What is the role of culture, diversity, and community engagement in transdisciplinary translational science?

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Abstract

Concepts of culture and diversity are necessary considerations in the scientific application of theory generation and developmental processes of preventive interventions; yet, culture and/or diversity are often overlooked until later stages (e.g., adaptation [T3] and dissemination [T4]) of the translational science process. Here, we present a conceptual framework focused on the seamless incorporation of culture and diversity throughout the various stages of the translational science process (T1–T5). Informed by a community-engaged research approach, this framework guides integration of cultural and diversity considerations at each phase with emphasis on the importance and value of “citizen scientists” being research partners to promote ecological validity. The integrated partnership covers the first phase of intervention development through final phases that ultimately facilitate more global, universal translation of changes in attitudes, norms, and systems. Our comprehensive model for incorporating culture and diversity into translational research provides a basis for further discussion and translational science development.

Keywords

Translational science, Diversity, Culture, Community engagement, Translational and transdisciplinary science

INTRODUCTION

This paper provides a conceptual framework for utilizing community engagement principles to facilitate an evolution in transdisciplinary translational science that relies on community-engaged partners throughout the translational process. Typical approaches in the field present shortcomings in recognizing the importance of culture and diversity throughout the translational science spectrum and the significant value of understanding how each impacts the effectiveness of sustainability of preventive interventions.

The proposed framework and supporting discussion purport that the standard translational science framework and scientific community, particularly the prevention science community, consider various ways to broaden the understanding of how culture and diversity may impact the

Implications

Policy: Implementation review boards that include citizen scientists should be standard components for behavioral health research to facilitate effective intervention design, implementation, and dissemination.

Research: Researchers need to incorporate cultural considerations to inform specific community contexts and the individual and system level factors that may impact the design, implementation, effectiveness, and dissemination of the intervention.

Practice: Prevention scientists and the prevention science field should actively seek to engage potential community-based research partners in all developmental and translational phases of research.

application of preventive interventions. This requires consideration of the target population, their specific community contexts, and the individual and system level factors that may impact the design, implementation, effectiveness, and dissemination of the intervention. This paper examines the role of culture and diversity from a community-engaged research perspective across the T1 to T5 translational spectrum (see Table 1).

BACKGROUND

Translational science is defined as a new effort to “bridge the gap between scientific discovery and the development of new strategies to diagnose, treat, and prevent disease [1]”. Culture and diversity are suggested as multi-system level considerations that will inform research design, implementation, effectiveness, and dissemination efforts while also increasing the translatability of intervention results at the individual and system levels.

The initial translational science movement can be traced back to responses to the National Institutes of Health’s “Roadmap for Medical Research [2, 3].”

Table 1 | Translational research stages

Type	Type 0 translation (T0)	Type 1 translation (T1)	Type 2 translation (T2)
Definition	The process of discovery, including theory and findings from basic sciences translated to applied theory	Moving from bench to bedside. Translation of applied theory to methods and program development	Moving from bedside to practice and involves translation of program development to implementation
Type	Type 3 translation (T3)	Type 4 translation (T4)	Type 5 translation (T5)
Definition	Determining whether efficacy and effectiveness trial outcomes can be replicated under real-world settings	Wide-scale implementation, adoption and institutionalization of new guidelines, practices, and policies	Translation to global communities. Involves fundamental, universal change in attitudes, policies, and social systems

Within this roadmap, the NIH was focused on the following three objectives:

1. The need to *stimulate the development of novel approaches* to unravel the complexity of biologic systems and their regulation, which is encapsulated in the “New Pathways to Discovery” theme;
2. *Exploration of various ways to reduce cultural and administrative barriers* that often impede such research; and
3. “*Re-engineering* the clinical research enterprise [3]”.

Community-engaged research participatory efforts that value the input and perspectives of community stakeholders have been embraced by philanthropic foundations and, more recently, by academic institutions as a key component to improving the human condition. Additionally, federal agencies have increased funding opportunities that promote researcher-community partnerships and collaborations to address agency-focused goals, objectives, and priorities. The leadership of foundations in this space provides an important resource and opportunity for prevention scientists to collaboratively explore the implementation of our proposed model. Zerhouni declared that “At no other time has the need for a robust, bidirectional information flow between basic and translational scientists been so necessary [3]”. In response to this, the translational science effort has evolved to focus on the development of transdisciplinary approaches that foster bidirectional information flow. However, ambiguity remains in what mechanisms/systems might establish, cultivate, and sustain this bidirectional exchange and the specific constructs that facilitate a bidirectional information flow between basic and translational work. We contend that each stage of the translational process should consider culture and diversity from a community-engaged framework as an integral component of the development process in order to develop preventive interventions that are effective and result in sustainable outcomes.

Fishbein et al. proposed a novel prevention-specific translational framework which could allow for additional conceptual consideration of the importance of culture and diversity. The prevention science-focused framework for the translational process begins in the T0 phase

wherein a problem is discovered and theory is developed. From theory comes methods and program development in T1 followed by efficacy trials implemented under controlled conditions in T2. By the third step of the translational process (T3), evidence-based programs, practices, or policies are moved into real-world conditions where effectiveness trials evaluate elements of adoption, adaptation, and dissemination. In the T4 phase, new interventions are translated and disseminated widely with a goal of sustainability and institutionalization of programming that result in lasting change. Finally, in T5, broader global translation of guidelines, policies, and practices occur for universal impact on attitudes, policy, and system changes.

Factors such as race and ethnicity must be considered because they are often directly correlated with levels of risk, disparities, and prevalence of high-risk behaviors [4]. As an example, African-Americans have been shown to not be more likely to smoke cigarettes than other races, but are more likely than other groups to smoke menthol cigarettes and to metabolize nicotine more slowly [5]. These types of findings indicate the interplay between social and biological environments experienced by individuals and how they combine to influence risk status. Using the tobacco example, nuanced differences in risk should be met with equally nuanced adaptations to preventive interventions with attention to cultural factors that should be considered.

The interplay between social and biological environmental influences on behavior and risk status illustrates the need for cultural consideration in translation science, especially for prevention. However, many behavioral interventions are developed with mostly white, suburban populations; and historically, researchers have utilized universal application of preventive interventions to facilitate cost-effective and sustainable approaches [6, 7]. Yet, the evidence base supporting the significant and positive impact of culture, diversity, and community engagement in preventive intervention development is growing [8]. Typically, culture and diversity are thought to be most relevant during the T3 or later phases of translation, but the proposed framework posits that culture and diversity should be actively included throughout the stages of intervention development, implementation, and sustainability.

CONCEPTUAL FRAMEWORK

Figure 1 presents the adapted framework that guides the proposed translational process. Specifically, this adapted model combines the culturally responsive model for recovery and the Cancer Institute NSW Translational research model to illustrate how and where prevention scientists and researchers should consider culture and diversity in the translational process for prevention science [9, 10]. Working from a translational prevention science, the development of preventive interventions in T1 relies on a thorough understanding of the risk and protective factors implicated in maladaptive behavior, such as substance abuse or violence. Cultural contexts and community environments are often risk and protective factors considered when developing and implementing preventive interventions.

As shown in Fig. 1, the culturally responsive model, which is heavily influenced by the ecological framework, has been modified for the purposes of the proposed framework [11]. An ecological system framework is very applicable to addressing the cultural focus because it attends to the interplay of family, community, and the socio-political environmental factors and the impact of these various system levels on individual behavior. This model further identifies culture, systems of oppression/privilege, and the social determinants of health, and history as key factors in predicting/improving behavioral outcomes. The continued evolution and development of a transdisciplinary translational approach to prevention science is supported by an ecological framework for

intervention development. Understanding the interdependence of the concentric domains (i.e., individual, family, community, socio-political environmental) that influence individual behaviors can be uniquely informed by the diverse but integrated perspectives of a transdisciplinary approach. However, this approach to intervention development and implementation is strengthened by a community participatory component that overlays and conjoins the relationship between and among the ecological domains.

The Cancer Institute model was developed to illustrate the translational research process from basic research to practice and policy implementation. The model shows four phases (three primary and one secondary) of the research model (Basic Research, Bench, Practice-based research, and Policy and Practice) and how T1, T2, and T3 processes are integrated throughout the process. The model was modified to reflect intervention development (Theory generation, Design, Implementation, Policy and Practice) with less emphasis on drug development and clinical trials. Type 4 (wide-scale implementation) and type 5 (translation to global communities) translation processes were also added to the original Cancer Institute model.

The objective of the original model was to consider issues in intervention designs that target improving a broad spectrum of health outcomes. The adapted model posits that cultural and community engagements are essential components for prevention scientists to advance translational science. More specifically, this integrated conceptual model shows various entry points for community-

Fig. 1 | A framework for the integration of community-engaged research approaches across the translational science spectrum

engaged approaches throughout the translational research process for prevention science.

DEFINITIONS

Key components in the model have operational definitions, but also recognize that these constructs overlap and complement each other. Considerations for the role of diversity and culture serve as the “what” and community engagement is an example of the “how” or an approach to provide practical context for the considerations posited.

Diversity

The term diversity and its operationalization is often constructed or *perceived to be constructed* primarily around race and ethnicity, but in the proposed model, it is expanded to include the broader terms of representativeness and perspective thinking. Representativeness involves having different groups involved in decision-making such as those of different gender, sexual orientation, socio-economic status, age, physical abilities, religious beliefs, political beliefs, and or ideologies. It suggests it is important to understand and recognize the uniqueness and individual differences within these groups [12]. As such, an important underlying principle includes the value of representation through participation in the translational process.

The second definitional component of diversity is perspective thinking. The concept of perspective thinking allows for the inclusion of multiple disciplines and thought processes. This component allows diversity of perspectives in the process of discovery, generation of theory, and development of intervention and pilot studies, which could result in the development of more effective preventive interventions. Furthermore, integration of a multi-disciplinary prevention field which embraces the value of different perspectives aligns with a transdisciplinary translational approach to intervention development.

Culture

Culture is an aspect of diversity in a community context that is important in successfully planning, designing, and implementing scientific approaches to engage a community and improve health outcomes [13]. Anthropologist Christie Kiefer defined culture as “a complex integrated system of thought and behavior shared by members of a group—a system whose whole pattern allows us to understand the meanings that people attach to specific facts and observations” [14]. Culture shapes identities and fosters notions of community by defining how individuals and groups relate to one another, how meaning is created, and how power is defined. Furthermore, culture provides a context for ideas about partnership, trust, and negotiation. Considerations for culture in the context of translational research require understanding the perspectives of disparate populations and disciplines and applying

that understanding to the translational process (see Table 1).

Community engagement

While diversity and culture are the “what” to improving the effectiveness of preventive interventions, *community engagement* is the “how.” It can be defined as the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people. Community engagement, through involvement of individuals with diverse perspectives, is an approach that is likely to facilitate or result in cultural considerations becoming a foundational aspect of the scientific discovery and translational research process. Community engagement is not a novel or innovative concept but it is frequently not optimally implemented because the application of a community-engaged approach often occurs late in the translational process.

The consideration of culture in translational science from a community-engaged perspective indicates the need for consideration of culture from a *multi-systemic perspective* that not only considers the cultural factors that surround the individual but also the cultural factors that define the broader community and policy system levels that encompass an individual’s culture [15]. Therefore, culture can shape the process of community engagement, and in turn, effective engagement would require an understanding of culture [15].

CONSIDERATIONS FOR TRANSLATIONAL RESEARCH

The following sections discuss the specific cultural considerations that impact the design, implementation, effectiveness, dissemination, and transdisciplinary implementation of translational approaches for populations that are often marginalized from the research process. This includes a focus on communities that face racial/ethnic and other economic disparities when addressing behavioral healthcare and the process that builds from integrating cultural considerations throughout the T1 through T5 processes. For each phase of the translational process, diversity-related and cultural considerations within the context of a community engagement approach are provided.

Considerations for T1: translation of basic and applied theory and findings to interventions

In its most basic form, identifying a health need with the precision of a basic scientific hypothesis, which is the first step in identifying the research method process, requires the scientific team to articulate a health need with both a firm grasp of the state of art of clinical medicine and critical scientific insight into how to construct a hypothesis. A community engagement translational approach with an emphasis on cultural specificity and competency can be achieved by building a research team that includes research scientists

and relevant stakeholders from a specific culture. The origins of theory generation are not necessarily forged from collaborative thought but the translation of theory to intervention development necessitates a diverse perspective at this stage of the process.

Beyond building a multi-disciplinary, culturally specific research team at the onset, the team should work from a foundation of not only experiential exchange, but didactic exchange. A consistent didactic exchange throughout the research process facilitates communication and trust to preserve a culturally specific and competent research approach. The development of a strong working relationship between traditional, academic scientists and community members is an important part of community-engaged research that allows for the free-flowing exchange of ideas [16].

From a community-engaged research perspective, the challenge at the T1 phase is to articulate how best to foster and encourage environments that allow a diversity of perspectives to co-exist such that a better product emerges. Collaboration and trust are foundational dimensions of these efforts but institutions often do not reward or incentivize multi-disciplinary translational approaches, which by definition, require sustained input from a diverse research team. On the other hand, the translation of theory to intervention development is iterative and non-linear, which may be perceived as too academic in the traditional community-based participatory research process. In order to be culturally responsive at this translational phase, the field needs to develop “citizen scientists” who are knowledgeable about the research process and can provide details about how theories apply to their unique cultures.

The individuals identified as citizen scientists may include a range of potential participants, such as local community advocates and individuals directly impacted by planned research activities, staff from community-based organizations embedded in the community of focus and other local agencies, and individuals who may not be local but are considered to be culturally informed/cultural experts about the particular group or issue of focus. Ideally, involvement of citizen scientists will be formally supported by funders and resultant budget considerations for researchers conducting community-engaged research. However, when such funding may not be feasible, it becomes even more important that researchers actively and innovatively seek increased and formalized community partner support and commitment to the work. For example, in their implementation of The Partners in Care Study to address depression in underserved urban communities, Chung et al. found that their utilization principles and structure of community-partnered participatory research (CPPR), which emphasize power sharing and collaboration, led to sustained investment from community partners even without direct compensation [17].

Such collaborations uniquely add to the research process because they can raise cultural considerations important to intervention development; but this

process is not unidirectional. Research scientists should actively seek to engage the citizen scientist in a manner that can inform the cultural relevance of an intervention’s core components. Developing citizen scientists surpasses the concept of simply identifying community members interested in research. Researchers must make their work and their process much more accessible and comprehensible, to laypersons. This requires creating easily comprehensible materials for the public such as fact sheets and newsletters to inform the community of research topics and T1 processes. Researchers should also use social media as a communication tool to increase public awareness of community-engaged research processes and results. Consistent and transparent communication of the T1 research process is essential to promoting community involvement and gaining alternative cultural perspectives.

Considerations for type 2: translation of program development to implementation

The implementation of preventive interventions should be informed by feedback received from the prevention science field and representatives of affected populations targeted by these interventions. This feedback can take the form of implementation review boards that provide diverse perspectives and representation to inform the implementation process. Extraction of the most salient data could be used to finalize implementation protocols and approaches. It is also conceivable that some modifications to the program development would occur in response to the review board’s recommendations.

When considering culture in identifying research implementation approaches, the potential impact of the research on improving health should be balanced with the effort and resources demanded of the culture to achieve the research goal [1]. More specifically, the translational scientist needs to not only understand the regulatory process and, in particular, the criteria for identifying an endpoint for the study that would justify approval for human subjects inclusion, but also the culturally specific implementation resources and the actual cultural limitations and characteristics (e.g., socio-political context, cultural context, network or community context, and micro-level or personal dimensions) [18]. It also requires an appreciation of the goals of the clinical investigators *and* community investigators, equally, who will recruit the participants and conduct the study *in* partnership and an understanding of their shared benefit in conducting the research. Insight into the availability of resources and limitations can be gained by first building this foundation of trust and communication through didactic exchange across a multidisciplinary team described earlier. However, there should be consideration of additional within group differences related to population characteristics such as nationality, language preference, generational status, level of acculturation, reason for migration, experience of racism, socio-economic

status, gender, and age. This requires moving beyond creating implementation review boards that are based on community or group membership alone [19].

The practical process of understanding the unique cultural factors to incorporate in prevention programs requires a multi-step, time-intensive process to build partnerships with community leaders and citizen scientists. Researchers should begin with broad strokes to understand community needs such as holding town hall meetings or community conversations. Careful transcription and coding of these events will yield qualitative data to help researchers understand which community leaders should be engaged and how. This should be followed by inviting identified community leaders to designated research meetings as well as informal conversations with them to build relationships and truly incorporate them into the research team. Off shoots of the core implementation review board may include subcommittees to effectively hone in on and discuss options with specific implementation issues and then bringing recommendations back to the larger group. This approach may facilitate efficient use of time but also foster engagement and collaboration building among members while furthering understanding of cultural differences that may come into play on an interpersonal level [20].

Considerations for type 3: translation from efficacy and effectiveness trial outcomes for replication in real-world settings

Sharing findings is an important factor in sustaining prevention efforts beyond efficacy and effectiveness trials. If positive results are found during the T2 (implementation) phase, researchers must clearly articulate with whom and under what conditions preventive interventions effective (T3) are tested. Even if an intervention was developed and designed to impact a universal population, it may require a customized dissemination approach to maximize adoption at the desired scale. Incorporating diverse perspectives and representation can directly impact how and where findings are disseminated among diverse populations, interests, and systems that serve these populations. For example, the number of evidence-based prevention strategies has increased significantly over the last two decades, but only a limited number of those strategies have been adopted and even fewer were adopted and implemented appropriately [21–24]. This is where a diversity-oriented approach can add tremendous value to promote the appropriate adoption of effective prevention intervention.

Culture and diversity often become important factors that researchers consider in dissemination and scalability trials, wherein cultural differences necessitate “adaptation” or changes in the fidelity of implementation in order to make interventions efficacious in new contexts. If culture and diversity are incorporated earlier into the translational process, dissemination to wider groups could be characterized by improved fidelity. If adaptation to different cultures and diverse

populations occur during development and implementation, it becomes less of a “problem” that threatens fidelity in the dissemination phase.

Typically, prevention programs are “culturally tailored” or adapted for use in different populations during this stage [8]. Surface-level changes include fitting the terms, materials, cultural references, and messages of a preventive intervention to the appropriate cultural norms of the targeted population. For example, pictures of people within curriculum material might be changed to match the general appearance of the targeted population in skin color, dress, etc. However, deep-level adaptations require the researcher to consider the culturally specific abstract elements underlying an intervention such as values, beliefs, and attitudes. Ensuring that a prevention program is salient to a certain population requires that cultural differences in these deep structures be woven into a curriculum rather than just added onto an existing program as a supplement. Additional research is needed to better understand the effects of cultural tailoring on preventive intervention outcomes. Very few instances exist of direct comparisons of programs that have been culturally tailored with those that have not [4, 5].

A case study of the adaptation of the “keepin’ It REAL” preventive intervention constitutes a unique approach that involves engaging youth participants in generating cultural adaptations to the intervention itself [25]. To adapt the program to an older age range, and to transition from school- to community-based implementation, youth across multiple school and community settings were asked to change the existing keepin’ It REAL curriculum using a participatory research process. Their suggestions were also used in changing the scenarios, wording, and details in the student workbooks of the program. These changes consisted of surface-level changes, though some themes about values, beliefs and other deep-level changes were woven into the new content. For example, some students reported that abstinence from substance abuse was unrealistic and preferred a harm reduction model, which is a substantial curriculum change.

Pre- and post-tests of these youth were compared with those of participants who received the keepin’ It REAL program without adaptation. Participating in the adaptation related to lower levels of alcohol use than the comparison condition suggesting that the adaptation process itself contributed to a prevention effect. The author suggested that this process met several goals simultaneously, including developing realistic adaptations for use with other youth and enhancing participant ownership and involvement in the intervention, resulting in better outcomes [25]. Understanding the value of diversity can directly impact how and where findings are disseminated among diverse populations, interests, and systems that serve these populations.

Considerations for type 4: translation from dissemination and evaluation to self-sustaining implementation, adoption, and institutionalization

If researchers are effective in disseminating new evidence and facilitating the adoption of new evidence, moving to wide-scale implementation (T4) is more likely. Unfortunately, the research community remains challenged with institutionalizing effective programming or effectuating the development of lasting policy change because this, in part, is not a traditional role for researchers. Prevention scientists make laudable arguments and justifications backed by solid research about the importance of their work and its potential impact on outcomes of interest. While positive findings are foundational components of scaling up, external support and advocacy from decision makers is a critical facilitator of the extent to which there is wide-scale implementation of policies or prevention programming.

The development of lasting policies or the institutionalization of prevention programming can be aided by cultivating understanding among and support from diverse stakeholders with common interest in improved health and well-being. As such, researchers in general and social science researchers in particular must leverage findings from the T3 phase to garner the needed support for wide-scale implementation of any evidence-based program, policy, or practice. However, this process should be initiated early in the translational process to be effective during this phase of translation. Researchers need to understand how diverse perspectives inform decision making and from that understanding, identify mechanisms that establish a platform for this translational phase. For example, legislative policy briefings provide an opportunity to frame future discussions about effective programs, policies, and practices by demonstrating the general value of prevention science and preventive interventions. Further, non-academic partners likely have more skills, community connections, and less restriction in influencing policy and thus may in fact be the drivers of this area of translation, especially if they have been partners during the initial translational phases.

Incorporating cultural adaptations from these partners during type 4 translation into dissemination can pose challenges to researchers due to threats to the fidelity of evidence-based programs. It is important to note that integrating culture at the dissemination phase does not have to alter the integrity of the prevention program. As an example, HIV prevention programs often use a model outlined by the CDC to identify *core elements* prior to dissemination that cannot be changed, whereas *key characteristics* are program activities that can be adapted [26, 27]. In one example, a family program for preventing health problems among military families was adapted during dissemination based on community and stakeholder suggestions using this framework [26]. By maintaining the core elements but adapting the key characteristics, researchers were able to respond to the community's needs by creating several new versions of their

intervention for families of wounded soldiers, couples, and families of young children. Similar adaptations could be done for special populations including race/ethnicity groups or socio-economic groups.

Considerations for type 5: translation from wide-scale implementation to global, universal impacts

With successful wide-scale implementation (T4) and culture and diversity considerations in the other translational steps, transitioning to broad translation to global communities and overarching impacts on attitudes, policies, and systems are more probable. However, often by the T5 phase, there has been insufficient incorporation of these critical cultural and diversity aspects which hinder feasibility of global dissemination and in turn, higher level, systemic impacts. Prevention scientists emphasize the use of RCTs and other rigorous intervention development processes and these are indeed significantly important steps in informing intervention effectiveness; yet, this process often has not included necessary infusion of cultural and diversity factors throughout T1 through T4 phases. Such shortcomings may limit appropriate application of the intervention programming for more extensive global changes on norms and attitudes among populations of focus and ultimately sustained program impacts on distal outcomes.

Success with the T5 phase is predicated on sustained input from diverse perspectives to ensure responsiveness to systemic needs such as those for supportive systems for families. For example, if an intervention is developed with an intended focus on certain Latino populations, cultural factors such as *familism* which taps into familial support, obligations, and other referents for behavior, and *respeto*, or familial hierarchy dynamics and filial obedience, are important considerations throughout the translation process [28, 29]. These are also important factors in sustaining outcomes given demonstrated impacts on both family and individual outcomes; but also in transitioning to relevant systemic impacts in this area [30, 31]. From a broader global translation perspective, variations and levels of importance of such factors for different Latino subgroups or other cultures would also have to be weighted appropriately. Ultimately, having cultural and diverse perspectives to inform the prevention science translation process, facilitates a research program's evolution to universal change.

The challenge for researchers at T5 is how to involve members of diverse communities in widespread implementation decision making. For many, this means including members of these communities on their advisory boards, steering committees, and other governing bodies. This level of community involvement would hopefully result from previous steps taken in T1–T4 in incorporating diverse perspectives, but it is also essential that the leaders of institutions and governing bodies that implement preventive programs understand the benefit of including these voices. Researchers are tasked with increasing their

dissemination of findings of culturally responsive programs not only to other researchers, but also to stakeholders who make implementation decisions. For example, prevention researchers in Richmond, Virginia, in collaboration with African-American community leaders were able to influence widespread implementation of banning of 40-oz alcoholic beverage sales in high-risk communities [32]. This success was due to rigorous research, but more importantly, partnerships with the African-American community and involvement of community members in the local government. Using such a model extends cultural representativeness beyond the scientific community and into broader society.

DISCUSSION

The intent of this paper was to highlight the importance of culture and diversity as core components of the prevention science translational research process and to offer practical considerations for their integration using a community engagement approach. Each of the papers included in this special issue addressed the complexities and unbound potential to developing (T0/T1), implementing (T2), disseminating (T3), and scaling up (T4/T5) interventions intended to improve the human condition.

The implementation of preventive interventions should be informed by feedback received from the prevention science field and representatives of affected populations targeted by these interventions. As indicated in Table 2, the incorporation of this valuable information should occur across the translation process. Implementation review boards can serve as vehicles for this process and the field should consider mandating that all prevention science researchers establish implementation review boards to inform the intervention implementation process throughout all translation phases. An implementation review board would facilitate diverse perspectives and diverse representation. For example, during the implementation stage (T2), research teams could engage the implementation review board to provide their perspective on how best to share information to improve adoption and uptake of new approaches or advances to existing approaches. The diversity of perspective should range from the individual (service user) to institutions (service providers). Sponsors of our work will need to encourage and support a diversified mechanism for dissemination including scholarly journals, practitioner publications, and potentially appropriate forms of social media.

Integrating culture into all phases of the translational process is wrought with challenges only surpassed by the enormous opportunity to improve behavioral outcomes targeted by preventive interventions. Cultural considerations at the T1 stage should emanate from a process that includes a robust interaction among intervention developers, service deliverers, and intervention participants. This approach allows the research scientist to develop a set of inquiries to

Table 2 | Culture and diversity in the translational prevention research process

Translation type	Type 0/1 translation [T0/T1]	Type 2 translation [T2]	Type 3 translation [T3]	Type 4 translation [T4]	Type 5 translation [T5]
Steps	<ul style="list-style-type: none"> - Create a multi-disciplinary, culturally specific research team - Seek to engage community members in research ("citizen scientists") - Create opportunities for didactic exchange between community members and researchers 	<ul style="list-style-type: none"> - Develop implementation review boards with professional and community investigators - Identify cultural factors associated with intervention uptake and buy-in 	<ul style="list-style-type: none"> - Customize a dissemination plan based on cultural needs, focusing on potential factors in scaling up an intervention - Complete surface-level and deep-level cultural adaptations 	<ul style="list-style-type: none"> - Cultivate an understanding of prevention needs among diverse stakeholders - Understand how diverse perspectives are incorporated into community decision-making - Collaborate with community leaders to disseminate information for policy change 	<ul style="list-style-type: none"> - Maintain sustained input from community members into research process - Identify cultural differences that are essential to sustainability

inform the design and development of an intervention, practice, or policy. The diversity of the research team in terms of cultural representation and perspectives ensures that cultural considerations are addressed at the T1 stage if necessary. Sponsors of intervention development should encourage or perhaps require applications to include discussion on plans to address known cultural differences and the potential impact on intervention design.

It is important to integrate community-engaged research principles as an essential part of the research discovery process that includes efforts to understand how and under what conditions these principles are implemented in a specific community's context. For example, engagement and participation during the early stages of development and translation may require stakeholder participation that is more knowledgeable about a particular research domain compared to engagement during the development of an implementation protocol. It is also conceivable that the size or duration of participation might vary as a function of the translational stage. However, a process that articulates community engagement as shared power and mutual respect offers fewer limitations compared to processes that do not value the importance of community engagement. If prevention scientists can think critically about how community-engaged research partnerships can moderate the practicality and effectiveness of preventive intervention development and sustainability, the more likely these principles are institutionalized and recognized as core elements of good science.

A theoretically sound intervention is not necessarily correlated with implementation fidelity. The nexus from type 1 (design) to type 2 (implementation) is best supported if research scientists are fully cognizant of how cultural factors influence and impact the implementation of preventive interventions. Efficacy trials with random assignment are essential to rigorously testing the impact of newly developed preventive interventions, but meaningful and sustained impact can only occur when these interventions produce similar results in a real-world setting (e.g., effectiveness trials). An implementation review board that is diverse in representation and knowledgeable about cultural nuances is likely to affect this type of intervention implementation. It is also suggested that consideration be given to the frequency in which assumptions about cultural impacts are revisited and adaptations to interventions are made accordingly. Communities are both organic and dynamic and researchers should not assume that well-tested interventions remain effective over time nor should assumptions be made about the existence of static predictors of implementation success.

Prevention Science and related fields of study have successfully designed and tested myriad preventive interventions targeting at-risk behavior and well-being. The proliferation of evidence-based programs, policies, and practices over the last two decades speaks to the impressive progress of the field. However, the

sharing of this information resultant in the adoption or uptake of these advances remains a challenge. The field and its funding partners should embrace more non-traditional avenues to increase the likelihood of more widespread dissemination of findings (positive and negative) among all relevant stakeholders. For example, publication opportunities between researchers and citizen scientists could improve visibility, awareness, and reach.

At least two of the manuscripts included in this special issue address efforts to scale up or institutionalize interventions. These are strong examples of how researchers must demonstrate effectiveness (T3) and develop relationships and trust with a culturally diverse cadre of stakeholders to institutionalize policies or support the wide-scale implementation of an evidence-based preventive interventions (T4) and broader globalization (T5). Moving from effective dissemination to wide-scale implementation involves both science and persuasion. Researchers should appreciate and understand different perspectives, articulate the need to scale up with cultural specificity, and actively incorporate an engaged community throughout the process. Adherence to these considerations could result in opportunities to assess the impact of increased reach.

Strategies for community engagement are the mechanism by which culture and diversity are integrated throughout translational research. A community-engaged translational approach with an emphasis on cultural specificity and competency can be achieved by building a research team that includes research scientists and relevant stakeholders from a specific culture. For example, community-based agency stakeholders in the form of patients, agency supervisors, or service providers should serve as equal research partners from the initial hypothesis-building phase (T0) throughout the translational process. This involves more egalitarian approaches, such as those principled with community-based participatory research and extensions of these principles such as Community-Partnered Participatory Research which engenders fully equitable power sharing and collaboration among the community-engaged and academic research partners [33]. The development of a strong working relationship between traditional, academic scientists and community members is an important part of community-engaged research that allows the free-flowing exchange of ideas [16].

It can be challenging to effectively bring members of different groups into the research process. If we are to be culturally responsive in translational science, the field must develop citizen scientists who are knowledgeable about the research process [34]. These individuals uniquely add to the research process because they can raise cultural considerations that are important to intervention implementation. Research scientists should actively seek to engage the citizen scientist in a manner that can inform the cultural relevance of an intervention's core components and more surface-level components.

A common method for bringing citizen scientists into the research process is involving people in focus groups and community conversations which allow for group interaction among individuals while sharing attitudes, beliefs, and perceptions regarding a particular item or issue. Social scientist utilize focus groups to better understand the acceptability and usability of prevention programs. Focus group members can assist with surface-level adaptations by providing feedback about curriculum written and audiovisual material [5]. Focus groups can help to clarify intragroup heterogeneity if researchers pay special attention to where focus group members' opinions differ. Groups can also be comprised of multiple minority groups or minority and majority groups to clarify how they differ and are the same. The use of focus groups as a research strategy for intervention development has been common, but they have been less widely used for researching adaptation of an existing intervention.

This paper intends to initiate a multidisciplinary dialogue to stimulate an ongoing discussion on how best to incorporate cultural considerations as core and paramount to effective intervention design, implementation, and dissemination. In order for transdisciplinary translational science to continue to progress, it is critical that this dialogue continue within the context of an evolving relationship across diverse disciplines with cultural awareness and in partnership.

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Compliance with ethical standards

Conflict of interest: The authors declare that they have no competing interests.

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