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Implementation Science and Nutrition Education and Behavior: Opportunities for Integration

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Abstract

Implementation Science (IS) is the study of approaches designed to increase adoption and sustainability of research evidence into routine practice. This article provides an overview of IS and ideas for its integration with Nutrition Education and Behavior (NEB) practice and research. IS application in NEB practice can inform real-word implementation efforts. Research opportunities include advancing common approaches to implementation measurement. In addition, the article provides suggestions for future studies (e.g., comparative effectiveness trials comparing implementation strategies) to advance the knowledge base of both fields. An example from ongoing research is included to illustrate concepts and methods of IS.

INTRODUCTION

Currently, dietary behaviors in the United States fall short of recommendations[1–3] Yet, a quality diet is important for reducing chronic disease risk.[4–6] To address this problem, researchers and practitioners in the field of Nutrition Education and Behavior (NEB) employ multifaceted interventions in complex settings (e.g., schools, worksites, food banks) with the aim of improving health outcomes for target audiences. Despite continued gaps, improvements in the US diet in recent years (e.g., increased whole grain intake, decreased sugar-sweetened beverage consumption[7]) suggest the implementation of NEB interventions produce valuable effects.[8]

Past publications in the Journal of Nutrition Education and Behavior (JNEB) illustrate attention to the process of implementing NEB interventions to produce desired effects.

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Specifically, the NEB field has used theory and formative evaluation work to assess participants' perceived barriers and facilitators to change[9–12] or to determine preferences of the target audience to inform design or improvement of intervention implementation.[13–15] Process evaluation is also relatively common with researchers documenting the activities of a program implementation effort.[16–19] Further, involvement of stakeholders in the design of interventions reflects awareness of the importance of culturally relevant programs for implementation success.[20–23] These are important strengths of the field that suggest a readiness for further integration of Implementation Science (IS) and NEB.

Implementation Science is "the scientific study and application of strategies to promote the systematic uptake of research findings and other evidence-based practices into routine use."[24] (See IS terms and definitions in Table 1). In other words, IS applies rigorous research methods to test and understand what approaches work to get individuals and systems to use evidence. An explicit interest in IS by the field of NEB began as early as 2012 when the need for application of IS approaches was noted by authors Allicock and colleagues.[25] These authors tested the effects of a fruit and vegetable intervention in churches led by church coordinators without utilizing researcher support for conducting the intervention (i.e., no extra resources, limited technical support). This study concluded, "dissemination may not achieve public health impact unless support systems are strengthened for adequate implementation." Since that time, interest in IS has continued to grow with application of IS theories[26,27] and focused attention on implementation processes.[28–30] This paper, after an introduction to IS, will present a continuum of expanded opportunities for engagement with IS for professionals in NEB.

Introduction to Implementation Science

Implementation Science recognizes that effective implementation of research evidence (e.g., programs, practices, products, pills, policies, principles, procedures)[31] demands active and systematic methods rather than passive processes to establish widespread use. Terms for IS in other countries include knowledge translation, knowledge transfer, and research utilization.[32] Promoting the adoption and sustainment of research evidence into everyday use is the primary goal of IS. IS concepts, methods, and theories are useful for the simultaneous study of effectiveness and implementation.[33] For example, IS can contribute to basic research when new research evidence is being created (to avoid investments in discoveries with low implementability) and when real-world circumstances encourage the spread of practices which have not yet been tested for effectiveness thoroughly (e.g., policy mandates).

In IS, the research evidence being implemented is referred to as an "innovation." Implementation Science pays attention to (a) the innovation being implemented, (b) by whom, (c) in what context, (d) at what interval, and (e) with what approach. Each of these is considered a factor for study and/or modification to understand and/or improve implementation. Unlike Intervention Science and Intervention Mapping techniques,[34] which work to create sound interventions, Implementation Science is concerned with how interventions and other innovations are adopted, adapted, scaled, and sustained. This paper will focus on several key features of IS with immediate applicability to JNEB authors and

readers and refer the reader to additional sources for a more comprehensive review of IS.[35–38]

Theories, Models, and Frameworks.

Implementation Science involves the application of theories, models, and frameworks as described by Nilsen and colleagues.[32] Theories propose relationships among variables; models recommend the sequence of implementation efforts; and frameworks describe determinants of implementation outcomes. Together, theories, models, and frameworks can help researchers to understand implementation problems, design implementation studies to test mechanisms, and evaluate implementation efforts. At present, there are over 60 identified theories, models, and frameworks in IS.[32,39,40] As application of theory is time-honored and necessary to the NEB field, IS theories, models, and frameworks may provide a fresh lens for NEB work.

A first step in using IS theories, models, and frameworks is in distinguishing among their functions.[32] Theories include both classical theories and implementation theories. *Classical theories* come from outside implementation science (e.g., Social Cognitive Theory[41]) and propose causes of behavior relevant to implementation. Theories are most useful for testing hypotheses about why an implementation effort worked or failed (e.g., implementation strategy targeting self-efficacy for disease management). *Implementation theories* (e.g., Normalization Process Theory[42]) originate from implementation research and attempt to explain the casual pathways of implementation processes. Process models are prescriptive in nature and provide guidance for how an implementation process might progress (e.g., Replicating Effective Programs[43]). For example, adapting and deploying an existing diabetes intervention designed for one cultural group and introduced to a new cultural group might benefit from the application of a process model. *Framework* types in IS include both determinant and evaluative types. A key feature of determinant frameworks (e.g., Consolidated Framework for Implementation Research[42]) is the emphasis on contextual and systems factors that may influence the adoption of NEB innovations. Nutrition education researchers and practitioners might use frameworks to anticipate barriers and facilitators to implementation of a new weight management intervention or to identify existing barriers to an ongoing program to address food insecurity among college students. *Evaluation frameworks* (e.g., Re-AIM[44]) guide decisions about how best to evaluate an implementation effort. Selection of a theory, model, or framework reflects stakeholder needs, goals of implementation, and the intended application.

Implementation Strategies

Implementation strategies are “methods or techniques used to enhance the adoption, implementation, and sustainability (p 2)” of research evidence.[45] The Expert Recommendations for Implementing Change project provides definitions of 73 implementation strategies to promote commonality in language and approach for implementation process.[46] These strategies are conceptually grouped into 9 clusters (See Table 2).[47] An implementation effort may focus on selecting strategies within 1 cluster to meet implementation needs or may consider selection of multiple strategies across several clusters to best support implementation. Inputs for strategy selection include information on

the barriers and facilitators of the innovation; the theory, model, or framework informing the study; the existing evidence about the effects of given strategy or strategy combination, and the preferences of stakeholders.

Implementation strategies are distinct from the innovation being implemented. Prudent selection of implementation strategies balances concerns of resources (e.g., personnel, material costs), pragmatics, effectiveness, and tailoring to barriers and facilitators for the target population. Proctor and colleagues[45] detail the process for reporting on specific implementation strategies which includes naming, defining, and specifying details of the strategy to be utilized. Explicitly, specification of strategies includes description of who deploys the strategy (the actor), the steps they take (the action), who receives the action (action target), on what schedule (temporality) with what intensity (dose), to what end (implementation outcome affected), and for what reason (justification). See Table 3 for an example. This is important because detailed á priori specification allows the researchers to monitor the delivery of the strategy relative to the design. Further, other researchers in the field can fully understand the implementation support design, replicate the design, and consider the intensity of the strategy when interpreting study findings. Common language[46] and parameters for specification of implementation strategies[45] promotes understanding of the action that is taken in an implementation effort.

Implementation Research Designs

Implementation Science employs study designs which are constructed to determine the most effective and feasible approaches to implementing an innovation. Selection of a research design is driven by the implementation research question. Brown and colleagues[31] detail study designs with application to implementation research, illustrating the breadth of options for conducting implementation studies. Over and above the more traditional designs (e.g., pre-post, between site comparisons, comparative effectiveness, factorial designs), use of adaptive and hybrid designs is growing in implementation research. Adaptive designs include Multiphase Optimization Strategy (MOST)[48,49] and Sequential Multiple Assignment Randomized Trial (SMART).[48] The MOST design employs an iterative process to identify the most effective components of an intervention or implementation approach. The SMART implementation design involves an initial randomization followed by re-randomization of non-responders in the treatment group to receive more implementation support, allowing for resource savings and ability to characterize responders/non-responders at each level of randomization.

Hybrid designs combine elements of traditional effectiveness research with implementation research across 3 types: Type I) investigate effectiveness and implementation processes and outcomes during early stages; Type II) concurrently focus on intervention effectiveness and an implementation strategy; or Type III) primarily compare the effects of differing implementation strategies on implementation outcomes while secondarily collecting health outcome data. Hybrid designs recognize the variability in evidence strength for the innovations researchers and practitioners are tasked with studying and deploying and suggest different approaches depending on the strength of the evidence base. For example, a mandated change (e.g., Supplemental Nutrition Assistance Program benefit restructure) may

be rolled out before a large-scale, randomized study is conducted; a Hybrid I could be an appropriate design for studying both the effectiveness as well as the ways of implementing the change. This illustrates that IS is not applicable only after a strong evidence base has been established but can be utilized concurrent to establishment of best practice. For more detail, the reader is referred to Curran et al.[33]

Measurement of implementation outcomes allows for determination of the reasons for success or failure of an implementation effort. Proctor and colleagues[50] outline 8 key implementation outcomes (See Table 1). Although all 8 may not necessarily be evaluated for every implementation effort, this list provides a common set of outcomes that can provide "a framework for evaluating implementation strategies." Selection of implementation outcomes for measurement is informed by the stage of implementation and the interests of key stakeholders. Unlike studies which measure these constructs as process measures, IS has the goal of addressing these as primary outcomes with research questions aimed at understanding the predictors of these outcomes, designing implementation strategies for the benefit of these outcomes, and identifying mechanisms linking implementation strategies and implementation outcomes.

A frequent goal of IS is the selection and deployment of implementation strategies for the improvement of implementation outcomes. One combination of strategies may lead to better implementation outcomes than another. Testing associations between implementation outcomes and health outcomes advances understanding of how to best target selected implementation outcomes with effective implementation strategies. For example, even with high fidelity, low perceived feasibility may limit the long-term uptake and effectiveness of a program. Understanding these relationships guides practitioners and researchers in where to invest their efforts in implementation strategies for targeting their population of interest. The primary focus on affecting process is a key distinction of IS from process evaluation alone which would *document* implementation outcomes without necessarily seeking to prioritize understanding their predictors and/or relationships with the targeted health outcomes. Conversely, IS seeks to rigorously *test structured manipulations* of process, rather than *record* process.

Focusing on common implementation outcomes in IS allows for important conclusions. Strong implementation outcomes without improved health outcomes suggest an ineffective innovation (i.e., innovation failure); poor implementation outcomes without improved health outcomes suggests a need for improved implementation (i.e., implementation failure).[50] Adding measures of the characteristics of the innovation (e.g., complexity) and context (e.g., readiness, climate) can further facilitate comparisons of the effects of implementation strategies across disciplines and varied contexts. Over time, combination of such well-measured studies will contribute to understanding of what type of strategies work best for certain features of an innovation, within context, and with certain characteristics.[50]

DISCUSSION

A Spectrum of Implementation Science Opportunities for Nutrition Education & Behavior

Much of the existing knowledge base of IS has been drawn from work in healthcare settings.[24,51] That is, IS researchers have often targeted health care providers and clinics to improve their use of evidence-based practice in clinical care by developing, testing, and comparing implementation strategies' effects on implementation of care and patient outcomes. This has produced a robust understanding of factors that influence implementation in clinical settings and generated a repertoire of strategies to improve healthcare delivery. However, clinical settings sometimes have greater resources and practitioners with different training perspectives than many settings of NEB implementation (e.g., Supplemental Nutrition Assistance Programs, school-based interventions). These differences create key opportunities to determine which lessons from healthcare can translate to NEB improvements.

Apply Implementation Science to NEB Practice.

Frontline practitioners in NEB are vital to implementation efforts. A primary opportunity for NEB practitioners is to engage in the *practice of implementation*[52] by using the IS knowledge base to improve the quality of everyday service delivery to targeted populations. Practitioners have critical expertise in the local context and in the needs and characteristics of the population they serve. In many projects, frontline practitioners (e.g., extension agents, Women Infants and Children counselors, school-based registered dietitians) are the key stakeholders for implementation; in other cases, they provide invaluable relationships with the audience being served by the innovation (i.e., clients, families, children). Regardless, knowledge of the context prepares practitioners to engage in successful implementation and/or to collaborate with researchers in selecting innovations for implementation as well as designing and evaluating implementation efforts. Further, practitioners can use the knowledge base of IS to inform selection of innovations that are most likely to be implementable (i.e., appropriate complexity, flexibility, adaptability)[42] or to drive appropriate adaptations of a program for their context.

Examples of the practice of implementation include consideration of a model or framework to design an implementation process; intentional selection of implementation strategies based on knowledge of the target population and context targeted; and monitoring implementation outcomes to adjust implementation approaches when needed. More specifically, a practitioner may be asked to lead implementation of a new nutrition education and physical activity program in a school setting that was originally developed for youth camps. Using IS, the practitioner could select a process model (e.g., Replicating Effective Programs[43]) to guide the adaptation of, preparation for, and launch of the program. Knowing that school leadership may not be inclined to prioritize NEB relative to academics, for example, the practitioner might select implementation strategies to engage leadership (e.g., formal commitments[46]), monitor and report teacher perceptions of feasibility, and report on the link between student participant and behavioral and academic outcomes to the leadership. Thus, IS provides practical supports at multiple decision points for real-world implementation.

Integrate Implementation Science Approaches in NEB Research.

Implementation research goes beyond the practice and documentation of implementation process and embraces the study of the most effective approaches for increasing adoption of research evidence. To date, evaluation approaches in the NEB field reflect a rich history in formative and process evaluation[26–28,53,54] Integration of additional IS approaches has the potential to strengthen NEB research by providing common terminology and by further advancing measurement processes. Implementation Science is also consistent with current strengths of NEB (e.g., stakeholder engagement and involvement in intervention development) and provides further structure for engaging stakeholders in implementation.

In IS, clear description of the innovation and the implementation strategy is essential to conducting implementation research. That is, studies and clinical trial registries require specification of interventions with enough detail to enable future studies to replicate them or bring them to scale. With a clear description of the innovation, context, and outcome measures in place, NEB researchers can then specify and describe the implementation strategies with the common language and recommendations of implementation science, thus further aligning the fields.[45,46,55] Even when strategies are simple (e.g., training, reminders) and not manipulated in a study, clear description and full specification can facilitate transparency. These recommendations are consistent with the Standards for Reporting Implementation Studies Statement.[56]

A process-oriented and framework-driven measurement plan is another aspect of implementation research which NEB researchers can apply readily. Such plans have at least 2 elements beyond ensuring quality measurement of implementation outcomes. First, a plan to track the delivery and use of implementation strategies is essential.[55] This allows the researcher to know if the strategy was delivered as designed and if the target audience utilized the support. For example, an audit and feedback report may be delivered to a school but not used; measurement of both delivery and utilization would provide important information. The researcher can then determine if variability in delivery and use of implementation support need to be addressed through changes to the implementation plan or stricter monitoring. Measuring the frequency and content of implementation strategy delivery and use also allows researchers to monitor the resources associated with an implementation effort. Without such measurement, researchers may reach inaccurate conclusions about contributing factors to implementation outcomes and be under-prepared to improve future implementation efforts.[45]

Second, researchers and practitioners can use common measures of implementation outcomes and context when possible. Often, the selection of these measures is driven by an evaluation framework. Weiner and colleagues (2017) have validated measures of acceptability, appropriateness, and feasibility which can be adapted for use with most implementation efforts.[57] Measures of organizational readiness,[58,59] implementation climate, and leadership support[60] are also adaptable to many contexts. Besides the time savings in item testing and psychometric validation of new measures for every study, common measures would facilitate comparison of implementation outcomes and influential factors on implementation across studies.

Consistent with principles and existing work in NEB, community-engaged dissemination and implementation research (CEDI)[61,62] structures the research process to engage stakeholders (e.g., implementers, end users, policy makers) in decision making and action planning. CEDI involves stakeholders in activities such as selection of an implementation framework, adapting an intervention, deciding health and implementation outcomes, choosing implementation strategies, and tailoring implementation strategies to their contexts. Long-term goals of CEDI are to improve implementation capacity among the stakeholders and to plan collaboratively for future projects and sustainability. Examples of CEDI include Evidence Based Quality Improvement (EBQI),[63,64] concept mapping, group model building, and conjoint analysis.[65]

Aligning with Implementation Science to Contribute to the Knowledge Base.

At present, there is increasing overlap between contributors in the field of IS and researchers in the field of NEB. Several IS topics are ripe for study within the context of NEB. Research in these areas can simultaneously advance IS and NEB.

A key opportunity to advance both NEB and IS includes the testing of strategies with a strong evidence base from the clinical realm (e.g., audit and feedback,[66] academic detailing[67]) in new, community-based contexts. Nuanced questions about which implementation strategies work, under which conditions, and why, are likely to provide practical value. However, studies comparing many implementation strategies to no implementation support (all or none approaches) will have limited significance. As of yet, the IS field has limited data on which strategies or combinations of strategies outperform other strategies and combinations in community settings. To address this gap in IS knowledge, Ivers and Grimshaw[68] have advocated for embedding sequential comparisons of implementation strategies and strategy combinations in projects across disciplines to identify different levels of efficacy, feasibility, acceptability, and costs. These types of head-to-head comparisons have the potential to prevent future research and practice waste by providing valuable information to inform selection of strategies.

Another opportunity for NEB researchers is contribution to common measurements. In particular, pressing needs are for common measures of fidelity and “technical assistance.” A recent review of family-based interventions to improve preschool diets documented that few studies (less than 20%) included implementation fidelity measures.[69] Likely, there are common aspects of fidelity measurement in NEB interventions that could be validated and standardized across projects (e.g., adherence to lesson frequency), particularly those of a similar content area (e.g., cooking skills, gardening). Schoenwald and colleagues[70] provide guidance on development of fidelity measures. Issues of frequency, source, and timing of fidelity collection are complex, and require intentional justified decisions for each project.[71] Application of this guidance to development of common, adaptable fidelity measures has the potential to strengthen the field.

An example of a key measurement issue is that of quantifiably measuring the activities that support implementation. For example, projects in nutrition education and behavior often use the term “technical assistance” to refer to site-level support provided for implementation from an outside expert. “Facilitation” is the term most often used to describe this type of

support in the IS literature (See Table 1 for definitions of each). IS researchers have illustrated how to define facilitation, track the activities of facilitation, train facilitators in a standard fashion, and evaluate the effects of facilitation with precision.[72] The field of NEB can apply this robust approach to tracking expert-level, on-the-ground support to understand its effects on implementation by measuring its frequency, content, target, and necessary associated resources.

A third opportunity is to move forward the study of program and intervention adaptation. Often, NEB researchers and practitioners intentionally take an intervention known to be effective for one group and translate it for use and/or testing in another group. Frequently, the goal in this process is to ensure adherence to gold-standard fidelity, expecting it will work in a new setting if deployed in the exact fashion it was previously found to be effective. However, IS recognizes the unavoidable and even desirable reality of adaptation. Beyond deliberate adaptations, organizations trained and equipped to deliver nutrition interventions often make situational and responsive adaptations in use or delivery of a program. In both cases, it is important to describe which aspects of the intervention or the implementation strategy are adapted and why. Application of the Wiltsey-Stirman framework[73] can assist with description of adaptations and, in the long-term, assist with identifying which adaptations contribute to success and longevity of a program. Further, researchers can move IS forward by answering key research questions about adaptation.[74,75] For example, it could be highly valuable to study decision-making about adaptations across different implementation contexts and to discover the drivers of decisions about such adaptations. Better study of adaptation processes has the potential to improve the delivery of research evidence to under-served groups who are often the recipients of adapted program and interventions.

Examining the Use of Implementation Science in NEB

In the authors' work, a study is underway to design and test solutions to an implementation problem identified in an earlier research investigation. From 2011–2016, the research team developed, implemented, and evaluated the Together, We Inspire Smart Eating (WISE) curriculum.[76] This evaluation documented gaps between the evidence-based practices WISE trained educators use and the practices they continued to use or did not adopt in their classrooms. For example, almost half of educators (46.7%) were proficient at the evidence-based WISE practice of role modeling by the end of the year; however, only 26% of educators, on average, adopted the practice of using the curriculum mascot as trained.

The subsequent IS study was designed to identify the barriers and facilitators to use of the evidence-based practices (i.e., developmental formative evaluation[77]), to prioritize and address this information with stakeholder input, and to develop and test strategies to improve implementation of the WISE practices. The full protocol is published elsewhere.[78] In brief, positive deviance methods[79–81] were used to identify educators at both ends of the implementation spectrum – those failing at the practices and those succeeding, using data from the previous study. Understanding these failures and successes was the initial focus of the subsequent research, which was accomplished through interviews with the educators based on the revised Promoting Action on Research Implementation (i-PARIHS).[82] Next, in

a series of EBQI sessions, a stakeholder panel of educators, parents, and administrators prioritized the most important barriers and facilitators to be addressed. After the session, priorities were mapped to potential strategies (by the researchers) and then described in a subsequent session to the EBQI panel. Using concept mapping in real time, the panel rated the feasibility and importance of potential strategies aimed to address the prioritized barriers and facilitators. Table 4 links examples of originally identified barriers to selected strategies, proposed mechanism for improvements, targeted implementation outcomes, and related theoretical constructs. This set of strategies is currently being tested in a cluster randomized Hybrid III trial[33] and compared to a basic implementation approach of training and newsletter reminders. Data is being collected on delivery of implementation support (e.g., facilitator logs), utilization of implementation support (e.g., teacher report), implementation outcomes (e.g., observed fidelity), and child health outcomes (e.g., carotenoid intake). Figure 1 summarizes the spectrum of opportunities to align NEB and IS and provides examples from WISE as applicable.

Exemplar work by other researchers in nutrition education and behavior provides examples of implementation of policies and programs in diverse settings. For example, Australian researchers (Nathan, Seward, Sutherland, Wolfenden, Wyse, Yoong et al.) have a robust collection of studies targeting childcare and school settings for promotion of implementation of policies to improve food offerings, physical activity opportunities, and adherence to guidelines for healthy food.[83–85] Their studies have targeted cooks, executive staff, and teachers as implementation agents. A specific, recent example from this group of researchers[86] applied Rogers' Diffusion of Innovation theory to the selection of 8 implementation strategies (e.g. audit and feedback, leadership support) targeting key theoretical constructs with the goal of promoting implementation of a healthy canteen (i.e., cafeteria) policy in Australian schools. Using Re-AIM to guide the evaluation of the project, the team found significant increases in reach, adoption and six-month maintenance of the policy. These studies illustrate examples of the types of implementation challenges in NEB that IS can address.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This paper was designed to provided practical opportunities in IS across the spectrum of NEB science and practice while illustrating the inherent pragmatic nature of IS and providing examples for improvement of implementation in the real world. Specifically, practitioners in nutrition education and behavior can contribute to meaningful advancement of the field through application of IS and involvement in study designs. Adoption of IS lens will lead to continued and increased engagement of front-line nutrition educators into the development of innovations that are more implementable and improved deployment and sustainment of existing programs. For NEB research, IS suggests research questions to understand the success or failure of implementation efforts and new methods to improve the field's ability to determine effective approaches to implementation. Application of IS can help to avoid discarding interventions with potential and to speed the translation and long-term sustainability of effective interventions. Finally, NEB researchers are well-positioned to advance the knowledge base through application of IS. Determining the relative value of implementation strategies and their combinations to one another is a clear contribution the

field can make, particularly as these comparisons are needed in complex community settings.[66] Comparisons are not only needed for implementing innovations but also for sustaining them[74] or stopping practices known to be harmful (i.e., de-implementation).[87] Ultimately, application of IS in NEB has the potential to accelerate the adoption, scale-up, and sustainability of innovations while contributing to exciting scientific discoveries which will transcend disciplines.

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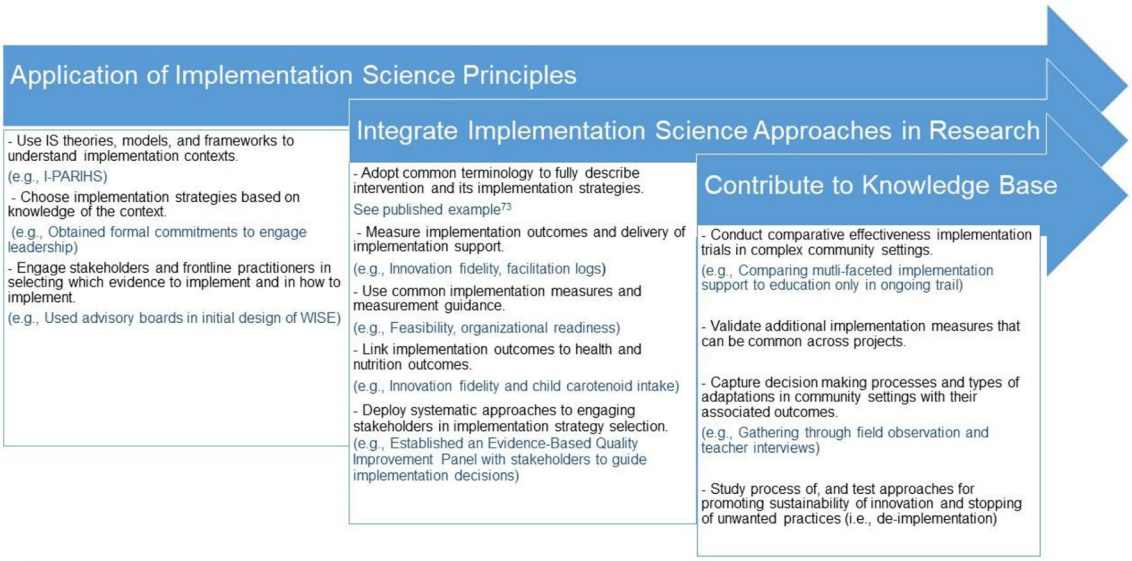

Figure 1.

Spectrum of opportunities for Nutrition Education and Behavior in Implementation Science: The WISE Example

Table 1.

Implementation Science Terms and Definitions

Term	Definition
Adaptation	Process of changes to an innovation to increase suitability for a particular population or organization while keeping core components; may happen deliberately or passively.
Dissemination	Targeted spread of information/interventions to a targeted audience
Context	The setting in which the implementation takes place; features of the inner and outer setting that may impact implementation including, but not limited to, culture, organizational structure, local policy, leadership, capacity, networks, and environmental (in)stability.[82]
Hybrid Designs	Research designs with a dual focus on clinical effectiveness (i.e., health outcomes) and implementation outcomes.
Facilitation	A process whereby a designated person (facilitator) uses a set of implementation strategies differentially between sites in response to varying contextual needs and barriers; akin to the current use of the term “technical assistance” in nutrition education and behavior, which has a different meaning in IS.
Innovation	A program, practice, product, pill, policy, principle, or procedure which has shown to be effective through outcomes evaluation to some degree for come contexts.
Implementation Strategy	The “how-to” of changing practitioner or organizational behavior toward the goal of improving implementation outcomes.
Implementation Research	The scientific study of implementation which focuses on the how and why of successes and failures of innovations in real-world settings; goal is generalizable knowledge.
Readiness	Degree to which an individual or organization is prepared to implement change[58]
Scale Up	Broadening the delivery of an innovation through deliberate efforts to reach a wider but similar audience and context to that in which the innovation was tested originally.
Stakeholders	Individuals or organizations impacted by the implementation effort; can include community members or patients targeted by the effort and/or frontline practitioners delivering the innovation.
Technical Assistance	Use of local or centralized personnel (e.g., call-in helpline) on an as-needed basis to address issues with implementation; an implementation strategy; one implementation strategy
Implementation Outcomes	
Acceptability	Practitioner or stakeholder satisfaction with elements of the innovation (e.g., content, complexity).
Adoption	Initial implementation or uptake of innovation by practitioner or organization.
Appropriateness	Perceived fit; relevance; compatibility; usefulness for practitioner, stakeholder, or organization.
Costs	Organizational resources to deliver innovation or implementation strategy(ies); cost-effectiveness or cost benefit to system.
Feasibility	Suitability for everyday use by practitioner or organization give available resources.
Fidelity	Program delivery quality by practitioner; extent of delivery as intended.
Penetration	Degree of institutionalization and/or spread across organization.
Sustainability	Organizational continuation of innovation; maintained integration into setting.

* This table was adapted and expanded upon from Proctor et al.,[50] Livet et al.,[52]

Table 2.

Clusters and Examples of Implementation Strategies Drawn from Expert Recommendations for Implementing Change (ERIC) project

Cluster of Strategies	Example Strategy
Engage Consumers	Use mass media; Prepare consumers to be active participants
Use Evaluative and Iterative Strategies	Audit and feedback; Develop a formal implementation blueprint
Change Infrastructure	Create or change credentialing and/or licensure standards; Change physical structure/equipment
Adapt and Tailor to the Context	Promote adaptability; Tailor strategies
Develop Stakeholder Interrelationships	Identify and prepare champions; Build a coalition
Utilize Financial Strategies	Develop disincentives; Use new payment schemes
Support Practitioners	Remind practitioners; Revise professional roles
Provide Interactive Assistance	Provide local technical assistance; Provide supervision
Train and Educate Stakeholders	Use train-the-trainer strategies; Develop educational materials

*This table was adapted from Powell, Waltz, and colleagues of the ERIC project.[46,47] Definitions of the strategies can be found in the original sources.

Table 3.

Example of Strategy Specification to Support Implementation of Motivational Interviewing (MI)

Strategy	Strategy Cluster	Definition	Actors	Action	Temporality	Dose	Justification
Make training dynamic.	Train and Educate Stakeholders	Interactive opportunities to practice and reflect	Experienced MI trainers	One-time workshop	1–2 weeks before start of MI intervention	6 hours	Provide foundational skills in MI.
Send reminders.	Support Practitioners	Electronic reminders via email	Automated by MI staff	Send reminders of key training messages	Once per week for 6 months	Approximately 24 emails	Remind trainees by commonly used mode of communication.
Provide audit and feedback.	Use Evaluative Strategies	MI trainer watches recorded session of trainee and provides feedback.	MI trainers	Identify strengths and weaknesses among new trainees.	Twice within first 6 months	1 hour of feedback and coaching on each occasion (Total of 2 hours)	Providing tailored feedback in supportive environment to encourage further MI skill

Table 4.

Example of Implementation Barriers Mapped to Targeted Strategies/Mechanisms and Implementation Outcomes

Barrier	Strategies	Mechanism	Implementation Outcome	Measure(s)	Theoretical Construct
Lack of support of admin/ director	Onboarding meetings, Signed commitment agreement, Implementation blueprint	Leadership increases buy-in and support; creates norms/ expectations	Feasibility, Sustainability	Weiner measure[57] of feasibility at baseline & follow up	i-PARIHS; leadership support; inner context, local level
Insufficient mechanisms for change (e.g., designated roles)	Champion training, Facilitator support	Center is given additional support to navigate establishing increased capacity for change.	Feasibility, Sustainability, Costs	Organization al readiness[59] – at training and follow up; Weiner measure of feasibility at baseline & follow up	i-PARIHS; inner context, local level
Inconsistent Teacher Beliefs	Training, Educational materials, Champion Support, Facilitator support	Present counter evidence to challenge beliefs; social pressure to get on board.	Adoption, Fidelity	Personal diet/knowledge at baseline & follow up; Role beliefs at baseline & follow up	i-PARIHS; recipient values and beliefs, recipient motivation