Journal of Community Engagement and Scholarship

Volume 13 | Issue 2 Article 8

March 2021

Common Models and Sub-Processes Inherent to Translational Research: Public Health Examples of Science for the Public Good

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Cover Page Footnote

The authors would like to thank Joe Antonides, Emily Baker, Beth Crawford, Ash Faulkner, Jessica Hurtt, Sara Owens, Cynthia Preston, Kapil Vasudev, Sandy Reed and student consultants from the Data Access and Analysis Core, Office of Research, Innovation, and Collaboration at The Ohio State University for their assistance in the preparation of this manuscript.

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Abstract

This study provides a formal review of eight of the most commonly cited models, frameworks, and approaches to translational research in public health. Translational research is defined as the process of moving scientific and other innovations into widespread use, and the authors suggest that such activities culminate in the use of proven practices to solve societal problems. Three critical subprocesses inherent in translational research are described: (a) knowledge generation, (b) translation, and (c) widespread implementation of proven practices. Implications for translational research professionals and organizations, mostly related to public health innovation and promotion of evidence-based practices, are discussed.

The purpose of this critical review is to understand how aspects of existing translational research models, frameworks, and approaches might guide self-identified translational research professionals and generate lessons that can be applied within organizations focused on translating scientific knowledge to practical contexts. Brownson et al. (2018) argued that individuals and organizations must be equipped with the capacity to effectively use evidence to promote public health and other interventions focused on enhancing well-being. Thus, the main focus of this study is process models and guidance related to the day-to-day activities of professionals engaged in developing and implementing evidence-based practices. The authors acknowledge that even though this review focuses predominately on public health innovation, there are many other segments of society (e.g., environmental science and policy) that engage in translational research.

This review analyzes practices employed by a center that conducts translational research within a research-intensive university in the United States. This center, referred to here as The Center, is the context for this case analysis. The Center has long been engaged in the implementation of evidence-based practices to address problems in schools, organizations, and communities. Typical projects focus on developing training resources, initiating program evaluations, and developing and implementing testing procedures to assess employee skills and competencies. Such projects are based on contractual arrangements that specify deliverables and dates when specific work tasks are to be completed. The development of an organizational strategic plan provided the impetus to revise The Center's mission and placed significant emphasis on what was referred to as "translational research."

Translational Research

Morris et al. (2011) noted that 17 years is often touted as the estimated time lag between the development of medical innovations and their application in practice. The authors of this paper note that convergence around an average time lag ignores the complexities of policy development and practice and the fact that some lags may even be beneficial. However, others argue that every effort should be taken to expedite the development and evaluation of evidence-based interventions that have the potential to address societal problems and enhance well-being. Translational research may serve such an accelerating function.

The National Center for Advancing Translational Sciences (2015) defines *translation* as the process of turning observations in the laboratory, clinic, and/or community into interventions that promote well-being. *Translational science* is the field of investigation focused on understanding the principles that

underlie the steps of the translational research process. Rubio et al. (2010) defined *translational research* as the multidirectional integration of basic research, patient research, and population research with the aim of improving the public's health. Woolf (2008) noted that, in large part, the focus of translational research is "harnessing knowledge from basic sciences" to produce new treatment options for patients (p. 211).

While most prominent in the medical sciences, translational research has gained traction in recent years in other fields that seek to use scientific evidence as a foundation for developing and implementing interventions to promote well-being. Reviews of the literature suggest a bevy of models, frameworks, and approaches for moving scientific innovations from concept to practice. For example, Tabak et al. (2012) identified 61 different models or approaches related to implementation and dissemination of knowledge. A recent review of the literature focused on public health intervention identified 41 translational research models described in literature published between January 1990 and December 2014 (Milat & Li, 2017). This review included a keyword search of PubMed—"(translational research OR knowledge translation OR evidence to practice) AND (framework OR model OR theory) AND (public health OR health promotion OR medicine)"—which resulted in the identification of 98 manuscripts.

Importantly, Milat and Li (2017) identified a number of commonly applied models in public health (see Table 1): (a) RE-AIM, (b) translational research continuum or T models, (c) knowledge to action, (d) promoting action on research implementation in health services (PARiHS), (e) evidence-based public health (EBPH), (f) stages of research progression, (g) the interactive systems framework for dissemination and implementation (ISF), and (h) the UK Medical Research Council (MRC) framework. This is but one example of the identification of approaches to translational research. For example, theory related to translational research has been incorporated in psychology (Provenzano-Haas, 2017), social work (Teater, 2017), education (Nadeem et al., 2018), criminology (Sullivan et al., 2017), and business (Wofford et al., 2011). Another example is McNie's (2007) review, in which the author examined literature from a variety of disciplines on "reconciling the supply of scientific information with users' demands so that scientists produce information that decision makers need and use in policy decisions" (p. 17).

Along similar lines, Teeters and Jurow (2019) pointed out that "research that links action across multiple scales of practice is particularly relevant for organizing consequential social change" (para. 1). The authors worked on an evaluation framework that included five dimensions of community-engaged research: (a) establishing partnerships, (b) developing trust, (c) working

Table 1. Commonly Applied Translational Research Models, Frameworks, and Approaches (adapted from Mitlak & Li, 2017)

Name	Descriptive Literature	Description of Steps, Phases, or Activities
RE-AIM	Glasgow et al. (2012), Glasgow et al. (1999)	**Activities related to five phases or questions relative to a specific intervention:** **(a)** reach, or participation in the intervention; **(b)** efficacy, or the success rate of the intervention; **(c)** adoption, or use of the intervention across multiple settings; **(d)** implementation, or use as designed; and **(e)** maintenance, or sustaining intervention over time.
Translational research continuum or T models	Glasgow et al. (2012), Khoury et al. (2010), Westfall et al. (2007)	**Five-phase research continuum:** **(a)** T0: problem definition; **(b)** T1: research allowing for the development of clinical interventions; **(c)** T2: research focused on health outcomes; **(d)** T3: research designed to increase uptake; **(e)** T4: research related to impact in real world settings.

Knowledge to action framework	Graham et al. (2006)	**Knowledge creation and action are the primary phases of activities. The action phase consists of seven steps:** **(a)** identifying the problem, **(b)** adapting knowledge to the local context, **(c)** assessing barriers to using knowledge, **(d)** implementing interventions to promote knowledge use, **(e)** monitoring knowledge use, **(f)** evaluating outcomes of knowledge use, and **(g)** sustaining knowledge use.
Promoting action on research implementation in health services (PARiHS)	Kitson et al. (1998)	**Three phases or dimensions are considered simultaneously:** **(a)** evidence, which includes a combination of research, experience, and acceptability; **(b)** context, which is the setting in which the intervention is implemented; and **(c)** facilitation, which refers to creating conditions that allow for implementation.
Evidence-based public health (EBPH) models	Brownson et al. (2009)	**Consists of a seven-step process:** **(a)** assessing the community, **(b)** quantifying the issue, **(c)** developing a concise statement of the issue, **(d)** determining what is known through the scientific literature, **(e)** developing and prioritizing responses, **(f)** developing an action plan and implementation, and **(g)** evaluation.
Stages of research progression model	Bauman & Nutbeam (2014)	**Four phases of activities:** **(a)** understanding the problem, **(b)** assessing outcomes of exposure to intervention, **(c)** assessing fidelity of implementation under real-world conditions, and **(d)** assessing rollout across jurisdictions and systems.
Interactive systems framework for dissemination and implementation (ISF)	Wandersman et al. (2008)	**Three interacting systems that engage in specific and complimentary activities:** **(a)** the Prevention Synthesis and Translation System compiles and summarizes information about innovations and converts scientific knowledge into user-friendly products, **(b)** the Prevention Support System provides general and innovation-specific support, and **(c)** the Prevention Delivery System implements innovations in practice settings.
UK Medical Research Council (MRC) framework	Craig et al. (2019)	**Consists of four primary phases or activities:** **(a)** development, or identifying the evidence base supporting potential implementation and pre-implementation planning; **(b)** establishing feasibility and piloting or testing procedures for acceptability and effectiveness; **(c)** implementation, or providing information to decision-makers and getting interventions into practice; and **(d)** evaluation, or assessing effectiveness.

with diverse linguistic practices, (d) planning for different forms of action, and (e) outcomes and dissemination. This framework allowed for the development of equity-oriented partnerships, a tenet of translational research in the social sciences. Additionally, Moullin et al. (2019) conducted a systematic literature review of the use of the exploration, preparation, implementation, sustainment (EPIS) framework. The authors concluded that the EPIS framework has been used in implementation research projects with some level of success. Other fields such as environment sciences and psychology have similar frameworks (e.g., Cash et al., 2003, focused on knowledge systems, and Wandersman et al., 2008, promoted the interactive systems framework). However, more work is needed to better operationalize the factors inherent in translational research and grow its application and network of users. Identifying common features might assist in achieving this goal.

Subprocesses Inherent in Translational Research

The models, frameworks, and approaches listed in Table 1 share several common subprocesses. First, most acknowledge the importance of scientific investigation, or what their authors call "knowledge generation," as the foundation for the development of interventions that solve or address specific problems. For example, in the MRC framework, Craig et al. (2019) defined "development" in terms of creating theory and modeling intervention processes and outcomes. In EBPH models, understanding the scientific literature is a key step in identifying interventions that address recognized community problems (Brownson et al., 2009). Similarly, ISF includes a component referred to as the "Prevention Synthesis and Translation System" that compiles and synthesizes scientific knowledge (Wandersman et al., 2008).

Second, the models, frameworks, and approaches highlighted in Table 1 place significant emphasis on the subprocess of translation. Review of these models, frameworks, and approaches suggests that implementation is a formal step in the translation process. For example, the RE-AIM model emphasizes implementation of evidence-based interventions consistent with design specifications (Glasgow et al., 1999). The EBPH model describes a seven-step problem-solving process that proceeds from problem definition and culminates in implementation and evaluation of a specific intervention (Brownson et al., 2009). Similarly, Graham et al. (2006) described the knowledge to action framework as a seven-step process that proceeds from problem definition, to implementation, to evaluation of problem-solving efforts.

Third, the models, frameworks, and approaches summarized in Table 1 are designed to facilitate the development of policies at the local, state, and/or national levels that promote widespread use and maintenance of evidence-based or proven practices. For example, the Centers for Disease Control and Prevention (CDC; 2014) refers to "institutionalization" as a formal outcome of problem-solving consistent with the knowledge to action framework. The CDC defines *institutionalization* as the maintenance of an intervention as an established activity in an organization, community, or other social system. The translational research continuum (Khoury et al., 2007; Westfall et al., 2007) and the stages of research progression model (Bauman & Nutbeam, 2014) refer to research related to real-world impacts and the assessment of rollout across multiple settings, respectively.

Based on these observations, we identified three subprocesses that appear to be inherent in translational research: (a) knowledge generation, (b) translation that includes implementation as a distinct step, and (c) policy development designed to promote widespread use of proven practices. The authors of this paper contend that each of these subprocesses is well understood and is performed routinely in universities, government agencies, and nonprofit organizations. Further, the authors of this paper contend that each of these subprocesses can be described more precisely in order to develop a more thorough understanding of translational research. Finally, the authors of this paper suggested that integrating these functions may provide an opportunity to streamline the process of translational research and enhance problem-solving at the local, state, and national levels. We describe the subprocesses inherent in translational research is provided below.

Once again, similar frameworks can be found in the environmental sciences (e.g., Cross et al., 2019; Daniels & Walker, 2001; Karl et al., 2007) and other disciplines. It may be that translational research as operationalized in these other fields contains similar components. For example, Griffin et al. (2010), Bamberg et al. (2010), and Nadeem et al. (2018) have focused respectively on promoting physical activity in older adults, building evaluation capacity in a community health

coalition, and implementing school-based mental health clinics. This review is not sufficient to claim that translational research procedures transcend disciplines. However, evidence is beginning to accumulate that such is the case. At a minimum, the conceptualization of translational research advocated by the authors of this paper may have utility to local problem-solving across a variety of fields.

Knowledge Generation

Knowledge generation can be defined as developing and/or testing scientific advances to determine if potential interventions are appropriate for translation or implementation in specific problem-solving contexts (Wilson et al., 2011). There are numerous descriptions of the process of scientific investigation or knowledge generation. Odom et al. (2005) suggest that scientific investigation proceeds from the development of preliminary ideas, hypotheses, and observations; to pilot studies; to controlled laboratory experiments; to real-world demonstration studies; and finally to randomized control studies. Our conception of knowledge generation also includes packaging and testing interventions in forms that are user-friendly (Wandersman et al., 2008) and implementable in local settings and assuring the utility of these interventions is adequately supported by evidence.

Translation

Translation focuses on the processes or steps necessary to ensure effective use of evidence-based practices, programs, or policies (Wilson et al., 2011). An *evidence-based* practice, program, or policy is defined as an intervention that is likely to produce a desired outcome given a specific set of circumstances, in which the likelihood of producing a desired outcome is based on the best available evaluation and/or scientific evidence (American Psychological Association, Presidential Task Force on Evidence-Based Practice, 2006). As noted above, translation subsumes *implementation*, which is defined as the process of using a known entity or intervention (Fixsen et al., 2005). However, translation includes additional activities that provide a structured process for problem-solving. A variety of processes could be used to ensure the effective use of evidence-based practices in specific problem-solving contexts. For example, Cash et al. (2003) advocated for a more literal meaning of "translation" whereby scientists help ordinary people comprehend scientific jargon.

The Center has adapted the rational problem-solving process to promote the use of evidence-based practices (Alexander, 1984; Allmendinger, 2009). The rational problem-solving process adopted by The Center consists of seven steps, as illustrated in Table 2. The Center's translational research professionals suggest that translation is a distinct subprocess inherent in translational research and proceeds from problem definition, to values clarification, to solution generation and selection, and finally to implementation and evaluation. This series of steps provides a structured process that can be applied by translational research professionals to address problems in schools, organizations, and communities.

Widespread Implementation of Proven Practices

Widespread adoption and uptake of evidence-based practices is often but not exclusively predicated on the development and initiation of

Table 2. Adaptation of the Rational Problem-Solving Process Used in the Case Study

Step	Objective of Step
1	Formulation of goals, objectives, and deliverables
2	Collection of data and other pertinent information
3	Analysis of data and problem definition
4	Development of problem-solving alternatives
5	Clarification of values and selection of a preferred alternative
6	Implementation of the preferred alternative
7	Monitoring, evaluation, and intervention improvement planning

relevant policies (Wilson et al., 2011). A *policy* is a law, regulation, procedure, administrative action, incentive, or voluntary practice of governments and/or other organizations that enhances well-being or serves to promote the public good (CDC, 2015). Ideally, policy-makers rely on a structured process that produces recommendations driven by evidence and/or other information. This process is highly consistent with the process of translation described above. The major difference between the two is that translation focuses on a specific instance of problem-solving, while widespread implementation involves policy development sufficient to support implementation of an intervention across multiple sites and/or settings (Wilson et al., 2011).

For example, a specific community might engage in a structured planning process relative to opioid abuse and elect to implement a particular evidence-based overdose prevention program. From our perspective, this represents an example of translation. Meanwhile, a state legislature might engage in policy-making to assure that this evidence-based opioid overdose prevention program is available to all interested communities in the state. This represents an example of widespread use of a proven practice. The policy-making process typically includes a number of distinct steps: (a) defining the problem or issue, (b) supporting problem definition with data, (c) developing a policy or policies to address the problem, (d) budgeting and acquisition of resources to support implementation across multiple settings, (e) implementation, and (f) multisite evaluation (CDC, 2015). Thus, translational research can be defined as a comprehensive process that proceeds from knowledge generation, to problem-solving through the use of an evidence-based intervention, to policy development that results in the widespread use of proven practices.

Furthermore, this conception suggests that the progression of translational research can be expressed as a continuum from knowledge generation through widespread use. Such a continuum, shown in Table 3, is useful in that any project that involves the potential or actual

Table 3. Translational Research Continuum Used in the Case Study

Subprocess	Station	Description
Knowledge generation	1	Developing preliminary ideas and hypotheses
	2	Conducting pilot studies, controlled laboratory experiments, and randomized control studies
	3	Packaging interventions in user-friendly formats
	4	Establishing interventions as evidence-based practices
Translation	5	Defining the problem to be solved
	6	Clarifying values, generating potential solutions, and selecting a preferred alternative
	7	Implementing the preferred alternative
	8	Evaluating implementation and intervention improvement planning
Widespread usse of proven practices	9	Defining a problem across multiple jurisdictions or settings and supporting problem definition with data
	10	Developing a relevant policy or policies
	11	Acquiring resources to support widespread implementation and implementation across multiple jurisdictions or settings
	12	Multisite evaluation

development, implementation, and/or evaluation of an intervention can be located somewhere on it. A critical objective of translational research is thus to move interventions along from one station to higher stations on the continuum. It might be argued that, with regard to a specific intervention, the translational research process is complete when the intervention is being used as it was designed, across a variety of jurisdictions, to address the problem or issue for which it was developed. However, "complete" is a relative term. While the process of translation is never complete, use across multiple settings for the intended purpose represents a terminal outcome for evidence-based practices, programs, and/or policies.

Scaling up the implementation of innovations is considered a critical component of translational research (Feller & Menzel, 1977; Rogers, 2002). *Innovation* and *adoption* have become mundane words in a world where technological innovation and policy generation move at a fast pace. Rogers (2003) defines *diffusion* as "the process in which an innovation is communicated though certain channels over time among the members of a social system" (p. 5). There are four key elements that make up this definition: innovation, communication, time, and social system. Diffusion of innovation includes both the spontaneous spread of new ideas and planned methods of propagating new ideas (Rogers, 2003).

The integration of knowledge generation, translation, and policy development may be best understood in terms of actual examples from the portfolio of projects undertaken by The Center. Translational research projects at The Center typically focus on workforce development, juvenile justice, environmental degradation, behavioral health, teacher training, and many other fields. For instance, a team from The Center worked with a local juvenile court to develop and implement quality assurance procedures designed to produce outcome data related to the impact of court programming on youth. In terms of translation, the rational problem-solving model provided a formal process for defining the problem the court was trying to solve and, in turn, identifying quality assurance as a potential solution. The problem focused on using data as a source of information to improve programming. Data were collected that provided the opportunity to consider the extent to which the court's programs produced desired outcomes. Finally, in the policy development realm, the quality assurance process developed in conjunction with the court is in the process of being disseminated to the field in the hope that other courts will adopt similar procedures. In another example, a translational research team from The Center is working with researchers to address water quality related to farming practices. With respect to translation, the team has helped researchers use several project management tools to support project implementation. In addition, evaluation data have been collected to illuminate the extent to which the project has met its goals of addressing water quality.

Implications for Translational Research Organizations

This review of translational research models, frameworks, and approaches has significant implications for organizations concerned with the dissemination of evidence-based practices. First, we suggest that translational research is a complex activity that transcends several key subprocesses. We support a definition of translational research that encompasses knowledge generation, translation focused on the implementation of evidence-based practices in specific problem-solving contexts, and the promotion of policies supporting widespread implementation of proven practices. Thus, translational research is a process likely requiring sustained action over a relatively long time frame and the application of a variety of skills that transcend research, translation, and policy development.

It is important to note that this conception of translational research is not sufficient to specify the responsibilities and duties of translational research professionals. The distinct responsibilities of researchers, implementation specialists, and policy-makers are relatively well-developed, and the critical competencies associated with these roles provide insight into the subprocesses of translational research. However, it can be argued that a translational research process must integrate or bridge knowledge generation, translation, and policy development to result in efficient and effective problem-solving (Abernethy & Wheeler, 2011; Patel, 2018; Tageja, 2011). To the extent that these three subprocesses represent a comprehensive approach to problem-solving, this bridging function might be conceptualized in terms of managing the problem-solving process (Julian, 2017). Finally, organizations concerned with moving proven practices into widespread use must consider developing structural arrangements and policies to support the array of activities related to the three subprocesses inherent

in translational research. For example, The Center is guided by a formal strategic plan that defines translational research and specifies procedures consistent with the subprocesses defined above.

Implications for the Field of Translational Research

This review also has several key implications for the field of translational research. As noted above, moving scientific and other innovations into widespread use is a complex and time-consuming endeavor. It is likely to be best accomplished by interdisciplinary teams composed of researchers, implementation specialists, and policy professionals. Bridging or linking these specialties may necessitate the designation of a fourth professional role, consistent with the concept of bridging or integrating the subprocesses. Thus, translational research professionals might conceptualize their bridging function in terms of managing the problem-solving process in schools, organizations, and/or communities. Such roles would appear to have relevance to a variety of fields, such as environment science, education, mental health, and many other domains.

This discussion also raises issues of community involvement and power dynamics relative to problem-solving that are beyond the scope of this review. How can people with lived experience best participate in knowledge generation, translation, and policy development? Finally, as best practices related to translational research evolve, questions are likely to arise about the competencies necessary to bridge the subprocesses of translational research and function in the role of translational research professional (as distinct from researcher, implementer, and policy-maker). Thus, educational programs might consider investing in training resources focused on the role of translational research professionals. Additionally, this discussion highlights the need for college administrators and faculty "to engage their communities to improve conditions and the efficiency and effectiveness of government and nonprofit organizations" (Barth, 2018, para. 1). Finally, it should be noted that community-based participatory research allows stakeholders to get involved and contribute to addressing the needs and problems of a community, particularly in the field of public health. For example, Brown et al. (2019) described the community-based participatory research partnership and the resulting needs assessment of HIV-related services for infected individuals in rural communities of Tennessee.

In summary, higher education institutions, learning organizations, and training and development groups should consider employing translational research professionals who are able to investigate the extent to which the organizational structures and professional roles and procedures are consistent with the subprocesses described above. Such action may facilitate problem-solving in local schools, organizations, and communities. Ultimately, scientific investigation may yield a translational research process that leads to greater diffusion of information and perhaps more efficient and effective resolutions to complex social problems.

Acknowledgments

The authors would like to thank Joe Antonides, Emily Baker, Beth Crawford, Ash Faulkner, Jessica Hurtt, Sara Owens, Cynthia Preston, Kapil Vasudev, Sandy Reed, and student consultants from the Data Access and Analysis Core, Office of Research, Innovation and Collaboration at The Ohio State University for their assistance in the preparation of this manuscript.

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