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Bridging community-engaged research and implementation science methods to advance public health practice

Introduction

The practice of implementing and understanding implementation to improve programs¹ has been at the forefront of public health research and practice for over a century. However, a specific research focus on improving the *process* of implementation is more recent, coalescing in the field of implementation science. “Implementation science” has been defined as “the scientific study of the use of strategies to adopt and integrate evidence-based health interventions (EBIs) into clinical and community settings to improve patient outcomes and benefit population health” [1].² Implementation science also involves *pre-implementation* research, used to identify gaps that affect outcomes related to program or intervention implementation so that new or adapted interventions can be introduced to address these gaps. Thus, implementation science can be thought of as having unique phases, ranging from identifying a “gap” in health outcomes, to developing or modifying an intervention to address

gaps, to evaluating the intervention’s implementation and impact on outcomes, to disseminating findings and preparing the intervention for scale-up [2, 3].

Concurrent with the development of implementation science methodology, community-engaged and participatory methods (often considered on a continuum and now playing a significant role in research) have become central to many research programs [4]. Increasingly, public health researchers involve communities in selecting strategies to improve program design, delivery, and dissemination, often as a way to improve equity. Because many public health challenges are embedded within inequitable sociological, political, and economic systems, community-engaged approaches can reach those for whom equity-focused programs are intended in ways that build trust and are more likely to be sustainable.

We present a discussion paper focusing on introducing methods at the intersection of implementation science and community-engaged and participatory research for improving public health practice. We organize our paper around a sequence of planning steps/phases adapted from the Knowledge to Action framework [5]. For each phase,

we introduce an example of a characteristic common constraint encountered in public health practice and research at this phase and summarize examples of implementation science and community-engaged methods that can be applied. The methods include both community-engaged and implementation science-focused methods and are illustrated with case studies from our collective work (Table 1). In Table 2 and the accompanying text, we detail *how* the methods were used from the authors’ experience.

Phase 1: identifying and defining “the problem”

A common constraint for the first phase is the absence of input from hard-to-reach populations about intervention or program “fit.” This presents missed opportunities to identify the most appropriate new interventions or to best tailor existing interventions to a context or population. We present a few options for methods that can be considered to ensure that community input is incorporated when interventions need to be contextualized to new populations and locations.

¹ We use the terms “program” and “intervention” interchangeably in this paper.

² See Table 3 for a summary of key definitions used in this paper.

Table 1 Community-engaged and implementation science methods to address key constraints in public health research and practice

Phase of work	Examples of implementation constraints in public health research and practice	Relevant implementation science and community-engaged methods	Included case studies that explore the method
Phase 1 Identifying and defining “the problem”	Input from hardly-reached populations is missing about intervention/program “fit,” program improvement, or approaches to tailoring	Rapid qualitative methods Intervention design models and frameworks Community diagnoses	CHOMA study SFDPH COVID-19 vaccination study Ecolectivos study
Phase 2 Designing and modifying the intervention	Emergent needs among program staff, administrators, or program recipients are identified once the program/intervention is underway, requiring a balance between “course corrections” and implementation fidelity	Intervention design models and frameworks Human-centered design	SFDPH COVID-19 vaccination study COVID-19 misinformation tool
Phase 3 Designing and evaluating the study	Traditional clinical trial designs are neither feasible for evaluation nor acceptable to community partners Quantitative data collection on implementation does not capture the full context	Quasi-experimental and hybrid study designs Mixed methods	JiTunze study Support Sisters study
Phase 4 Communicating and disseminating the results	Hardly-reached populations’ input is missing for program messaging, communication planning, and dissemination work	Participatory data analysis Deliberative democracy Human-centered design Discrete choice experiments	Homelessness and Family Stays study MindKind study Guatemala vaccine study California vaccine study

Rapid qualitative methods

Formative qualitative research (e.g., in-depth interviews and/or focus group discussions with key stakeholders; observations in “real-world” settings) is often critical to identify and define challenges in delivering interventions. However, time and resource constraints may limit this key formative step. For example, “traditional” qualitative research methods involve a process of data expansion whereby teams of trained analysts move from interview or focus group discussion transcripts to hundreds of coded text excerpts [6, 7]. This coding process, along with the time to synthesize coded excerpts into a story from the data, can take months or years.

Rapid qualitative methods can overcome many challenges of “traditional” qualitative techniques, particularly in the time-consuming analysis phase. There are several types of rapid qualitative approaches (see [Table 3](#) for definitions) [8, 9]. While these approaches can be distinguished based on their scope (some provide a framework for both rapid data collection and analysis, and others focus only on analysis), they all involve stakeholders in a process of memo writing for collected data, which both speeds up data synthesis and ensures that formative findings are grounded in community perspectives. In the CHOMA study,

we used the Hamilton rapid qualitative analysis approach to identify key stakeholder perspectives on integrating mental health and HIV services for adolescents in South Africa [10]. This technique was selected because our funding constraints required that analysis take place in a few months because data were urgently needed to inform standard care practices. Our set of focused, formative research questions was well-suited to such a practical analysis strategy. Our analysis had five steps. First, members of the research team and the community created summary templates based on our interview guides. Second, we piloted the template with transcripts to ensure reliability across our analysis team. Third, we developed matrices to organize themes. Fourth, we extracted themes by reviewing matrix data. Fifth, we organized our findings by domains from an implementation science framework, the Consolidated Framework for Implementation Research (CFIR), which helped us to understand barriers to integrated mental health and HIV service delivery [11].

Intervention design models and frameworks

Successful behavior change-focused interventions have been linked to a greater understanding of underlying theoretical constructs that can be applied to new in-

terventions and their contexts [12]. There are many ways to apply behavior change theory to determine *what* to target for interventions and to guide a “coordinated set of activities” to develop interventions. One of the most widely used implementation science approaches is the Capability, Opportunity and Motivation for Behaviour Change (COM-B) model and the related Behaviour Change Wheel (BCW; [Table 3](#)). As described by Nilsen, the COM-B model can also be thought of as a framework for implementation insofar as it can help identify determinants of implementer behavior change related to delivery of an intervention [13]. Another framework, the CFIR framework, could also be used alongside or instead of the COM-B and BCW. The tools to apply these (and other) methods and frameworks for intervention design and implementation are well-developed for working with community partners from the outset to shape the development or improvement of an intervention or program.

The COM-B model is an example of an implementation science tool that helps determine which factors affect the behavior that is desired for public health or clinical care ([Table 2](#)). Questions can be developed for interviews or focus groups that link to constructs that help identify modifiable barriers and enablers for a behavior. These constructs include

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Bridging community-engaged research and implementation science methods to advance public health practice

Abstract

Addressing public health challenges through equitable, evidence-based strategies remains a pressing global need. Implementation science bridges research and practice, offering methods to improve intervention design, delivery, and evaluation. Concurrently, community-engaged research embeds equity and trust into public health initiatives. This paper introduces selected community engagement methods and related implementation science approaches to address characteristic common constraints in public health practice,

illustrated with real-world examples. Adapting the Knowledge to Action framework, we present a discussion of community-engaged methods and accompanying case studies. The discussion follows four phases present in applied public health research: (1) identifying and defining the problem, (2) designing and modifying the intervention, (3) evaluating the intervention, and (4) communicating and disseminating findings. For each phase, we highlight common barriers, recommend methods, and present case studies such as rapid

qualitative methods, human-centered design, and participatory data analysis. Case studies demonstrate these methods' effectiveness in addressing common constraints. These approaches ensured that interventions were culturally tailored, contextually relevant, and evidence-based.

Keywords

Intervention design · Evidence-based interventions · Knowledge to Action Framework · Implementation Frameworks · Evaluation

Verbindung von gemeindeorientierter Forschung und Methoden der Implementierungswissenschaft zur Förderung der öffentlichen Gesundheitspraxis

Zusammenfassung

Die Bewältigung von Herausforderungen im Bereich der öffentlichen Gesundheit durch gerechte, evidenzbasierte Strategien ist nach wie vor eine dringende globale Notwendigkeit. Die Implementierungswissenschaft schlägt eine Brücke zwischen Forschung und Praxis und bietet Methoden zur Verbesserung der Konzeption, Umsetzung und Bewertung von Interventionen. Gleichzeitig verankert die communitybasierte Forschung Gerechtigkeit und Vertrauen in Initiativen im Bereich der öffentlichen Gesundheit. Dieser Beitrag stellt ausgewählte Methoden der Beteiligung von Communities und damit verbundene Ansätze der Implementierungswissenschaft vor, mit denen häufige Hindernisse in der Praxis der

öffentlichen Gesundheit angegangen werden können, und veranschaulicht diese anhand von Beispielen aus der Praxis. In Anlehnung an das „Knowledge to Action Framework“ (Rahmenkonzept für die Umsetzung von Wissen in die Praxis) diskutieren wir Methoden der Einbindung der Bevölkerung und begleiten diese mit Fallstudien. Die Diskussion folgt vier Phasen, die in der angewandten Gesundheitsforschung zu finden sind: (1) Identifizierung und Definition des Problems; (2) Konzeption und Modifizierung der Intervention; (3) Evaluierung der Intervention; und (4) Kommunikation und Verbreitung der Ergebnisse. Für jede Phase zeigen wir häufige Hindernisse auf, empfehlen Methoden und

präsentieren Fallstudien, wie z. B. schnelle qualitative Methoden, menschenzentriertes Design und partizipative Datenanalyse. Die Fallstudien belegen die Wirksamkeit dieser Methoden bei der Bewältigung häufiger Hindernisse. Die oben genannten Methoden stellten sicher, dass die Interventionen kulturell angepasst, kontextbezogen und evidenzbasiert waren.

Schlüsselwörter

Interventionsdesign · Evidenzbasierte Maßnahmen · „Knowledge to Action Framework“ · Umsetzungsrahmen · Evaluation

motivations (social role and identity, emotion, beliefs about consequences, expected outcomes, goals), *skills* (beliefs about capabilities, memory, attention and decision processes, self-efficacy, behavioral regulation), and *context* or *opportunity* (environmental context and resources, social influences) [12]. This approach allows for a deeper understanding of the behavior and guides the researcher to target what to change if an intervention is to overcome identified barriers [14]. Developing questions and working together with community partners to interpret findings can identify modifiable barriers, leading to inter-

vention co-development in a follow-up phase, using the BCW (see also [14]). We applied this approach in a public health initiative in California aimed at improving COVID-19 vaccine uptake among Spanish speakers who were close contacts of cases [15]. The formative phase, based on COM-B questions in interviews, revealed that knowledge and misinformation barriers (capability) about vaccine safety and efficacy were foremost, combined with opportunity barriers stemming from limited access to vaccine sites due to work schedules and transportation issues. Motivation barriers were linked to mistrust of gov-

ernment-led health campaigns. We then mapped these barriers to communication campaigns with local public health partners, as outlined in step 4 of the Knowledge to Action framework.

Community diagnosis

“Community diagnosis” is used in medical anthropology as an assessment tool in which community members work together to systematically assess needs, priorities, and resources to then take action to address a key health problem such as a source (e.g., water) or a disease (e.g., childhood diarrhea), or for disaster pre-

Table 2 Case studies applying implementation science and community-based research methods for public health

Study name	Population	Primary method(s) used	Way that method(s) used	Key findings
<i>Phase 1: identifying and defining "the problem"</i>				
SFDPH COVID-19 contact tracing study (Abascal Miguel, 2023) [15]	Spanish speakers in San Francisco, California, reached through the COVID-19 contact tracing program administered by the county health department	COM-B model and BCW	To conduct semistructured interviews and turn coded data into themes that were translated into intervention and policy recommendations To assess barriers and enablers to COVID-19 preventive behaviors (quarantine, testing, vaccination) in "real time" within a public health program	Lack of knowledge/access to information was one of the biggest barriers to following recommendations Systemic barriers included being unable to take time off work and an uncoordinated system (vaccines and testing) Some hesitancy but not as prevalent as what we saw afterward Education and communication interventions were the most widely recommended for identified barriers
NACER study (Thompson, 2018) [14]	New adopters (50 pregnant women) of liquefied petroleum gas stoves in rural Guatemala	COM-B model and BCW	To identify barriers and enablers to the adoption of a gas stove and the concurrent deimplementation of a wood stove	COM-B framework revealed that other household members needed to be involved if the gas stove was to be consistently used Social identity and empowerment were key in decisions about stove repairs and LPG tank refills The seven intervention functions included training, education, persuasion, incentivization, modeling, enablement, and environmental restructuring
CHOMA study (Velloza, 2024) [10]	Adolescent girls, clinic staff, and implementation partners in South Africa; at risk for HIV infection and candidates for PrEP	Human-centered design Rapid qualitative methods	To conduct a needs assessment with in-depth interviews and rapid qualitative methods To use findings to adapt an integrated mental health and HIV prevention intervention for young South African women	In-depth interviews revealed the importance of <i>integrated</i> mental health and PrEP services for young women and identified key barriers to service delivery Workshops, conducted through an iterative human-centered design process, matched barriers to potential intervention of content counselor training and supervision
Ecolectivos study (Thompson, unpublished)	Xinca indigenous communities in rural Guatemala	Community diagnosis	To identify key actors and practices related to solid waste management (e.g., community clean-up, recycling) with a focus on plastic burning To understand in detail the context for behaviors related to solid waste management and plastic burning	Interviews were used to inform workshop activities (whom to invite to community clean-up activities; recycling events) and to understand the solid waste management practices in the intervention (and control) villages prior to randomization Deductive thematic analysis using APEASE criteria to assess potential effectiveness of intervention activities selected by workshop participants in intervention villages
<i>Phase 2: designing and modifying the intervention</i>				
Ecolectivos (Hengsternmann, Thompson, under review) [19]	Xinca indigenous community in rural Guatemala	COM-B model and BCW	To conduct a pilot for the main trial to determine intervention components related to solid waste management and plastic burning	Attendance ranged from 25 to 87 women participants at each class Two themes emerged: (1) lack of environmental health literacy and agency and (2) marginalization and lack of a waste management system 12 adults completed additional training to become micro-entrepreneurs in solid waste recycling in their community
Misinformation tool (Abascal Miguel, 2024) [24]	Spanish- and Indigenous language-speaking immigrants in California	Human-centered design	To co-develop a tool to help Spanish speakers identify health misinformation on social media	Through formative interviews with key informants and community members, misinformation was identified as a significant barrier to vaccine uptake Three co-design workshops were conducted with 15 Spanish-speaking women, in which participants evaluated real examples of online health misinformation, providing critical insights on source reliability, messenger credibility, and visual cues The collaborative process resulted in a practical 10-step checklist co-designed with participants to help Spanish speakers identify and counter misinformation

Table 2 (Continued)

Study name	Population	Primary method(s) used	Way that method(s) used	Key findings
<i>Phase 3: designing and evaluating the study</i>				
JiTuze study (Conception, 2023) [26]	Adolescent girls, clinic staff, and implementation partners in Kenya	Interrupted time series	To test an evidence-based provider training strategy and simulated patient encounters on mental health service delivery for adolescents in public HIV clinic settings	Provider competency scores and fidelity of mental health service delivery according to national Kenyan guidelines improved after the training compared with before the training We abstracted data from 1154 medical records and found that mental health screening and referral rates (primary outcomes) had a relative increase in the 3 months following the training compared with the 7 months prior to the training
Support Sisters (Vellozo, unpublished)	Support Sisters (community health workers), postpartum women	Mixed methods	To understand program reach, program engagement for patients, and program effectiveness both in training Support Sisters and in improving strategies to support and link patients to prenatal resources	Support Sisters model was acceptable and feasible for linking patients to resources, which was perceived to improve postpartum health outcomes and child health
<i>Phase 4: communicating and disseminating the results</i>				
Guatemala immunization (Abascal Miguel, 2022) [38]	Indigenous communities in rural Guatemala	Human-centered design	To develop culturally and linguistically appropriate social media COVID-19 vaccine communication	Lack of information/knowledge; common myths and misinformation are prevalent High social media engagement and reach Pre-/post-evaluation showed a significant impact of intervention on COVID-19 vaccine uptake among target populations
Vaccine messaging preferences (Abascal Miguel, unpublished)	California-based participants from a wider social network study	Discrete choice experiment	To assess preference of social media communication on COVID-19 and flu seasonal vaccines	Individual attributes play a role in preferences Participants preferred TikTok-style videos vs. static text-only posts and favored posts with real pictures over cartoons, although this difference was not statistically significant Information from local outlets was preferred over unsourced or federally sourced information, and participants favored factual over humorous tones Images featuring older adults were more popular, and information specific to COVID-19 or the flu was more compelling than general vaccine content
Homelessness and family stays (Handley et al. 2022) [30]	Older adults experiencing homelessness and their family members	Participatory data analysis Ground-truthing	To include the views of those with experiences of homelessness into health promotion materials for training of social and health care service providers working with older homeless adults and their families	Ground-truthing discussions reinforced and expanded findings (e.g., importance of neighborhood identity, training needs, how self-improvement affects readiness to live with others) Recommendations that include composite stories can effectively bring structural factors affecting housing stays to the forefront
MindKind (Sieberts, 2023) [36]	Adolescents in India, the United Kingdom, and South Africa	Deliberative democracy	To conduct public deliberation sessions to gauge concerns and aspirations around governance of a prospective mental health data bank and how to talk about it with young people in the future	With our visual graphics and interactive videos, co-developed with our in-country community advisory boards, we were able to inform participants about complex topics of open-access data sharing and data governance Participants were sensitive to linguistic and semiotic choices in informational materials and helped refine language for future dissemination, particularly among youths who would prefer to use materials in a language other than English
<i>COM-B</i> capability, opportunity, and motivation for behavior, <i>BCW</i> Behaviour Change Wheel, <i>LPG</i> liquefied petroleum gas, <i>PIEP</i> pre-exposure prophylaxis, <i>APEASE</i> acceptability, practicability, effectiveness, affordability, spillover effects, equity				

Table 3 Implementation science and community-engaged research terms and related concepts used

Term	Definition and related concepts
Behaviour Change Wheel (BCW)	A framework that builds off of the COM-B model to help identify relevant intervention functions and match them to evidence-based intervention strategies that can be used to encourage behaviors in a target population
Capability, Opportunity and Motivation for Behavior (COM-B) model	A behavior change framework that proposes three necessary components for any behavior (B) to occur, through assessing capability (C), opportunity (O), and motivation (M)/
Co-design	A process in which researchers partner with community members and stakeholders to create programs or interventions
Community-engaged research	A process that incorporates input from people whom the research outcomes will impact and involves such people or groups as partners throughout the research process
Consolidated Framework for Implementation Research (CFIR)	A practical framework to help guide systematic assessment of potential barriers and facilitators for implementation in order to guide selection of implementation strategies and to determine which types of adaptations may be important for interventions
Convergent parallel design	Involves simultaneous collection of both quantitative and qualitative data, and analyses typically focus on similarities and differences between quantitative and qualitative results as key findings
Deliberative democracy	A method to engage community stakeholders around open, iterative dialogue in a two-step process of (1) providing education and (2) holding a series of public discussions to come to group consensus on ethically or logistically challenging issues in public health practice
Discrete choice experiment (DCE)	A method that helps quantify preferences to guide decision-making. By presenting individuals with hypothetical scenarios that vary across key attributes, DCEs help identify the features most valued by target populations and stakeholders
Explanatory sequential design	Includes quantitative data collection and analysis, followed by qualitative data collection and analysis, which could be used to provide further context or elaboration around quantitative findings (this may be a useful design for the quasi-experimental designs described above in which quantitative findings could benefit from further qualitative explanation in the study population)
Exploratory sequential design	Includes qualitative data collection and analysis, typically to inform study design or measurement development, followed by quantitative data collection and analysis (this may be useful in designing a new survey instrument)
Human-centered design	A method that encourages development of interventions to take place in close collaboration with the needs of the people (end users) and the settings where interventions will be used
Hybrid studies	Study designs that intentionally include implementation outcomes alongside effectiveness outcomes in a single study to inform understanding of implementation processes. Data collection can include a variety of quantitative and qualitative approaches such as in-depth interviews, surveys, and focus groups
Hybrid type 1 study	Has a primary focus on effectiveness but also may focus on better understanding of the context for implementation, often using a combination of qualitative and quantitative data collection
Hybrid type 2 study	Has a dual focus on effectiveness and implementation research question(s) and may involve many different approaches to evaluation of outcomes
Hybrid type 3 study	Focuses on assessing the implementation of interventions to determine which is best suited for the setting and situation. The effectiveness of the program on health outcomes is viewed in hybrid type 3 studies as less essential to measure
Implementation science	The “scientific study of the use of strategies to adopt and integrate evidence-based health interventions (EBIs) into clinical and community settings in order to improve patient outcomes and benefit population health” [1]
Interrupted time series	A study design in which multiple observations are evaluated for several consecutive points in time before and after an intervention within the same individual or group
Knowledge to Action framework	A framework that outlines steps in the process of translating research findings and evidence into practical actions and real-world applications
Mixed methods	Approaches that include both quantitative and qualitative data collection and analysis in a single evaluation
Participatory data analysis	An approach that involves community members in the discussion and interpretation of data findings
Participatory research	A type of community-engaged research in which community stakeholders participate actively in the research process, from problem identification and development of the research question to dissemination of results
Quasi-experimental design	Studies that include a wide range of nonrandomized or partially randomized pre-/post-intervention studies
Rapid qualitative methods	A set of methods to rapidly synthesize qualitative themes, typically through an iterative, team-based process of memo-writing and matrix building; examples include rapid assessment procedures, rapid ethnographic assessments, rapid and rigorous qualitative data analysis, Hamilton rapid qualitative analysis
Re-storying	Methods that come from the field of health communication and are also referred to as <i>narrative health promotion</i> ; has been widely applied to patient–provider communication, with studies indicating positive impacts on patient–provider relationships, provision of culturally sensitive care, and behavior

paredness [16–18]. Methodologies that may be used to conduct this diagnosis include key-informant interviews, participant observations, photovoice, and social network mapping.

Given the obvious complexity of the quantitative and qualitative data that could be collected, and the length of time required for analysis, an in-depth community diagnosis could take years. In the context of public health problems requiring “sooner-rather-than-later” solutions, a pragmatic approach could combine in-depth interviews with community walk-throughs. For example, community diagnoses were piloted during the formative phase of our intervention study, which aimed to reduce household plastic waste burning in rural Guatemala, a common problem in low-resourced countries that lack adequate waste disposal infrastructure [19]. In *Ecolectivos*, our village-level cluster randomized trial, community diagnoses were conducted in 16 villages prior to baseline assessments and randomization [20]. Once we had permission from village council members, semistructured interviews with key informants about recycling and waste services, household waste management, and clandestine garbage dumps were ascertained. A community walk-through, including photos and handheld GPS devices to show the locations of the clandestine dumps, open burn pits, and evidence of burned plastic waste, also took place. With snowball sampling, we further interviewed stakeholders working on recycling or community clean-up campaigns related to plastic waste. This community diagnosis method contextualized the “who, what, where, and how” and enabled partnerships with stakeholders for subsequent interventions, such as recycling or community clean-up programs.

Phase 2: designing and modifying the intervention

One constraint that often occurs in the phase of designing, modifying, and implementing an intervention or program is challenges identifying the “right” set of intervention components to be included or tailored. Intervention mod-

els or frameworks can help guide this process. In addition, methods that can be rapidly applied to specific parts of the intervention, especially those that involve co-design with community partners, such as human-centered design, can be useful tools to support this stage.

Intervention design models and frameworks

After identifying “barriers” and “enablers” of a health problem using an approach such as community diagnosis or the COM-B model, the BCW³ can be used to provide an evidence-based approach to design intervention strategies, often with community partners [12]. The BCW helps organize and select which functions of an intervention could “map” to the barrier or facilitator identified (for example, intervention strategies such as education, skill building, and persuasion). Following the selection of intervention strategies, the final step is to determine how to deliver the strategy, for example, how education might be delivered (e.g., 1:1 counseling, health coaching, training). Taken together, this approach can link (1) a comprehensive assessment of potential barriers to behavior change in a particular setting, (2) a rational process for selecting which barriers to target, and (3) a method to match evidence-based strategies for overcoming barriers to those that have been identified and prioritized.

Using the BCW in the case study related to the COVID-19 vaccine uptake study, we made recommendations for the local health department to focus on education in our communication intervention to address the barrier of misinformation, while enablement strategies such as mobile vaccination units and evening clinic hours tackled logistical barriers. Persuasion strategies were also implemented, leveraging trusted messengers such as local community leaders and Spanish-speaking health care providers to build trust and counter vaccine hes-

itancy. To develop an intervention focusing on reducing plastic waste burning, we conducted focus groups to develop intervention components using the COM-B model and the BCW (unpublished data; see [19]). These frameworks are valuable not only for developing new interventions but also for refining and evaluating existing programs. By folding this approach into existing programs, public health organizations can systematically assess performance and address emerging or previously unknown challenges and can ensure that interventions remain effective and responsive to the target population.

Human-centered design

Human-centered design (HCD) is a participatory method that centers the needs, perspectives, and experiences of end users (e.g., community members, patients, staff) in the development of products, services, or interventions [21]. It employs a structured yet flexible framework to ensure that solutions are user centered, contextually relevant, and practical to implement. The process typically involves three main phases: *inspiration* or understanding, wherein researchers seek to deeply understand the challenges and lived experiences of target populations; *ideation*, which involves brainstorming and prototyping potential solutions; and *implementation*, which focuses on testing, refining, and scaling interventions [22]. A key aspect of HCD is its iterative nature, enabling teams to test hypotheses, prototype ideas, and learn from failures. The cyclical process involves revisiting earlier stages—such as problem definition and ideation—to integrate new insights, ensuring that solutions remain aligned with the needs and contexts of end users. Human-centered design facilitates empathy-driven solutions, ensuring that interventions are not only evidence-based but also resonate with and are embraced by the communities they serve. This approach has been shown to increase adoption rates, improve satisfaction, and create sustainable change by deeply embedding community voices throughout the intervention design process [21, 23].

³ Note that there are many other intervention-related implementation science approaches in addition to the COM-B model and BCW framework.

In public health, iterative inquiry is particularly valuable in addressing dynamic issues such as misinformation and vaccine hesitancy, where the context and barriers may shift over time. For example, in a project addressing COVID-19 misinformation among Spanish-speaking communities in the San Francisco Bay area of California, we applied HCD principles to refine a tool designed to counter the spread of false information [24]. Initial phases involved qualitative research through interviews and focus groups to understand how misinformation was perceived and spread within these communities. Building on this input, a prototype checklist (paper and online) was co-designed with participants to help individuals critically evaluate online health information. Feedback loops during subsequent workshops allowed the team to refine both the content and the delivery format of the tool, ensuring cultural and linguistic relevance.

Through this process, the intervention evolved to address practical concerns, such as the readability of the checklist and its applicability in real-world settings. Participants emphasized the need for visually engaging content and accessible language, which led to the integration of infographics and simplified messaging. Trusted community organizations played a pivotal role in distributing the tool, further enhancing its credibility and reach. This iterative approach not only strengthened the intervention but also empowered community members to become active participants in combating health misinformation.

Phase 3: designing and evaluating the study

When an intervention is being prepared for introduction into a community, traditional evaluation approaches to determine its effectiveness are often not feasible or acceptable to partners, such as with a randomized clinical trial, which then limits which types of evaluation can be considered. Equally important to quantitatively examining effectiveness outcomes is that community partners, who are often the implementers, may also want to explore indicators related to

the implementation process and/or experiential experiences of those included in the research. As a result, approaches that include hybrid study designs and that incorporate qualitative data collection can help address this constraint.

Quasi-experimental and effectiveness–implementation hybrid design studies

Public health researchers often must consider the constraints of designing studies by balancing internal and external validity. This balance requires trade-offs in enrollment decisions (e.g., promoting enrollment without strict criteria to ensure external validity) and aligning intervention procedures to resemble “real-life” conditions (e.g., simplifying programs to ensure feasibility, acceptability, and lower costs). Randomized controlled trials often prioritize strong internal validity at the expense of generalizable and actionable results. Alternatively, quasi-experimental designs, such as pre/post studies, interrupted time series, and cluster studies, can yield valid but still practical results, making them often ideal choices to evaluate community-based public health programs. When working in real-world settings, random allocation of an intervention is unlikely to be realistic [25]. For example, it may not be acceptable to community partners to have a “control” group that does not receive a program.

A widely used quasi-experimental design is the interrupted time series. Interrupted time series studies allow for the comparison of trends in an outcome before and after the introduction of an intervention or policy without the disruption to community partners and the complexity of conducting a randomized trial [25]. An example of an interrupted time series study design using routine health system data is the JiTunze study in central Kenya. JiTunze sought to improve adolescent-friendly mental health service delivery in HIV and primary care clinics by training clinic providers in screening and referral practices for common mental disorders (CMDs; e.g., depression, anxiety) using a simulated patient-encounter approach with mock adolescent patient actors [26]. We abstracted clinical data

on screening proportions before and after the introduction of our simulated patient-encounter training. Screening rates were estimated as the number of clinic visits with any CMD screening recorded of the total number of clinic visits each week. We fit generalized linear regression models to estimate differences in CMD screening 7 months prior to our training compared with 3 months after our intervention and to estimate the immediate change in CMD screenings after our training. We found that CMD screening proportions more than doubled in the week immediately following our simulated patient-encounter training and continued to increase over time compared with the pretraining period.

In implementation science, implementation outcomes are important to evaluate in order to improve programs more quickly and thoroughly, as well as to identify equity, sustainability, scale-up, and other factors that are also important to community partners. Hybrid effectiveness–implementation studies (■ Table 3) are a type of study design that has at least one effectiveness research question (e.g., “How effective is the program/intervention on the outcome being targeted for change?”) and one implementation research question (e.g., “How acceptable is the program/intervention to different community members?”). The benefit of hybrid studies is that they maximize the usefulness of effectiveness studies by allowing both effectiveness and implementation research questions to be included in the same study. There are three main types of hybrid studies, which exist on a continuum depending on the emphasis placed on the effectiveness vs the implementation research questions (■ Table 3).

Mixed methods

In constrained health systems or community settings, program evaluation often involves collection and analysis of quantitative metrics of success (e.g., program uptake or adherence). However, focusing exclusively on quantitative measures can result in missed opportunities to understand key stakeholder and community narratives around the context of

implementation and program success or failure. Mixed methods, which include both quantitative and qualitative data collection and analysis in a single evaluation (this can be in-depth interviews, focus groups, or other forms of qualitative data collection), can overcome this challenge and allow for a deeper understanding of both metrics of success and the broader context around them [27]. There are three main study designs for mixed methods research (■ Table 3), and in all three, both quantitative and qualitative data must be used to assess the same topics so that the two types can be analyzed together [27].

In the Support Sisters study, we conducted a convergent parallel mixed methods study to evaluate a community health care worker model of prenatal care for women in San Francisco, California (Velloza, unpublished data). Our quantitative data included programmatic health record information for patients and quantitative surveys for community health care workers (the “Support Sisters”) around domains of program reach, program engagement for patients, and program effectiveness both in training Support Sisters and in supporting and linking patients to prenatal resources. In parallel, we conducted in-depth interviews with patients and Support Sisters to further contextualize the quantitative findings. We met our program reach and engagement targets, and the program was able to effectively address women’s needs around prenatal resources based on our qualitative findings informed by the COM-B model, which included assessment of capability, opportunity, and motivation-related domains.

Phase 4: communicating and disseminating the results

Creating a communication strategy that allows participants to “see themselves in the data” (not literally but figuratively) is the goal of community-based research dissemination, but it can be challenging to accomplish. There are many different methods that can be applied for this work, and we include several to provide some breadth for this important phase. Some rely on iterative qualitative techniques

such as participatory data analysis; others involve stand-alone mini-studies to explore how best to craft and deliver messages, such as HCD or discrete choice experiments. Another approach, deliberative democracy, offers a structured process to support complex decision-making around both next steps and communication strategies.

Participatory data analyses

One of the strategies of community engagement is to involve community members in the discussion of data findings, which can be considered participatory data analysis [27]. One type of participatory data analysis used for dissemination is called ground-truthing or re-storying, a deliberate process to have results re-framed to embed community voices and perspectives into tools (e.g., training materials or messages) that will be disseminated [28]. With re-storying, research teams and community advisors create initial thematic summaries from the data from qualitative (mostly) interview data and create an initial story of a person or situation that reflects composite findings that do not incorporate specific details of any one participant’s individual story [29].

One of the benefits of re-storying is that it can elevate themes that are not always explicit from how someone might discuss their situation in an interview or focus group. For example, in our study examining barriers to older adults experiencing homelessness, we identified several structural themes, such as poverty or housing policies that impact homelessness. We emphasized these in composite stories, which might show the “behind the scenes” barriers more explicitly, to model how to successfully overcome barriers to staying housed. In our re-storying, we worked with community advisors to create the composite stories [30]. The final stories incorporated several themes and are planned to be used in training community agency staff working with this population to emphasize structural themes (e.g., policy-driven restrictions on the numbers of days someone can stay as a guest in public housing, and discriminatory policies that disallow

those experiencing homelessness to stay on housing lists while temporarily staying with family or friends).

Deliberative democracy

Communication about and dissemination of study findings assume a general understanding of the health problem, evaluation methods, and implications of results in the target community. However, complex health topics or those that involve ethical issues or difficult decisions about resource allocation often require community capacity-building and open dialogue to ensure full understanding of results and to collectively make decisions about where to go next with implementation efforts. Communication around these types of complex health topics can be aided with deliberative democracy approaches, which engage community stakeholders around open, iterative dialogue in a two-step process of (1) providing education and (2) holding a series of public discussions to reach group consensus on ethically or logistically challenging issues in public health practice [31]. Deliberative democracy is distinct from other types of community-engaged and qualitative research methods in its focus on education and capacity-building as a critical starting point; its application primarily to complex and emerging health issues such as biobanking, genomic research, and novel vaccines; and its goal of translating community dialogue directly into policy and implementation decisions [32–34].

In the MindKind study, we used a deliberative democracy approach to share findings around a global data bank of mental health indicators to youth participants in India, South Africa, and the United Kingdom. Specifically, we educated participants about data governance policies and approaches for a future mental health data bank and aimed to come to consensus about their preferences on data governance models to inform future practice [35–37]. Educational content included a series of youth-friendly animated videos, developed with our community advisory board, to explain prior work on mental health data banks and different governance model approaches.

The deliberative process included a series of virtual meetings with the youth to discuss seven key questions (e.g., “Who can access the data?”, “How can people see the data?”, “What kind of research can people do with the data?”). Key findings included guidelines and policy language to establish distributed control of data bank access to ensure appropriate use and requirements for data management that include diverse representation [37].

Human-centered design

Human-centered design is particularly suited to the communication phase of research in which community members shape the content, format, and delivery of public health messages. In a Guatemala-based vaccine campaign, HCD principles were applied to co-develop social media materials aimed at increasing vaccine confidence among Indigenous communities [38]. The process began with qualitative research, including interviews and focus groups in Indigenous languages, to identify key barriers such as misinformation and mistrust in governmental health messages [39]. Through iterative feedback, videos were tailored to reflect local cultural contexts and were narrated in K'iche', Kaqchikel, and Spanish to ensure accessibility. This iterative design process demonstrated the potential of HCD to improve vaccine messaging by addressing community-specific concerns and promoting trusted messengers. Post-campaign evaluations revealed increased vaccine uptake among participants exposed to the materials.

Discrete choice experiments

Discrete choice experiments (DCEs), traditionally used in health systems and health economics, are powerful tools for quantifying preferences and guiding decision-making in health care design, and as such they constitute a promising but underused area for public health communication campaigns. By presenting individuals with hypothetical scenarios that vary across key attributes, DCEs help identify the features most valued by target populations and stakeholders [40]. This approach has been instrumental in areas

such as optimizing clinic configurations and designing public health messaging, revealing the trade-offs that individuals are willing to make between factors like accessibility, quality, and cost. In implementation science, DCEs offer a systematic method to tailor interventions to specific populations by uncovering preferences that directly inform intervention content and delivery strategies [41, 42].

In a recent study conducted in California (Abascal Miguel; unpublished data), we used a DCE to identify attributes of social media posts that most effectively encourage engagement with vaccination messages. Participants were first educated about the study goals and presented with a series of public health posts that varied systematically across attributes such as messenger type (e.g., community member vs. health worker), tone (e.g., factual vs. humorous), and source (e.g., U.S. Centers for Disease Control and Prevention vs. unsourced). Participants then engaged in iterative rounds of paired comparisons, choosing their preferred posts. This approach not only quantified preferences for specific attributes but also identified the most popular posts overall.

Educational materials included examples of public health posts, curated with input from a community advisory board and public health experts, to ensure relevance to California's diverse population. Analysis revealed strong preferences for factual messages from trusted sources such as the California Department of Public Health and the U.S. Centers for Disease Control and Prevention. Posts featuring health care workers and older adults were more likely to be selected. Humor, while effective in specific cultural contexts, was less favored overall, highlighting the importance of audience-specific tailoring. Messaging strategies that prioritize factual information, trusted sources, and relatable imagery can enhance vaccine confidence and social media engagement. The results are now being used to design a follow-up social media campaign aimed at promoting COVID-19 booster vaccines, with a focus on measuring real-world impact on vaccine uptake.

Conclusion

Public health practice can stall despite good intentions, most often arising from poorly implemented interventions in which barriers were not addressed and contexts were poorly understood. Implementation science is a rapidly evolving field that allows public health practitioners and researchers to employ new methods, theories, and frameworks to address public health problems and to combine tools across a range of approaches. Increasingly, research and practice are focused on tackling health inequities that are growing globally, and they should prioritize community partnerships to be successful. We have presented some useful methods within four planning steps/phases for public health research and practice that emphasize community engagement, including the following: (1) identifying and defining the problem, (2) designing and modifying the intervention, (3) designing and evaluating the study, and (4) communicating findings. Many of the designs and methods discussed here, such as HCD, deliberative democracy, and participatory data analysis, bring community collaboration into implementation science approaches as well as qualitative methods, such as rapid qualitative methods and mixed methods. We used our own research to illustrate the use of these methods to advance public health practice. Improving public health through the effective implementation of strategies that address real-world challenges and that are grounded in evidence and community engagement is not only hard work but is essential for creating sustainable and meaningful change.

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Declarations

Conflict of interest. M.A. Handley, L. Abascal Miguel, L. M. Thompson, and J. Velloza declare that they have no competing interests.

For this article, no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case.

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