thead>
<tr>
<th>RE-AIM Processes and Outcomes</th>
<th>Adaptations Needed to Evaluation Questions</th>
<th>Adaptations Needed for Evaluation Measures</th>
</tr>
</thead>
</table>
| **Reach**                    | • What percentage of the target population came in contact with the digital health technology?  
• How does this compare with the percentage of the target population that is typically reached by these types of technologies?  
• Are there any systematic differences by race or health status in terms of who is reached by the digital health technology compared with who can most benefit from the digital health technology? | Number, proportion, and representativeness (at the intersection of race and gender) of individuals who participate in a given digital health technology compared with both the number, proportion, and representativeness (at the intersection of race and gender) of individuals who can most benefit from the digital health technology and compared with the demographics of the intended target population (e.g., captured through a health equity affect assessment) |
| **Efficacy and Effectiveness** | • Did the digital health technology achieve its key goals or have any unintended consequences?  
• Did the digital health technology have differential outcomes based on participants’ access to broadband, digital literacy, or other issues related to digital equity?  
• How did the digital health technology affect the health equity of quality-of-life outcomes (including participant satisfaction)? | Impact of digital health technology on key outcomes, including health equity (at the intersection of PROGRESS+ characteristics) and quality-of-life outcomes, unintended consequences related to broadband access and quality of care, and economic outcomes |
| **Adoption**                 | • Were there both organizational (or institutional) and community stakeholder support for the digital health technology?  
• How does support for this digital health technology vary by the specific communities of focus that it reaches?  
• Are there any systematic differences in support by race, health status, or other PROGRESS+ characteristics in terms of whom is reached by the digital health technology compared with who can most benefit from the digital health technology? | Number, proportion, and representativeness (at the intersection of race, gender, and other PROGRESS+ characteristics) of (1) settings and (2) providers willing to initiate digital health technology compared with both the number, proportion, and representativeness (at the intersection of race, gender, and other PROGRESS+ characteristics) of settings and providers that participate(d) in the digital health technology and compared with the demographics of intended specific communities of focus |
TABLE 3—CONTINUED

<table>
<thead>
<tr>
<th>RE-AIM Processes and Outcomes</th>
<th>Adaptations Needed to Evaluation Questions</th>
<th>Adaptations Needed for Evaluation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Implementation</strong></td>
<td>• Was the digital health technology implemented equitably?</td>
<td>Responsiveness of the digital health technology to the needs and strengths of the local community and the groups who can most benefit; presence of relationships, engagement, connection, and reciprocity between digital health technology providers and recipients; fidelity to core components of effective digital health technology; and cost benefits of implementation</td>
</tr>
<tr>
<td><strong>Maintenance/Sustainment</strong></td>
<td>• Revisit how the digital health technology process is evaluated.</td>
<td>Longer-term effects of (1) outcomes at the intersection of race, gender, and other PROGRESS+ characteristics and (2) digital health technology implementation at one to two years, or longer</td>
</tr>
</tbody>
</table>
Another key adaptation of RE-AIM is the focus on equitable implementation rather than proper implementation. *Equitable implementation* measures assess implementation quality as a balance between responsiveness of the intervention to the needs and strengths of the local community and the groups that can most benefit; engagement, connection, and reciprocity between the providers of digital health technologies and the recipients; and fidelity to core components of effective digital health technologies. In contrast, more traditional or *proper implementation* quality measures focus primarily on how digital health technologies adhere to developer-recommended implementation guidelines.

When selecting evaluation measures, future implementation studies should consider whether their implementation evaluation measures meet the following criteria:

- They hold implementation researchers and practitioners accountable for routinely examining how implementation outcomes are collected, measured, or analyzed, by whom, and under what conditions.
- They address the erroneous notion that an inquiry can be objective only if divorced from historical context.
- They consider implementation outcomes that may vary based on co-occurring social categories that compose PROGRESS+ (e.g., race, gender, sexual identification).

**SUMMARY**

This section has highlighted several approaches to centering equity in the implementation processes and evaluation of digital health technologies. Table 4 summarizes the approaches discussed and their alignment with the essential elements of equitable implementation. No single approach will result in equitable implementation; however, through a combination of approaches, digital health technologies can be implemented more equitably.

In this section, we discuss three applied examples of emerging health fields that are advancing quickly through innovative digital technologies: (1) genomic medicine, which is leveraging digital platforms to integrate genetic data and medical records for health care providers and patients to make tailored and more-informed joint health care decisions; (2) AI, using LLMs to compile and analyze massive amounts of information to provide clear answers to health questions and to predict health behaviors; and (3) participatory digital media (e.g., blogs; wikis; music, photo, and video sharing; podcasts; digital storytelling; social networking sites) to engage with and understand the people from marginalized communities. For each of these three fields, we first review the potential promise and pitfalls of implementation for digital and health equity. Next, we describe how the application of the adapted implementation processes and evaluation framework (described in Section 3) could help each field achieve its promise while avoiding potential pitfalls. Finally, we identify the stakeholders in each field that should be responsible for adopting the updated implementation processes and evaluation framework (described in Section 3).
### TABLE 4
Approaches to Center Racial Health Equity in the Implementation of Digital Health Technology

<table>
<thead>
<tr>
<th>Essential Elements of Equitable Implementation</th>
<th>Approaches</th>
</tr>
</thead>
</table>
| Design and select digital health technologies with implementation in mind. | • Revisit what counts as “evidence.”  
  • Revisit how digital health technologies are selected and prioritized.  
  • Routinely examine how implementation outcomes are collected, measured, and analyzed, by whom, and under what conditions.  
  • Consider that implementation outcomes may vary because of co-occurring social categories (e.g., race, gender, sexual identification, and other PROGRESS+ characteristics). |
| Identify and develop adaptations to digital health technologies that respond to the needs and strengths of the local community and the groups who can most benefit. | • Revisit how needs that drive decisions about the use of digital health technologies are identified and prioritized.  
  • Revisit how adaptations to digital health technologies are prioritized.  
  • Operationalize equity in implementation evaluation questions and measures.  
  • Test the effectiveness of digital health technologies among the populations that can most benefit. |
| Emphasize relationships, engagement, connection, and reciprocity. | • Support data sovereignty across digital health technologies and evaluation.  
  • Support cocreation of digital health technologies and their evaluation plans.  
  • Make the development process of digital health technologies more transparent. |
| Take a critical approach to thinking about the validity and objectivity of research and evaluation. | • Revisit how digital health technology process and outcome evaluation are designed and conducted.  
  • Revisit how evaluation findings are interpreted and applied for quality improvement.  
  • Address the erroneous notion that an inquiry can be objective only if divorced from historical context.  
  • Consider how digital health technology will be affected by, and in turn affect, the social determinants of health, including the PROGRESS+ social characteristics. |
1: GENOMIC MEDICINE
Scientific progress following the mapping of the human genome, via the human genome project, has been phenomenal and has catalyzed the field of personalized genomic medicine, transforming health care and clinical practices (Aiyar, Channaoui, and Ota Wang, 2020; Seyerle and Avery, 2013; Royal College of Pathologists, undated). In parallel, digital health applications have proliferated significantly, especially in the wake of the COVID-19 pandemic, which created incentives for the rapid digitization of health provision (Bombard and Hayeems, 2020). In fact, genomics has been cited as the “vanguard” for digital health care and has highlighted the need to empower patient-led decision-making, integrate large arrays of complex genetic data into medical health records, and include this information in clinical workflows and practices (Bombard et al., 2022).

Genomics is a subfield in biology that involves studying the entire set of genes of living organisms (i.e., the genome). The genome is considered a living organism’s “operating manual” (National Institutes of Health [NIH], undated). The use of this knowledge to prevent, diagnose, treat, and manage an individual’s condition, in a manner most suited to their biological and sociocultural circumstances, is termed personalized or precision medicine.

SECTION 4
Centering Equity Can Help Emerging Fields Equitably Implement Digital Health Technologies
Equity Promise and Pitfalls
The practice of personalized and genomic medicine holds great promise for population health because it focuses on prevention and considers every person’s unique set of biological makeup and social circumstances. Furthermore, combining genomic medicine with a digitally led health care approach provides the opportunity to increase service provision, diversify access points into the health service, improve patient-doctor dynamics, and allow people the room to make personalized sensitive decisions with regards to genetic testing and results. For the purposes of this paper, we are defining health equity in genomic medicine as the equitable access to genomic services, such as testing and counseling, as well as treatment (Jooma et al., 2019). Studies have shown a heightened sense of trust and less uncertainty in decisionmaking while offering continuity of care through digital channels, especially for those in remote settings (Bombard and Hayeems, 2020). Although digital health care and genomic medicine offer great promise for population health, there are several potential pitfalls that may widen racial health inequities if genomic medicine innovations are implemented without considering digital and racial health equity.

Diagnosis and Treatment
Through an improved understanding of the genomic and biological underpinnings of specific groups in a population, diagnosis and treatment of diseases can be improved and missed diagnoses could be minimized. Studies that assess associations between genes and physiology to understand normal levels of variation versus those that can cause disease are crucial in advancing genomic medicine, and the application of AI tools is accelerating this research. However, because the vast majority of these research and clinical studies were based on a skewed subset of the population with significant underrepresentation from social, racial, and ethnic minority groups, the datasets that they generated are broadly homogenous and narrow. In other words, these datasets are not representative of the general population and do not factor in the genetic diversity of such minorities and underrepresented groups. This biased dataset is then used to train algorithms, compounding existing inequities. Alongside other measures, it is crucial to expand these studies to examine a variety of traits in ethnically diverse populations to address algorithmic and data bias (Atutornu et al., 2022). There is a great deal of uncertainty in clinically actionable outcomes for ethnically diverse populations (Seyerle, 2013), and genetic result interpretations and accurate risk assessments remain a challenge because it is not known whether results vary because of natural differences among different ancestral populations or because of a potential disease or condition (Aiyar, Channaoui, and Ota Wang, 2020). Despite the exponential growth of health care data, the ability to generate equitable insights and improve health among the aforementioned populations and the underrepresented is limited because of the algorithmic biases that emerge from training based on homogenous datasets. In this regard, challenges also include poor data structure and data siloes. However, the most crucial of these challenges is inadequate ethnic representation (Cabreros, 2022). For instance, in 2018, non-Hispanic White Americans represented 60.7 percent of the U.S. population; however, more than 90 percent of the clinical trial population consisted of non-Hispanic White Americans of European ancestry (Cabreros, 2022). Although the medical profession is keen
to harness the transformative power of AI for diagnostics and risk assessments because of AI’s ability to analyze data and generate useful insights, the challenge of mitigating against existing biases and their amplification and further “disadvantaging those already marginalized by genomic medicine” is immense (Bergh, 2021; Bombard and Hayeems, 2020).

Moreover, among the plethora of digital offerings in genomic medicine, few have considered equity from the start of a service through its implementation. For instance, although the Genomics ADvISER (which is a decisionmaking tool for those receiving genetic test results) is intended to assist patient-centered decisionmaking, it was primarily developed and tested on populations of European descent (Shickh et al., 2021).

Access to Care
Digitizing services to establish virtual health care can offer access to those unable to travel because of cost or circumstances, and studies have reported that the hierarchical dynamics of a doctor-patient relationship can dissipate in a digital setting when patients are empowered to be experts of their own condition and care requirements (Barretto, 2024). However, systemic biases in society with regard to employment, justice, housing, and insurance have perpetuated inequities that translate into the health setting (Yearby, Clark, and Figueroa, 2022), in which a lack of access to the internet, mobile devices, or technology literacy has also created inequities in access to services.

Diversity in Genomic Medicine Workforce and Research
The promises offered by the digital advancement of genomic medicine can only be realized once systemic racial health inequities can be addressed. Digital provision of genomic medicine creates opportunities for people to be paired with practitioners who they are more likely to trust and are aware of their sociocultural needs (Atutornu et al., 2022; Bombard and Hayeems, 2020; Argyres et al., 2022). However, underrepresentation of racial and cultural minorities in the genetic counseling workforce is a longstanding issue. Although elements of cultural awareness and competence in genomic medicine are not novel—having been introduced in 1993 through the foundation of the Audrey Heimler Special Project Award—the challenges of diversity within the workforce itself remain (Aiyar, Channaoui, and Ota Wang, 2020). Among other factors, this lack of diversity contributes to a lack of trust in the research community. The willingness of underrepresented communities to partake in clinical research—thereby improving its utility to personalized genomic medicine—relies on building trust between marginalized groups and the research workforce. Studies have reported that this can be accomplished by increasing diversity in the research workforce and by creating meaningful exchange in a culturally and linguistically sensitive manner (Atutornu et al., 2022).

Applying Implementation Science to Realize Equity Promise and Avoid Pitfalls
IS can play a crucial role in realizing the promise of genomic medicine through digitization and in mitigating against the pitfalls outlined previously. This can be achieved by ensuring that process-focused IS frameworks consider, capture, and address equity challenges up front by design and that evaluation measures of implementation outcomes consider equity to incentivize appropriate and inclusive behaviors. For instance, in the field of predictive
algorithmic and data bias, equity metrics can be developed for relevant stakeholders, and these biases can be treated as a quality-control issue during the process of developing computational models and tools. There are proposals to codify equity (i.e., consider “equity as a code” built into testing and development cycles of genomic prediction algorithms), which create a relevant framing for addressing inequity—at least in algorithms (Bergh, 2021).

More specifically, from a population health perspective, there have been calls to look to IS for evaluating complex health interventions from a diversity and equity perspective with an emphasis on assessing those populations in which there are the largest gaps in implementation (Khoury et al., 2022). More specifically, such initiatives as the Clinical Sequencing Evidence-Generating Research program and the Implementing Genomics in Practice program have conducted projects in diverse settings to generate clinical data that can help close the genomic medicine equity gap (Khoury et al., 2022). The health care fusion framework, developed for health care data management, also proposes considering culturally and demographically diverse outcomes in precision medicine (Zhai et al., 2023).

Although these initiatives are promising, they are sporadic and do not consider the entire end-to-end process of implementation and its measures when it comes to addressing digital health inequity and racial health inequity. A more systematic and structured approach, which uses existing IS frameworks, could benefit such areas as genomic medicine to bridge the digital health and racial health equity gaps.

In this section, we consider what the essential elements of an equitable implementation framework–based adaptation to the GTO manual (as proposed in Table 2) would look like in the practice of genomic medicine and digital health equity (second column of Table 5). We specifically focus on building trust and reach within marginalized communities, list some examples of what the adaptations may look like in practice, and what differences they may make for addressing the pitfalls and promise of genomic medicine.

Just as implementation evaluations should consider equity and reach from the outset through a consistent IS-focused process, they also need to consider equity-centric evaluation measures to ensure that a given policy or intervention has benefited those that it was intended for without perpetuating further inequities. Here, we consider the adapted RE-AIM framework for considering outcome measures (as proposed in Table 4) and discuss their significance and value in the context of genomic medicine. We specifically focus on the reach outcome as an example (Table 5).

Taken together, these applications could help address systematic and structural bias and promote equitable reach and engagement—and thus help genomic medicine to combat bias and underrepresentation in research, workforce, and access—which is needed to improve implementation of genomic medicine.
# TABLE 5
How the Adaptations to Implementation Processes and Evaluation Could Help Promote Health Equity in Genomic Medicine

<table>
<thead>
<tr>
<th>Area of Genomic Medicine</th>
<th>Applications of Adapted Implementation Processes</th>
<th>Applications of Adapted Evaluation Framework</th>
</tr>
</thead>
</table>
| **Iterative and participatory diagnosis and treatment** | • Rather than working from a static diagnosis and treatment plan, use iterative cycles of diagnosis and treatment (data collection, algorithm development) to tailor care so that historical and existing biases in genomic data, prediction algorithms, and care planning are not perpetuated (relevant to GTO Steps 9–10).  
  • Develop implementation strategies for genomic medicine platforms and interventions, as well as genomic research, with the end users in mind; use participatory approaches to build trust in marginalized groups and foster the engagement of and improve reach into target communities and the broader community. This is crucial for combating structural biases (relevant to GTO Steps 1–6). | • Assess the reach of genomic databases to ensure that underrepresented populations (at the intersection of race, gender, and genetics) are sufficiently reflected (i.e., reflect the demographics of intended patients). Create a sensitivity indicator to help patients understand when there is a mismatch between their own characteristics (e.g., race, gender) and the characteristics of the population that were used to predict a diagnosis or care plan. This can be a crucial indicator for surfacing systemic biases and structural racism. |
| **Equitable access to care tailored to genomic profiles** | • Cocreate genomic medicine evaluation metrics to assess equitable access to care with patients and participants in genomic databases, and explicitly acknowledge and mitigate against systemic and structural biases (and underrepresentation). Ensure that these metrics incentivize positive behaviors by those implementing care based on genomic data (relevant to GTO Steps 7–8).  
  • Conduct a baseline assessment of whether equitable digital access to genomic care is feasible (e.g., do patients have access to the internet, needed devices, data literacy to understand the linkages between genomic profiles and health care, trust in algorithms that predict health care needs from genomic data) to improve reach and engagement, while mitigating against structural bias and racism (relevant to GTO Steps 1–6). | • Assess whether genomic medicine is implemented equitably by evaluating  
  − the responsiveness of genomic medicine to the needs of the overall population and the groups that can benefit the most  
  − the presence of engagement and reciprocity between genomic counselors and patients.  
  • Evaluate the effectiveness of genomic medicine at the intersection of race, gender, and other key population characteristics to provide a more rounded view of whether a given program has benefited all segments of a population and to identify early on any evidence of structural bias and racism in care. |
| **Diversity of genomic workforce and research** | • During planning, consider diversity (staff and patients) as a needed capacity for genomic diagnosis and care planning approaches to elicit more trust in the care being implemented (relevant to GTO Steps 1–6).  
  • Develop communication and outreach to patients and potential participants in genomic databases in a linguistically and culturally sensitive manner to improve both reach and access to care within the community and build trust (relevant to GTO Steps 1–6). | • Assess the adoption of genomic medicine by evaluating the number, proportion, and representativeness of genetic counselors, digital platforms, and patients that engage with care.  
  • Use results from the assessment of adoption to support early- to mid-course corrections to promote equitable reach and engagement, thus combating bias and underrepresentation. |
Engaging Genomic Medicine Stakeholders in Promoting Equity

In this section, we highlight some of the key national and international stakeholders focused on digital enablement and genomic medicine. These stakeholders can act as early adopters and champions of the holistic approaches outlined in this paper, focusing on IS as a mechanism to address health equity in the context of digitally led genomic medicine.

The National Health Service (NHS) general medical services (GMS) alliances in the United Kingdom are helping embed genomics into routine medical care across the whole country’s population by bringing together multidisciplinary teams and functions (i.e., clinical, operational, and digital). The NHS GMS Alliances proposed to review equity of access for patients to the genomic tests commissioned by the NHS (Hill, 2020). Using the RE-AIM framework to ensure reach and effectiveness can be an important use case for this initiative to highlight the value of equity-focused IS measures.

In Africa, the African Genome Variation Project has curated the genomic profile of 100 individuals from 10 ethnic groups each to review genetic variation to further whole genome sequencing of individuals with complex genetic variations (Gurdasani et al., 2015). This is a crucial step in understanding genetic diversity and how personalized interventions for ethnic minority groups can mitigate underrepresentation in data. Further expansion of efforts to curate 3 million African genomes has been proposed alongside the need to engage public groups to understand concerns related to genomic data collection (Atutornu et al., 2022). This effort represents another key platform and opportunity to apply the frameworks highlighted in this paper to create an end-to-end process that can be designed, implemented, and measured following a standardized approach to meaningfully assess impact. Many of these initiatives are funded by entities, such as NIH and Wellcome, that may be well placed to adopt these approaches and make them a key component of funding requirements. Capacity building will likely be necessary for funding recipients to fulfill this requirement.

Population health informatics tools, such as electronic health records, are a critical part of the digital genomic medicine infrastructure that can be leveraged to surface inequities in health care in many countries. Organizations, such as the NIH and the NHS, could put in place standardized processes and outcome measures that we propose to capture data in health informatics tools and their use. In its 2009–2013 strategic plan, NIH called for an enhanced health disparities informatics capacity to create a knowledge platform that can pull together a multitude of health datasets across institutional boundaries (Carney and Kong, 2017). This represents a large-scale opportunity to adopt IS standards and frameworks to benefit vulnerable populations in a consistent and transparent manner.

The private/commercial sector is developing digital tools for health and digital genomics tools more specifically that could bridge the equity gap for marginalized groups. For example, Unite Us, a technology company that builds coordinated-care networks of health- and social-service providers, hires individuals from each community it engages with to ensure solutions are culturally sensitive and relevant (Unite Us, undated). Similarly, Savvy Cooperative, a patient-owned cooperative, allows patients to share their health experiences with companies and researchers. This enables businesses to better understand the personal and individual experiences, leading to products that
are developed with greater sensitivity. Genome Access, a digital app and platform for providing genetic counseling services across Europe is working to support patients in a personalized manner by building on their complex medical and social circumstances (Genome Access, undated). This sector represents an exciting opportunity to be agile and for early adopters of the approaches that we have highlighted to evidence the value and effectiveness of embedding equity in product development by using standardized frameworks to mitigate against bias (Assamad et al., 2023). Digital innovators can address diversity and inclusion from initial research and concept to the testing and implementation of interventions, programs, and products, which makes them ideal candidates for standardized framework adoption.

2: LARGE LANGUAGE MODELS
LLMs, which are a type of AI, are essentially prediction algorithms that compile and analyze massive amounts of information to provide simple answers. Importantly, LLMs can generate sophisticated text to answer questions in a human-like voice. For example, anyone can create a ChatGPT account, allowing them to pose questions as they would to a friend or colleague, receiving detailed information. The variety of uses is almost limitless: Rather than being restricted to seeking specific information (as with web searches), ChatGPT and other LLM tools are a type of generative AI that can synthesize information to create novel content ranging from book summaries to computer code to images of nonexistent scenes.

Equity Promise and Pitfalls
This capability underscores the promise of LLMs to support the public interest—part of the power of this technology derives from the fact that the results seem easy to interpret. Because LLM tools, such as ChatGPT or Bard, use understandable natural language, they can be convincing and easy for people to relate to and absorb information they might not otherwise have access to. LLMs could therefore improve digital and racial health equity by democratizing access to accurate health information or tools that could help people support their health in an inclusive, trusted, and transparent manner. However, each of these attributes (accuracy, transparency and trust, and inclusivity) reflect both the potential promise and pitfalls of LLMs.

Accuracy
LLMs provide information that is more easily understood than results that rely on statistical thresholds or otherwise require interpretation. LLMs could allow more people to take advantage of AI and could provide another useful channel to engage members of the public in the field of public health. For example, implementation tools could teach members of vulnerable communities how to use LLMs to find accurate information about medical conditions, to explore neighborhood and community supports for health, or to assess health or community providers.

The reality is likely more complicated and speaks to the challenges of understanding and interpreting what LLMs tell us. Although LLMs can democratize access to information, there is no guarantee that AI-generated information will be accurate. LLM tools (e.g., ChatGPT) often provide neither sources nor levels of confidence in the information they provide. As of this writing, there is no good way to
detect or indicate content that is synthetically generated. People can be misled by information that is made easy to grasp, such as information that seemingly confirms one’s existing views (Klayman, 1995). LLMs could thus contribute to digital and racial health inequities in several ways, such as by repeating racial stereotypes that could offend or alienate users or by omitting accurate information or providing inaccurate information. Specifically, LLMs could pick up and replicate misinformation and disinformation, amplifying their power. For example, misinformation can proliferate during a disease outbreak in what is known as an *infodemic* (World Health Organization, undated). Such misinformation can increasingly spread through digital platforms, making it possible for digital health inequities to persist.

**Transparency and Trust**

Biased AI results are well documented and wide ranging, from facial recognition (Gender Shades, undated) to recidivism prediction (Angwin et al., 2016). Some of these biases stem from existing biases in the data that were used to train AI tools, when tools are used in ways that go beyond their original design, or whether people interpret subjective AI results in a biased way. User engagement with vulnerable communities could be one approach to mitigating potential bias or inaccuracies.

However, most people know very little about AI, including how it works and who works on it (Brauner et al., 2023). Because many LLMs are developed by private companies, the models they rely on may be proprietary, creating uncertainty or ambiguity about how they are developed, the information they take in, and accordingly, the results they provide. This means that there is a lack of transparency about what input or parameters the models use to deliver results. This makes it extremely difficult to test whether those results are biased or inaccurate.

As LLMs improve, they have also been increasingly used to generate creative content—that is, wholly new textual or audiovisual products—rather than simply to make predictions or automate tasks. This opens up a whole new domain of uncertainty about whether content has been created, how such content is created, and whether it could end up having an exacerbating or mitigating effect on either digital or racial health equity. However, initial reports indicate that similar biases crop up: For example, Stable Diffusion, an AI tool that generates images from text prompts, was found to generate photos of darker-skinned individuals in response to the keyword “inmate” (Nicoletti and Bass, 2023).

This lack of understanding, especially among racial and ethnic minority groups, could lead to mistrust in LLMs and powerful institutions (e.g., government agencies) that wield those tools. Recognizing this possibility, the Biden administration released an AI-focused executive order calling for “safe, secure, and trustworthy artificial intelligence” (White House, 2023). For example, the order directs actions to increase transparency about the potential risks of AI systems, protect privacy in the data used to train AI systems, and combat algorithmic discrimination.

**Inclusivity**

LLMs are largely built by a workforce that both lacks diversity and concrete incentives to work in the public interest. For the most part, LLM tools have been released by established technology companies, such as Microsoft (Claude), Meta (Llama), and Google (Bard). Even the company behind
ChatGPT, Open AI, is now largely private, even though it was founded as a nonprofit with the stated goal of improving the public good (Salmon, 2023).

The workforces of large technology companies have been widely reported to be—at least among their engineers and other technology developers—relatively nondiverse: mostly male, White or Asian, and not poor (U.S. Equal Employment Opportunity Commission, undated). Like social media, AI tools appear to require a large “underclass” of low-paid workers to continually purge the massive amount of objectionable content (e.g., hate speech) or to perform manual tasks that label data so that AI can learn from it (Wong, 2023).

Nonrepresentative workforces could exacerbate inequities in several ways, such as by overlooking or minimizing inequitable access or other cultural issues specific to racial minority groups. Increased use of LLMs might displace some of those workers. At the same time, increased use of LLMs might also generate demand for a new marginalized class of underpaid and often-exploited workers, such as content moderators and data labelers who generate training data. More-representative workforces could better identify such issues or act on issues that have already been raised (O’Neil, 2023).

Private institutions with profit goals inherently provide their workforces with incentives that are not necessarily aligned with the public good. These incentives include both profit and speed, both of which make it likelier that advanced tools, such as those built on LLMs, are developed with inadequate consideration of ethical issues, equity concerns, or the guardrails. These incentives persist even while many such institutions publicly call for—and sometimes engage in—efforts to be socially responsible. At an individual level, the often-greater salaries and resources that these large companies boast can likely attract better technology talent than organizations focused on the public good with fewer resources. For instance, public health agencies will largely lack any internally sophisticated capabilities, such as skilled technical staff, to work more than superficially with LLM tools.

Applying Implementation Science to Realize Equity Promise and Avoid Pitfalls

Variation in LLM output depends on how individuals use LLMs, for what purposes, and how they provide inputs (“prompts”). Exploring some of these implementation-focused processes, such as GTO, could help ensure that LLM uses realize the promise and avoid pitfalls related to digital and racial health equity (Table 6). For example, implementation interventions could help community organizations better understand how to use LLMs to create accessible and engaging information that could be used to improve transparency and public engagement.

There is also a need to understand—that is, measure—the impact of LLMs on racial and digital health equity. The RE-AIM framework includes several outcome measures that could help illuminate this impact. One example would be using the adoption-outcome component to measure the impact of designing and selecting interventions for organizational use of LLMs with implementation in mind (Table 6). After going through the implementation process, measuring adoption by specific communities could help explain how successfully the interventions were designed with equity in mind.
TABLE 6
How the Adaptations to Implementation Processes and Evaluation Framework Could Promote Health Equity in Large Language Models

<table>
<thead>
<tr>
<th>Features of Equitable LLMs</th>
<th>Applications of Adapted Implementation Processes</th>
<th>Applications of Adapted Evaluation Framework</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>Continuously monitor the implementation of LLMs by incorporating sensitivity measures to assess the accuracy of outputs (i.e., racism and misinformation conscious) (relevant to GTO Steps 9–10).</td>
<td>Assess the implementation of LLMs to determine the levels of confidence in the information they provide in key areas, such as being racism conscious (i.e., avoid repeating racial stereotypes that could traumatize users, use culturally sensitive language) and misinformation conscious (i.e., avoid omitting accurate information or providing inaccurate information).</td>
</tr>
<tr>
<td><strong>Transparency and trust</strong></td>
<td>Develop LLMs with end users in mind; use participatory approaches to build trust in marginalized groups; foster engagement and improve reach into target communities and the broader community. This is crucial for combating structural biases (relevant to GTO Steps 1–6).</td>
<td>Evaluate the effectiveness of LLMs for populations at the intersection of race, gender, and other key population characteristics to provide a more rounded view of whether LLM accuracy varies by population and to identify early on any structural bias and racism creeping into outputs.</td>
</tr>
<tr>
<td><strong>Inclusivity</strong></td>
<td>During development and testing of LLMs, consider engaging a diversity of staff and end users. If a lack of staff diversity at technology companies makes this infeasible, establish an inclusion and diversity advisory board to support planning and evaluation (relevant to GTO Steps 1–6). Continuously monitor the impact of LLMs on equitable employment opportunities (e.g., who is affected by jobs that are replaced by LLMs; who is affected by jobs that are created, such as content moderators and data labelers who generate training data) (relevant to GTO Steps 7–8 and 9–10).</td>
<td>Assess the adoption of LLMs by evaluating the representativeness of the impacts that LLMs have on employment opportunities (both by eliminating or creating opportunities) at the intersection of race, gender, and health. Use results from the assessment of adoption to support early- to mid-course corrections to avoid perpetuating racial inequities.</td>
</tr>
</tbody>
</table>

**Engaging LLMs Stakeholders in Promoting Equity**
A set of natural stakeholders—and potential collaborators—for efforts to improve digital and health equity around LLM use are research groups and advocacy organizations that focus on equity in AI (Schwartz et al., 2022). These groups can help create incentives for technology companies that are creating LLMs to use more equitable implementation processes, such as GTO. For example, the Distributed AI Research Institute—which was founded by researcher Timnit Gebru, who examined bias in LLMs at Google—conducts AI research that attempts to “center the voices and experiences of those most affected by technology” (National Academy of Medicine, undated). Another AI research institute, AI Now, investigates the consolidation of power among technology companies and their lack of transparency and accountability. Traditional advocacy
organizations, such as the American Civil Liberties Union, the Electronic Privacy Information Center, or the Electronic Frontier Foundation should continue to incorporate AI into their advocacy agendas to help encourage more equitable development and application of LLMs.

Stakeholder groups that have formed to explore both the potential for and responsible use of AI in health care, such as the Alliance for Artificial Intelligence in Healthcare and the Coalition for Healthcare AI, should add equitable implementation processes and transparent reporting of equitable implementation measures to their requirements and codes of conduct. For example, the National Academy of Medicine and other organizations have developed an Artificial Intelligence Code of Conduct (National Academy of Medicine, undated), which should include an explicit mention of equitable implementation processes and transparent implementation measures.

Government bodies are also developing AI policies and standards. For example, the National Institute of Standards and Technology (NIST) has evaluated demographic differences in the results from commercially available facial recognition technology (NIST, 2020). NIST has also proposed a framework to “identify and manage bias” in AI tools (NIST, 2021). NIST emphasizes that efforts to mitigate bias must take place “in context”—that is, across a variety of use cases and sectors, which alludes to the importance of implementation efforts. However, this framework does not go far enough in explicitly recognizing the importance of equitable implementation. The NIST framework should explicitly incorporate the equitable implementation processes and evaluation framework, such as those proposed in Table 6.

3: PARTICIPATORY DIGITAL HEALTH MEDIA

Prior to the advent of digital technologies, traditional media relied on an asymmetrical relationship between the broadcaster(s) and audience in which—simply put—the broadcaster communicated and the audience received. Participatory digital media has changed the asymmetry of that relationship by making it possible for all people connected to the internet to both broadcast to and receive information (via text, video, audio, tags, links, etc.) from every other person. Blogs; wikis; music, photo, and video sharing; podcasts; digital storytelling; social networking sites (e.g., tagging, bookmarking); and videoblogs are all examples of participatory digital media. Participatory digital media can be used to engage with and understand the voices of people in marginalized communities, allowing them to have a say in shaping the world they live in. In the context of health, participatory digital health media offers online opportunities for interactions around various health topics, including health promotion (e.g., nutrition, exercise) (Stark, Geukes, and Dockweiler, 2022), crisis communication (e.g., COVID-19 vaccinations), public relations (e.g., health agencies advertising to promote a positive image), and health education (e.g., health podcasts) (Roland, 2017).

Equity Promise and Pitfalls

This section focuses on understanding the pitfalls and achieving the promise of using participatory digital health media to engage with and understand the voices of marginalized communities in regard to health topics. Although the modality of media varies widely, the defining characteristics of participatory digital health media are as follows: (1) Participatory digital health media derives its value from engaging many people and linking people with one another
for broader, faster, and lower cost communication and coordination of activities, thus disrupting traditional media power structure between broadcasters and audiences; and (2) it enables broader, faster, and lower cost coordination of activities allowing more people to be engaged more quickly.

Activating Communities
Participatory digital health media can engage audiences through interactive and immersive technologies. For example, Fantasy Congress (undated) is a computer simulation–based game that engages people daily in congressional actions by following the contributions of individual senators and representatives to their “legislative team” in a similar format as a fantasy sport league. The creators of Fantasy Congress developed the game to promote government transparency and help people “stay informed, engaged, and introduce a spark for government that wasn’t there before” (Fantasy Congress, undated)—essentially activating the public to be more engaged in civic and legislative affairs—which can be critical when health policy changes are being considered. Digital health technologies have also gamified specific health behaviors. For example, such health trackers as Fitbit or Apple watches come with gamified features to motivate users to be physically active, monitor heart health, and join online communities for support and competition. mySugr is a diabetes management app in which people can earn points, receive personalized insights, and feel incentivized to keep their blood glucose level in a desirable range (mySugr, undated).

Producers of participatory digital media need both the technology and the health and technological expertise to use technology to effectively activate communities through participatory digital health media (Gürsoy, 2021). Additionally, participatory digital health media must be implemented in a way that reaches the intended audiences. For example, research has consistently found age and race disparities in the use of patient portals, which suggests that the availability of technology is insufficient to overcome access barriers and promote more-equitable health outcomes (Walker et al., 2020). Digital literacy support programs are one option that has been identified to moderate the factors that result in disparate technology use among older adults (Tirado-Morueta, Aguaded-Gómez, and Hernando-Gómez, 2018). Few effective options exist to advance racial health equity through digital health technologies. As previously mentioned, the digital divide can influence who has access to the needed technologies, reliable internet connectivity, and the needed digital literacy training to both develop and maintain a collection of participatory digital health media (Lythreatis, Singh, and El-Kassar, 2022). A recent study suggested that current digital and media literacy curricula have inadequately prepared youth for the barrage of race-related information and messages they receive online (Tynes et al., 2021).

Generating Collective Intelligence
Participatory digital health media offers an opportunity to deliver more-focused messages regarding local health issues than is possible for traditional media (Rheingold,
2008). For example, iEARN (undated) is a participatory civic engagement platform that connects students to online dialogue about civic issues and supports their use of web publishing, digital photography, and video production to create digital stories to promote civic engagement (O’Dowd, 2017). Digital health media can be a powerful tool for promoting precision public health, and digital health technologies can be used to better understand public health risks and customize community-based approaches (Dolley, 2018). At the individual level, Health 2050 refers to the goal of using digital health technologies for the self-monitoring and self-management of health and wellness, including existing and future medical conditions, by 2050 (Swan, 2012). Using data collected through digital technologies (e.g., cell phone, smart watch), individuals can better understand their patterns and obtain early warnings on specific health issues.

Without legitimate and authentic engagement, participatory digital health media can increase symbolic or biased perspectives rather than collective intelligence. Poorly produced stories or biased participatory digital media can have negative repercussions for the producer and the issues that they are trying to address. Research has identified an increasing trend of health misinformation online—particularly related to communicable diseases (e.g., human papillomavirus, measles, Zika virus, Ebola virus). Misinformation on noncommunicable diseases (e.g., cancer, cardiovascular disease, psoriasis, bowel diseases) and on dietary and nutritional issues, smoking, and water safety or quality also exist (Wang et al., 2019). For example, the COVID-19 pandemic showed how false or biased local digital participatory media can be used to create political discord or propagate misinformation or mistrust of government agencies or political figures (Tong et al., 2021). Although the impact of misinformation is difficult to quantify, a recent study examined the specific impact of COVID-19 misinformation and found a relationship between misinformation and increases in psychological disorders, panic, fear, fatigue, and depression (Rocha et al., 2021). Additionally, AI-powered social bots, which are “autonomous actors driven by algorithms and software” that post online content, can quickly generate and then widely spread misinformation based on participatory digital media, further escalating political discord and mistrust (Hajli et al., 2022, p. 1238). Again, the COVID-19 pandemic provides a salient example: Studies have found that AI social bots were purchased to falsely increase the popularity of specific online accounts and post supportive comments to online accounts that posted misinformation (Hajli et al., 2022; Yang, Torres-Lugo, and Menczer, 2020). AI social bots were also found to post significant amounts of misinformation about health topics, including vaccinations and smoking, to influence public opinion and sentiment (Allem et al., 2021; Broniatowski et al., 2018).

Raise the Visibility of Alternative Perspectives
Participatory digital media also enables the use of storytelling and narratives that provide a different way of knowing and generating new hypotheses and theories to understand complex social phenomena. If done well, these processes can help to operationalize the concept of “centering the margins” or elevating the lived experiences and voices of marginalized populations (Doucet, 2019). Centering the margins can help illustrate the impacts of broader historical and structural contexts on individual experiences and elevate the experiences of marginalized populations. Raising the
visibility of marginalized perspectives can help showcase equity barriers to implementing digital health technologies and approaches and can provide counter-storytelling to explain null or racist research findings.

**Digital Storytelling: A Promising Example of Participatory Digital Health Media**

One of the most compelling approaches to participatory digital health media is *digital storytelling*, which uses a motivating narrative based on lived experiences as a springboard for engaging audiences (Choo, Abdullah, and Nawi, 2020). Digital storytelling proceeds in five phases. The first phase identifies which topics to address and people to help tell the story. The second phase involves an offline story circle to help develop the storytelling approach. In the third phase, the story is digitized. In the fourth phase—digital story sense making—the digitized story is screened to a select audience for feedback and quality improvement. The digital story is then shared with subjects of the story (i.e., the local community) and online to a global audience in the fifth phase (digital story sharing) (Copeland and De Moor, 2018). Research has shown that digital storytelling that focuses on health promotion positively affects a variety of health issues and determinants (Lohr et al., 2022) and brings new insights to complex problems (e.g., challenging racial stereotypes associated with traditional digital health literacy narratives) (Lewis Ellison and Solomon, 2019). For example, Flicker et al. (2020) evaluated the impact of digital storytelling on indigenous youth about HIV activism and found that these stories sparked conversations in the community about HIV prevention and care and increased community support in kinship networks.

Copeland and De Moor (2018) have identified four dimensions of an efficacious community digital storytelling method that are required to make digital storytelling part of a larger, ongoing stakeholder discourse and enable authentic community voices in social innovation. For example, research has found that using digital storytelling can improve health knowledge transfer and ultimately contribute to more shared decisionmaking in health care (Park, Forhan, and Jones, 2021). The first dimension is *legitimacy* in which both the topics and storytellers selected must represent the community context. The second dimension, *authenticity*, is characterized by the use of personal narratives to ensure that the voice heard is authentic. In the third dimension, *synergy*, multiple personal narratives are brought together to create a balanced view of the community. Finally, the fourth dimension captures the use of an open digital commons to allow for collective ownership of digital stories and a repository of collective intelligence. A *commons* is any collectively owned resource held in joint use or possession to which anyone has access without needing to obtain permission from anyone else (Németh, 2012). For example, the Massachusetts Institute of Technology (MIT) has created a commons with a series of Learning Adventure Card (LAC) libraries that digitally archives stories about MIT’s *living lab research* (i.e., a place-based research approach that uses a college campus as a test bed for innovation and coproduction of sustainability knowledge) (Wolff, 2020). The structured and unstructured online data stories used are produced in a LAC format, which is intended to make research more accessible by copying the format of common trading cards (e.g., baseball cards for researchers) and linking to further information through a QR code.
Legitimate and authentic engagement can be time-consuming and elusive without careful attention to the four dimensions of effective digital storytelling (Copeland and De Moor, 2018). Even well-produced stories could be considered by some decisionmakers as less useful and impactful than quantitative data.

Digital storytelling that draws on individual narrative perspectives has been incorporated into a variety of health communication campaigns and congressional testimonies (Hudson, 2021) and can often provide more-effective, relevant strategies and solutions to health inequities because these solutions better reflect the lived experiences of affected individuals (Goodman and Sanders Thompson, 2017). Digital storytelling has also been used as a research method that is particularly effective at grounding findings in local and cultural knowledge and evoking change by creating a safe space for storytelling (West et al., 2022). For example, a study found digital storytelling to be a culturally relevant approach for Hispanic and Latino Americans of Mexican origin to share personal stories about overcoming or managing health issues and finding community support (Briant et al., 2016). In particular, photovoice participatory action research aims to reach policymakers through the use of photography, narrative, and dialogue to provide information about community factors, as well as potential solutions that go beyond administrative data (e.g., U.S. Census data) (Petteway, 2019; Wang and Burris 1997).

**Applying Implementation Science to Realize Equity Promise and Avoid Pitfalls**

Digital participatory media holds great promise in activating and empowering the voices of marginalized populations—but only if done with an explicit focus on equitable implementation. Understanding who to reach, how to reach them, and how to capture the impacts of reaching them are all critical steps in the strategic use of digital participatory media. Table 7 outlines additional considerations for how equitable implementation processes can help ensure that the decisions about how to use participatory digital media strategically and effectively are led by the specific communities of focus. Equitable implementation processes are especially critical for digital storytelling to be effective and to ultimately generate collective intelligence among marginalized populations.

Implementation evaluations, such as those proposed in Table 7 that have been adapted for digital participatory media, are needed to realize digital participatory media’s value and power. Implementation evaluation questions and measures can play a prominent role in understanding its efficacy. By assessing whether this media is viewed by marginalized populations as legitimate, authentic, synergistic, and generative of collective intelligence using a commons, we can begin to understand the potential for this emerging digital technology to affect health equity.

**Engaging Participatory Digital Media Stakeholders to Promote Equity**

The participatory and pioneering nature of the digital media environment and the increasing use of open-source tools to promote more innovation (versus the use of purely proprietary platforms) make it difficult to pinpoint a specific set of stakeholders that are the primary owners of this media. The Center for Media and Social Impact has identified a broad set of stakeholders for public media 2.0, which is an expanded vision of media that places engaged publics at its core rather than the newspapers and...
TABLE 7
How the Adapted Implementation Processes and Evaluation Framework Can Help Promote Equity in Participatory Digital Media

<table>
<thead>
<tr>
<th>Features of Participatory Digital Media</th>
<th>Applications of Adapted Implementation Processes</th>
<th>Applications of Adapted Evaluation Framework</th>
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<tr>
<td>Activate communities</td>
<td>Use a codesign approach to digital storytelling through an iterative and participatory cycle of dialogue, decisionmaking, and continuous improvement to maximize their alignment with local culture, values, and context. This can encourage social groups (across the PROGRESS+ characteristics) to uncover their own capacities for creating meaningful change, provide opportunities for reflection at every stage of work, help these groups unpack and understand the sociopolitical contexts of community engagement and change that contribute to inequality; and encourage these groups to interact strategically with leaders, decisionmakers and policymakers, and community activists. Deliberative spaces can be created for authentic voices to be heard and recorded (relevant to GTO Steps 1–10).</td>
<td>Assess the implementation of digital participatory media to determine its fidelity to seven key elements of effective digital stories: (1) point of view (using the first-person narrative perspective and conveying a clear message to the audience), (2) dramatic question (drawing an audience into a story using an initial hook), (3) emotional content (conveying authentic emotion), (4) economy (making every word count and using images and sound to replace words in the text wherever possible), (5) voice (use real voices and authentic emotion during any voiceovers), (6) power of soundtrack (using music to complement, not interfere with, the story), and (7) pacing (maintaining natural intonations and varied tone and tempo when storytelling).</td>
</tr>
<tr>
<td>Generate collective intelligence</td>
<td>Support data sovereignty across program service delivery and evaluation. For example, establish a storytelling commons. Once a commons is established, populated, and becomes accessible to stakeholders in society at large, the cycle can be evaluated and repeated (relevant to GTO Steps 7–8).</td>
<td>Evaluate the efficacy of digital participatory media by assessing its adherence to four dimensions of digital storytelling for social innovation: (1) legitimacy, (2) authenticity, (3) synergy, and (4) commons.</td>
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<tr>
<td>Raise the visibility of alternative perspectives</td>
<td>Intentionally plan for community ownership and control of digital media to address historical and current mistrust. For example, selected storytellers represent the stakeholders they tell stories about or whose perspectives they adopt. Furthermore, in a community context, there should be legitimacy in the chosen topics (relevant to GTO Steps 7–8). Co-create strategies to disseminate stories in ways that are maximally useful and empowering. Weave these stories together to provide a balanced picture (synergy) (relevant to GTO Steps 9–10).</td>
<td>Assess the effectiveness of digital participatory media by evaluating its impact on racism, beliefs and attitudes about health equity, and behaviors to promote health and digital equity.</td>
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newscasts associated with more traditional public media. Public media 2.0 is inclusive of a digital participatory environment and its content creators and distributors. Policy and cultural organizations, citizen media makers (e.g., bloggers, podcasters), community media makers (e.g., community radio, ethnic media), pubcasters (e.g., local stations), nonprofits, community institutions (e.g., hospitals, churches), educational institutions, and online platforms (e.g., search engines, video sites) are all stakeholders in participatory digital media and public media 2.0.

Participatory digital health media must both reflect and reach the right number and diversity of participants to adequately engage marginalized populations (Cossutta et al., 2023). Unique engagement approaches may be required to reach marginalized populations that are not comfortable with traditional digital engagement techniques (Tacchi, 2020). Without a thoughtful implementation that truly centers the margins, participatory digital health media can risk promoting the voices of those who are already reflected in decisionmaking and administrative data (Amponsah, 2023). Without centering the margins, participatory digital health media cannot achieve its promise of promoting new understandings of complex phenomena.

There are no established regulatory bodies to support quality control and ethical conduct in these spaces. Nevertheless, some participatory approaches have emerged through crowdsourcing to vet participatory digital media content for quality and accuracy. For example, some programs allow users to differentiate factual and false sources of online information by crowdsourcing users to rate online content’s accuracy, fairness, context, and sourcing and then use the ratings to curate a higher quality of participatory digital media.

Randomized controlled trials without fidelity and implementation outcome measures can no longer be the gold standard. This paper has proposed several options for including equity in the implementation processes and evaluation measures. However, more research is needed to understand the key features of equitable digital participatory media implementation and to provide a counternarrative (or complementary narrative) to more traditional statistical analyses. Federal government and foundations need to incorporate measures of equitable implementation, including those that rely on digital participatory media into evaluation frameworks—particularly for projects that focus on the intersection of digital and racial health equity.

Academic institutions and their partners (e.g., journal and textbook publishers, academic societies) can lead the way in providing incentives for the use of equitable implementation processes and measures by incorporating requirements for evaluation measurement or process steps into academic standards. For example, the Consolidated Standards of Reporting Trials diagram, which is required for most studies to submit to top-tier scientific journals, should be updated to not only show the study procedures were rigorous but also equitable.

Universities and nonprofits can lead the way in building partnerships to foster more connections to the public using digital participatory media. For example, Saint Louis University’s College for Public Health and Social Justice established a new literary journal in public health that engages academics, practitioners, and even youth in creatively communicating about public health issues through art, letters, stories, poetry, and other creative works (Leaders Igniting Generational Healing and Transformation, undated). Entitled Leaders Aimed at Generational Healing
and Transformation (LIGHT), this journal was founded in 2021 and aims to center the public in public health by allowing all voices to be heard and shared.

Finally, while the majority of U.S. teenagers have consumed digital media, more than 50 percent have also created it. Youth reflect an early adopter group that could be leveraged through existing youth-serving organizations, national organizations (such as the Boys and Girls Club or Young Men’s Christian Association), and through partnerships with youth-oriented media companies. For example, Music Television Entertainment Studies is pioneering a Mental Health is Health initiative, which is focused on promoting mental health and treating it as having the same importance as physical health (Mental Health Is Health, undated). This initiative is being done through a partnership with nonprofits (e.g., The Trevor Project), foundations (e.g., Born This Way Foundation, the Jed Foundation), and advocacy organizations (e.g., National Alliance on Mental Illness).

“Digital participatory media holds great promise in activating and empowering the voices of marginalized populations—but only if done with an explicit focus on equitable implementation.”
This paper offers ways to conceptualize how to achieve and measure equitable implementation for three emerging fields focused on leveraging the innovations made possible through digital technology. All three emerging fields (i.e., genomic medicine, LLMs, participatory digital media) show great promise in helping to address health inequities but face similar pitfalls that require the thoughtful application of implementation processes and evaluations.

A key promise of equitable implementation is the engagement of marginalized communities in the key policy issues that affect them—often significantly and unfairly. However, if emerging fields (such as genomic medicine, LLMs, and participatory digital media) do not pay attention to equitable implementation processes, engagement might be symbolic rather than authentic—if there is engagement at all—further perpetuating bias and underrepresentation across the PROGRESS+ characteristics that predict health outcomes and widening inequities at the intersection of digital and health equity. The adaptations to implementation processes and an evaluation framework proposed in this paper represent an important first step in thinking about how stakeholder groups can center equity in the implementation of digital health technologies. In what follows, we outline the crosscutting implications for advancing equitable implementation of digital health technologies for the primary audiences of this paper—policymakers and regulatory bodies, funders, academics and implementation scientists, and advocacy and nonprofit organizations.

**POLICYMAKERS AND REGULATORY BODIES**

Government bodies are developing digital health technology policies and standards and should explicitly incorporate
the equitable implementation processes and evaluation framework outlined in this paper. Standards and regulations guiding implementation processes are needed to support the application of these implementation process and evaluation framework adaptations. Regulatory and advocacy groups need to push forward the measures of equitable implementation as a requirement for federally funded and private technology companies. Each case study identified specific stakeholder groups that could be engaged to push forward these implementation processes and measures. As new standards are released or existing standards are updated, equitable implementation processes and evaluations need to be included. In particular, equitable implementation processes and evaluation will be critical to the NIST framework to identify and manage bias in AI tools and the new AI-focused executive order from the Biden administration to promote safe, secure, and trustworthy AI. Therefore, these initiatives should apply the measures of reach, adoption, effectiveness or efficacy, and equitable implementation to their ongoing work.

**FUNDERS**

Funders, such as foundations and the federal government (e.g., NIH), should make the inclusion of equitable implementation a key component of funding requirements, especially for projects that are focused on the intersection of digital and health equity. These can include measures that leverage participatory digital media, such as digital storytelling. Population health informatics tools, including national surveillance systems, should be augmented and leveraged to surface and monitor health inequities at the intersection of PROGRESS+ characteristics. Funders, such as NIH and NHS, can lead the way by putting into place standardized processes and measures.

**ACADEMICS AND IMPLEMENTATION SCIENTISTS**

More research is needed to validate the importance and impact that the careful monitoring and improvement of equitable implementation processes can have on racial and digital health equity. Specifically, research to test the impact of the proposed adaptations on implementation is needed. An explicit focus on equitable implementation and engagement of marginalized populations could also help ensure that future studies of EBPs have more-diverse authors, populations, and settings involved.

Academic institutions and their partners (e.g., journal and textbook publishers, academic societies) can lead the way on providing incentives for the use of equitable implementation processes and measures by incorporating requirements for evaluation measurement or process steps into academic standards. More research to understand the key features of equitable digital participatory media implementation could provide a counternarrative (or complementary narrative) to more-traditional statistical analyses.

It is only with an explicit focus on equity and transparency within regulatory compliance, using equitable implementation measures, that technology companies will be incentivized to approach their innovations in ways that advance public interest and build public trust. Without these types of checks and balances, the promise of even the most–well intentioned emerging digital technologies will be compromised by significant unintended consequences on the most marginalized communities in the United States, further exacerbating health inequities.
ADVOCACY AND NONPROFIT ORGANIZATIONS

Advocacy and nonprofit organizations that have formed to explore both the potential for and responsible use of digital health technology should add equitable implementation processes and transparent reporting on equitable implementation measures to their requirements and codes of conduct.

Nonprofits can also lead the way in building public partnerships to foster more connections to the public by leveraging digital participatory media or approaching early adopters. For example, youth reflect an early adopter group for participatory digital media, and partnerships with existing youth-serving organizations could help reach this specific community of focus. Private and commercial companies are potential agile and early adopters for digital health technologies that could bridge the equity gap. The adapted implementation processes and evaluation questions and measures in this paper are a first step in mitigating bias in emerging digital health technologies, which may incentivize private and commercial companies to be early adopters.

If health equity is centered in the implementation of digital health technologies, these technologies can realize their promise of promoting public health in a way that addresses health inequities. Not only could these types of changes lead to greater transparency, and consequently greater trust in the process, but these changes could also lead to greater reach and uptake of digital health technologies in populations that have not benefited from these innovations. Ultimately, changes to implementation processes and evaluations to promote more-equitable implementation is critical to address the growing health inequities in the United States.

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AI</td>
<td>artificial intelligence</td>
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<tr>
<td>COVID-19</td>
<td>coronavirus disease 2019</td>
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<td>EBP</td>
<td>evidence-based practice</td>
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<td>GTO</td>
<td>Getting To Outcomes</td>
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<td>IS</td>
<td>implementation science</td>
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<tr>
<td>LLM</td>
<td>large language model</td>
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<td>NHS</td>
<td>National Health Service</td>
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<td>NIH</td>
<td>National Institutes of Health</td>
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<td>NIST</td>
<td>National Institute of Standards and Technology</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<tr>
<td>PROGRESS+</td>
<td>place of residence; race, ethnicity, culture, and language; occupation; gender and sex; religion; education; socioeconomic status; and social capital; personal characteristics associated with discrimination such as age, disability, sexual identity, and both lasting and time-dependent relationship characteristics</td>
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<tr>
<td>RE-AIM</td>
<td>reach, effectiveness or efficacy, adoption, implementation, and maintenance/sustainment</td>
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</table>
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Barretto, Amilcar Ismael, “Perspective Chapter: The Challenges of the Relationship Between Doctors and Patients in the Digital Age,” Management in Marketing Communications [Working Title], 2024.


Challenges,” *Journal of Biomedical Informatics* to Foster a Smart Systems Response to Health Disparities and Health Equity


Fantasy Congress, homepage, undated. As of November 15, 2023: https://fantasycongress.com/


Gender Shades, homepage, undated. As of January 18, 2024: http://gendershades.org/

Genome Access, homepage, undated. As of January 31, 2024: https://www.genomeaccess.it/en/


iEARN, homepage, undated. As of January 18, 2024: https://www.iearn.org/


Mental Health Is Health, homepage, undated. As of October 15, 2023: https://www.mentalhealthishealth.us/about/


NIST—See National Institute of Standards and Technology.


Unite Us, homepage, undated. As of January 18, 2023: https://uniteus.com/


World Health Organization, “Infodemic,” undated. As of September 22, 2023: https://www.who.int/health-topics/infodemic#tab=tab_1


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Despite the unprecedented spending on health in the United States and rapid expansion in types and innovations of digital health technologies, many populations still get sick and die at higher rates than others. To address these persistent health inequities in the United States, it will be crucial to center health equity in the implementation of digital health technologies. As the two nascent fields of health equity and digital equity find their footing after rapid implementation and scale-up in the post–COVID-19 pandemic world, a focus on equitable implementation is particularly important to ensure that digital health technologies do not perpetuate or create new health inequities. However, to date, these fields have had a limited or siloed focus on implementation.

To our knowledge, this paper will be the first to center health equity in the implementation of digital health technologies by adapting a methodological framework to support the planning and evaluation of digital health technologies. Without an explicit focus on equitable implementation, digital health technologies run the risk of further perpetuating existing health inequities or creating new ones. This paper will be of interest to policymakers, implementation scientists, government regulatory bodies, and those working in the health and digital technology fields.

This paper is part of the RAND Methods Volume in Racial Equity Policy series.

RAND CENTER TO ADVANCE Racial EQUITY POLICY

RAND Social and Economic Well-Being is a division of RAND that seeks to actively improve the health and social and economic well-being of populations and communities throughout the world. This work was conducted in the RAND Center to Advance Racial Equity Policy, which aims to develop and apply approaches and solutions that build racial equity in systems and policies for the future. The center’s work is focused on three key components: methods and action, dialogue and change, and policy leadership. For more information, visit www.rand.org/well-being/racial-equity-policy.

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