PHARMACOTHERAPY

SPECIAL ARTICLE

Implementation Science to Advance Care Delivery: A Primer for Pharmacists and Other Health Professionals

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Health care is experiencing increasing pressure to implement evidence-based interventions that improve quality, control costs, and maximize value. Unfortunately, many clinical services and interventions to optimize medication use do not consistently produce the intended humanistic, clinical, and economic outcomes. The lack of conclusive results is believed to stem from the widely recognized research-to-practice gap. The field of implementation science seeks to discover and apply strategies designed to accelerate successful integration of interventions into routine practice. This primer provides an overview of implementation science principles for pharmacists and other health care providers interested in accelerating practice transformation to improve health care delivery and, ultimately, patient care.

KEY WORDS implementation, implementation science, pharmacy practice.
(**Pharmacotherapy 2018;38(5):490–502) doi: 10.1002/phar.2114**

> *"Knowing is not enough; we must apply. Willing is not enough; we must do."*
>
> Johann Wolfgang von Goethe

Health care practices are slow to change. It requires years, sometimes decades, for a small percentage of original research findings to be translated and routinely adopted in practice.[1] In addition, the results of basic science and clinical research often lead to more questions and spawn more research, but little attention is paid to understanding how these discoveries can and should be used in real-world settings. Although generating evidence of the efficacy of a particular service or intervention under tightly controlled conditions is a necessary first step, it is far from sufficient to ensure broad-scale adoption and implementation in clinical practice.[2] Adopting new knowledge into practice is not simply a matter of increasing awareness through passive methods, such as publishing clinical practice guidelines, offering

Funding source: Not applicable.
Conflict of interest: The authors have declared no conflicts of interest for this article.
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continuing education programs, or sending mass mailings. Effective uptake requires use of more active and systematic approaches that purposefully facilitate quality implementation.[2] Because health care professionals and institutions often lack implementation knowledge and strategies (i.e., the roadmaps and vehicles for quality implementation), patients often do not benefit from the most innovative services and interventions. The need to accelerate translation, adoption, and use of evidence-based interventions is critical to maximize their potential clinical and humanistic impact.

The proverbial research-to-practice gap between what researchers collectively know and what practitioners collectively do has long been recognized.[3] Examples of this quality chasm abound. For instance, 30% of all antibiotic prescriptions in the outpatient setting are inappropriate and unnecessary.[4] One in three older adults are prescribed at least one potentially inappropriate medication.[5] A high percentage of laboratory tests ordered prompt unnecessary diagnostic work-ups.[6] It is important to note that the problem is not just due to overutilization; the underutilization of preventive services has also long been a challenge. Less than 25% of high-risk adults younger than 65 years receive the pneumococcal vaccination, and only about half of adults age 50–75 years have been screened for colorectal cancer.[7] Moreover, strong regional and institutional differences exist in the quality of care[8] as well as variations based on the day and time of hospital admission.[9] Clinicians are not ignorant of these facts, and many feel frustrated that they cannot deliver the highest quality of care.[10] Thus it is not a lack of caring or clinical knowledge but rather implementation *know-how*.

The field of implementation science has gained attention in recent years as an important discipline to address the research-to-practice gap and accelerate implementation of evidence-based interventions and services in real-world settings. Implementation science seeks to discover and apply methods that influence and accelerate the routine use of innovations (e.g., services, interventions, programs, processes, guidelines) in practice, thereby improving the well-being of a population.[11–13] This primer is intended to inform pharmacists and other health care providers about the principles of implementation science—its terminology, history, frameworks, and methods—and provide guidance on how to use implementation science principles to accelerate practice change.

What Is Implementation Science?

Implementation science is defined as the scientific study and application of strategies to promote the systematic uptake of research findings and other evidence-based practices into routine use, thereby improving the quality and effectiveness of health services.[12, 14] In other words, implementation science is about facilitating and understanding what it takes for health care settings to put an intervention or service into practice and do it well enough to maximize its desired clinical, humanistic, and economic outcomes. As such, it is concerned with the "what," "how," "when," and "who" of implementation rather than with discovering or creating a new clinical innovation.[13] Table 1 provides a glossary of commonly used terms in implementation science.

Similar to other sectors, the field of implementation science includes and benefits from both implementation *practice* and implementation *research*. The *practice of implementation* is concerned with applying evidence-based knowledge and strategies to enhance the quality of implementation and improve clinical and humanistic outcomes in real-world settings. Its focus is on the "doing" or "how-to" of implementation. In contrast, *implementation research* focuses on evaluating the most effective approaches for implementing an innovation. It is the scientific study of the use of strategies to adopt and integrate interventions or services into clinical and community settings to improve patient outcomes and benefit population health. Typical implementation research questions include: How can evidence or knowledge be most efficiently translated for use in practice? What are some of the current knowledge-practice gaps (including facilitators and barriers) and their determinants? Which implementation strategies are most effective, for what purpose, and in what context? and What does it take to sustain and scale up services that have been found effective?[15] Both implementation practice and implementation research inform and are guided by a set of *implementation frameworks*. These frameworks, defined as a broad set of constructs that organize concepts to account for a particular phenomenon, describe, systematize, and anchor the discipline. Frameworks, implementation practice, and implementation research

Table 1. Commonly Used Terms in Implementation Science

Term	Definition
Adaptation	The process of making changes to an innovation to make it more suitable for a particular population or organization without compromising or deleting its core components.
Adoption	The intention, initial decision, or action to try or use an innovation.
De-implementation	The discontinuation of an innovation after it was previously adopted.
Dissemination	The spread and sustainability of knowledge about an innovation.
Dissemination research	The scientific study of targeted distribution of information and interventions to a specific public health or clinical practice audience using planned strategies.
Dosage	The amount of an intervention received by participants; in other words, ensuring the frequency and duration of the intervention is received by the participants as prescribed by designers.
Evidence-based intervention	A specific treatment or therapeutic regimen that has been shown to be effective, to some degree and in some context, through outcome evaluations.
Fidelity	The degree to which an intervention is being delivered or implemented as intended.
Framework	A graphical or narrative representation of the key factors, concepts, or variables to explain the phenomenon of implementation.
Implementation	A specified set of activities designed to put into practice an activity or program of known dimensions. Implementation refers to how a service, program, intervention, or other innovation is operationalized for routine and systematic use in an organization.
Implementation practice	Refers to the "doing" or “how to” of implementation. Focused on the application of evidence-based knowledge and strategies to enhance the quality of implementation to drive intervention effectiveness in real-world settings.
Implementation research	Refers to the scientific study of implementation. Focused on understanding how and why interventions work or fail to work in real-world settings, with the goal of producing generalizable knowledge.
Implementation science	The scientific study and application of methods to promote the systematic uptake of research findings and other evidence-based practices into routine use, thereby improving the quality and effectiveness of health services, and, ultimately, the well-being of a population.
Implementation strategies	The methods or techniques by which adoption, implementation, and sustainability of an innovation are enhanced. Constitute the “how-to” of changing health care practice.
Innovation	A novel idea, set of behaviors, or ways of working (e.g., program, intervention, service, technology) that involve a change in practice within a health care setting.
Participant responsiveness or engagement	The degree to which participants respond to, or are engaged by, an intervention. It involves judgments by the participants or recipients about the outcomes and relevance of the intervention.
Program differentiation	The extent to which an innovation’s theory and practices can be distinguished from other innovations (innovation uniqueness).
Program reach	An individual-level measure of participation, referring to the percentage of persons who receive an intervention as well as representativeness.
Quality	The extent to which an innovation is put into practice in such a way that it meets the necessary standards to achieve the innovation’s desired outcomes.
Quality improvement	A structured approach to the analysis of performance and systematic efforts to improve it.
Replication	The process of reproducing key aspects of a well-defined innovation with the intent of achieving the desired outcomes and build the evidence for that innovation.
Scaling out	The deliberate efforts to broaden the delivery of an innovation to a setting or target population that is different from previous implementations.
Scaling up	The deliberate efforts to broaden the delivery of an innovation with the intention of reaching larger numbers of patients that involves similar settings and target populations as previous implementations.
Sustainability	The extent to which a newly implemented treatment is maintained or institutionalized within a service setting’s ongoing stable operations.

are described in more detail in the following sections.[16, 17]

Implementation science is different from its cousin disciplines, such as clinical efficacy research, clinical effectiveness studies, improvement science or quality improvement, and dissemination research. Although the methods used might overlap, each has a unique focus. These disciplines represent different phases within the research pipeline (Figure 1). For instance, efficacy research and effectiveness studies occur earlier than implementation science studies or improvement science work. An innovation typically moves from efficacy (proving it works under ideal and controlled circumstances) to effectiveness (proving it

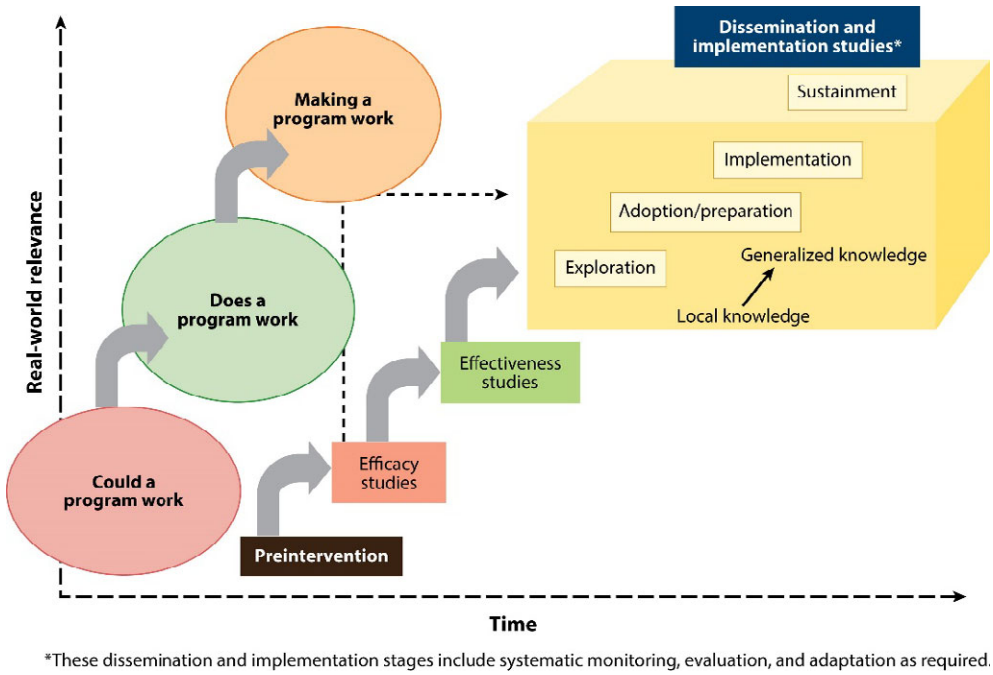

Figure 1. The standard research pipeline for implementation. Reprinted with permission from Annual Reviews of Public Health.[19]

works under controlled, but more routine, real-world conditions) to effective implementation and sustained application in practice.[18] Whereas efficacy and effectiveness studies focus on *whether* an intervention works, implementation science is concerned with *how and why* interventions work or fail to work in real-world settings.

Implementation science can also be distinguished from quality improvement, in that its focus is broader (implementation rather than improvement) and its explicit goal is to create generalizable knowledge.[20] Quality improvement efforts typically focus on solving health care delivery problems in specific contexts (e.g., a clinic or hospital), whereas implementation science seeks to develop generalizable knowledge that can be applied and replicated beyond the individual contexts/systems under study.[18] As such, implementation science is concerned with the overall implementation and delivery of interventions, with specific implementation-related challenges and gaps being naturally identified as a result of facilitating the implementation process.[18] Quality improvement emphasizes rapid-cycle testing in the field in an effort to improve performance and spread for a specific change effort within a specific organization.[21] Methods used in the two fields often overlap (e.g., use of improvement cycles), due in part to being rooted in similar approaches (e.g., lean manufacturing) and principles (e.g., importance of multidisciplinary teams, commitment to feedback).

Finally, dissemination research focuses specifically on the spread and sustainability of knowledge about an intervention. Dissemination science is the scientific application and study of targeted distribution of information and evidence to a specific public health or clinical practice audience using planned strategies.[22, 23] Implementation and dissemination science are closely related fields, and successful implementation often calls on the knowledge and strategies developed by dissemination scientists.

Why Is Implementation Science Important?

Evidence shows that implementation science can have a significant impact on both accelerating the pace of health care change and increasing the potential impact of health services. Unlike natural diffusion ("let it happen") and dissemination ("help it happen") that result in only 14% use of evidence-based interventions after 17–20 years,[13] active implementation can accelerate this process to 80% use after 3 years.[24–26] Previous research also demonstrated that well-implemented interventions and services yield significantly better outcomes than

those that have been poorly implemented.[27] It is not evidence-based interventions, but rather *well-implemented* evidence-based interventions, that are effective. Unfortunately, health care practices are often suboptimally implemented,[27] which is understandable because the process of implementation is complex, takes time, and is not without challenges. For example, previous research identified at least eight different components of implementation,[27] more than 20 multilevel factors that influence the level of implementation,[28] 14 steps or activities necessary to increase implementation effectiveness,[17] at least 8 different implementation outcomes,[29] and 73 implementation strategies.[30]

In addition, by seeking to understand successful field-based implementations, implementation science plays a crucial role in generating learnings, processes, and tools needed for replication, sustainability, and scaling of these interventions. For instance, to be effectively replicated and scaled, an intervention needs to first have been sufficiently defined to be usable by a diversity of providers. The contextual factors that can be leveraged to facilitate its implementation need to be understood. Measures designed to monitor implementation success should have been created or tailored to that intervention. Suitable implementation strategies to support quality delivery should have been identified. Without these foundational elements and processes, it would be difficult to replicate success across providers, patient populations, and settings; sustain these interventions beyond the initial implementation efforts; and scale up and out to foster the greatest impact on patients and health care systems.

How Has Implementation Science Evolved Over Time?

Interest in implementation initially arose from the need to address intervention and policy failures in health and other human services. The general lack of intended impact was noted in evaluations of national initiatives (e.g., President Kennedy's New Frontier), public policies, and human service efforts conducted in the 1960s and 1970s.[1, 31, 32] These concerns fueled the evidence-based interventions movement that focused on developing "effective" interventions. However, it soon became clear that traditional research paradigms, such as efficacy and effectiveness trials, were not sufficient to ensure success once the intervention was implemented in real-world settings. Growing emphasis on accountability and continued calls for better understanding service delivery processes to improve outcomes led to the emergence of implementation science.

Although implementation science as a field is relatively recent, the understanding that quality execution is key to success is not a new idea. Research and practice in many sectors, including business, education, mental health, public health, and health care, have led to important insights that were foundational to implementation science and contributed to its continued evolution through separate streams of activity.[33] For instance, approaches and fields, such as lean manufacturing, have had an influence on implementation science thinking and principles. That being said, this section focuses more specifically on the evolution of implementation science in health.

Within health care organizations, systems and individual clinicians have been implementing and de-implementing policies, programs, and practices since the inception of formalized health care delivery. Before the existence of valid scientific methods to guide and evaluate health care services, trial and error was often the only way to approach implementation. Early efforts in the 1970s and 1980s focused on investigating strategies designed to change physician behavior. This research was largely fueled by concerns over resource utilization and costs.[33] As it became clear that conventional strategies (e.g., education, information dissemination) were largely ineffective, research shifted to studying more active strategies, such as social influence. Simultaneously, the lack of agreement regarding best practices in patient care fueled the introduction of evidence-based medicine (EBM), a precedent discipline to implementation science defined as the conscientious, explicit, and judicious use of current best evidence in making decisions about individual patients.[34, 35] EBM was essential yet proved insufficient.

Concurrent with these shifts was the growing interest in the role of organizational structures and processes in the 1980s and 1990s. The flourishing of implementation science frameworks in the early 2000s, developed mostly outside of the health care field, stimulated efforts to align implementation research in health with existing theories and frameworks. More recently, seminal work has focused on defining implementation strategies,[30, 36] operationalizing

implementation outcomes,[29, 37] and outlining methodological approaches that are most appropriate for conducting implementation research.[19, 38, 39] The maturation of implementation science has led to an expansion of the field to also include dissemination (now dissemination and implementation, or D&I), a tremendous growth in national conferences, and additional funding opportunities for research.[40] In addition, *Implementation Science*, a peer-reviewed journal launched in 2006, provided the first scientific venue exclusively devoted to implementation science research in health. Finally, certificate programs, postdoctoral fellowship programs, federal training programs, and programs granting graduate degrees in implementation science have gradually emerged, offering a path forward for those interested in gaining additional training and experience.

What Do I Need to Know about Implementation Science to Be Able to Apply It Effectively?

Navigating and applying implementation science, whether to facilitate delivery of an intervention (implementation practice) or investigate the most effective approaches to implementation (implementation research), requires understanding of its main concepts and their interrelationships. Figure 2 provides a high-level overview of the decision-making process that could be used when planning an implementation science project based on the field's main concepts. Briefly, selection of an implementation science framework depends on the needs and purpose of the project. The framework, alongside the implementation stage of the intervention, will then guide subsequent implementation practice and research decisions, both of which are interdependent. Each of these considerations are described next in more detail.

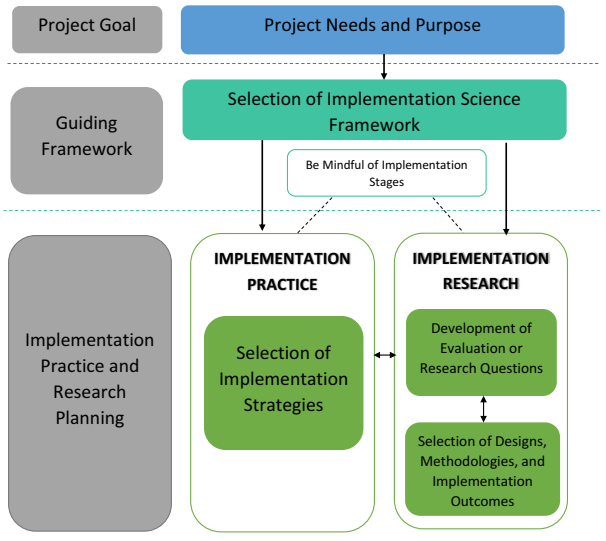

Figure 2. Overview process to guide decisions for implementation science practice and research.

About Implementation Frameworks

Over the past decade, over 30 implementation frameworks have emerged.[16, 41] This number is even larger with inclusion of dissemination frameworks. Implementation frameworks are integral to the implementation science field and are used to describe and/or guide the implementation process; identify and explain factors influencing the implementation process; and evaluate implementation.[42] Selection of a particular framework should be guided by the fit between the type of framework (e.g., is it a process model that specifies particular steps and activities? Is it a determinant framework that identifies barriers and facilitators of implementation? Is it an evaluation framework that allows one to assess implementation success?) and the stakeholder's underlying needs (e.g., To guide a research study? To facilitate implementation practice? To evaluate implementation?). An excellent classification of the various implementation frameworks, models, and theories is available elsewhere.[42] Examples of some of the more commonly used frameworks are the Consolidated Framework for Implementation Research (CFIR),[43] the Active Implementation Frameworks (AIFs),[44] and the RE-AIM evaluation framework,[45] each of which is briefly described here.

The CIFR[43] is a determinant framework that identifies five domains of influences on implementation, each of which includes multiple constructs: Intervention, Inner Setting, Outer Setting, Individuals, and the Implementation Process. The constructs within each domain provide guidance on factors to identify and measure as potential implementation facilitators or barriers. For example, the Inner and Outer Setting domains refer to the structural functioning of the organization and its interactions with other organizations and systems. CFIR has been widely used in health services research, and most recently in pharmacy practice. Use of this framework has facilitated understanding of the implementation success/failures related to interventions, such as medication synchronization, immunizations, point-of-care testing, and

hypertension management in community pharmacy settings.[46–48]

The AIFs provide a conceptual and practical road map for implementers.[44] The AIFs arose from a synthesis of implementation articles across a variety of disciplines.[2] The AIFs outline the mechanisms and strategies needed to put into practice any innovation of known dimension. The AIFs consists of five core frameworks: a Usable Innovation (ensures that an intervention is "usable", that is, teachable, learnable, doable, and readily assessable); Implementation Stages (describes four stages of implementation, i.e., exploration, installation, initial implementation, and full implementation); Implementation Drivers (outlines the core components that create the environmental conditions and infrastructure necessary for the intervention to be implemented as intended); Implementation Teams (emphasizes the importance of having organized teams, composed of members with diverse expertise who are committed to the implementation effort); and Improvement Cycles (designed to help teams detect and continuously improve implementation efforts). The AIFs rely on a "formula for success" that suggests positive outcomes result from multiplying the effects of three elements: an effective innovation ("what" will be done), effective implementation ("how" it will be done and "who" will do it), and enabling contexts ("when" and "where" it will thrive). The AIFs have been used by many disciplines including maternal and child health, child welfare, early childhood programs, and education. This framework is also being used in a large study to guide efforts to advance the successful implementation of comprehensive medication management in primary care medical practice.[49] The AIFs are designed to operationalize the practices of implementation in real-world settings, whereas CIFR classifies implementation facilitators and barriers to guide research.

The RE-AIM framework,[45] more aptly characterized as an evaluation rather than an implementation science framework, was originally developed for consistent reporting of research results and later used to organize existing literature on health promotion and disease management.[50] Since its conception, RE-AIM has been primarily used to guide evaluation of implementation efforts through the five outcome domains outlined in the framework: Reach (the extent to which the intended or target population of the implementation effort is impacted); Effectiveness (the impact of the intervention on important [usually patient-level] outcomes); Adoption (the extent to which an intervention is being initiated); Implementation (the quality of delivery of the intervention as intended, often referred to as implementation "fidelity"); and Maintenance (the extent to which the intervention becomes institutionalized over time).

Although each framework has unique goals and strengths, they share common assumptions. First, they recognize the critical importance of context and multi-level influences on implementation. As noted above, implementation is a complex process. Second, the needs and perspectives of all stakeholders should be considered and taken into account. For implementation to be successful, buy-in and commitment at multiple levels both within and outside of the implementing organization is needed. Third, use of active implementation design and facilitation should be emphasized. As mentioned above, simply "letting implementation happen" has not yielded positive outcomes. And finally, there is consensus that implementation unfolds in stages. These stages often include pre-implementation (sometimes divided into exploration and preparation), implementation (sometimes divided into early and full implementation), and post-implementation (expansion, sustainability, and scaling). While stages are dynamic, they each are associated with specific *implementation practice and research* activities.

When determining which framework to use to guide implementation practice or research, careful consideration should be given to the purpose and overarching goals of the implementation effort and the intended purpose of the framework. The selected framework, and understanding of the implementation stages that the intervention will span, will in turn influence the range of implementation practice and research activities. It is likely that more than one framework exists to meet a stated need.[37]

About Implementation Practice

Quality implementation requires use of practical activities and strategies designed to actively facilitate uptake of the selected intervention or service. When faced with implementing an intervention, health care professionals should engage in these activities to ensure that the intervention is delivered as intended. These activities and strategies operationalize the process of *implementation*. *Implementation* is defined as "a specified set of activities designed to put into practice an

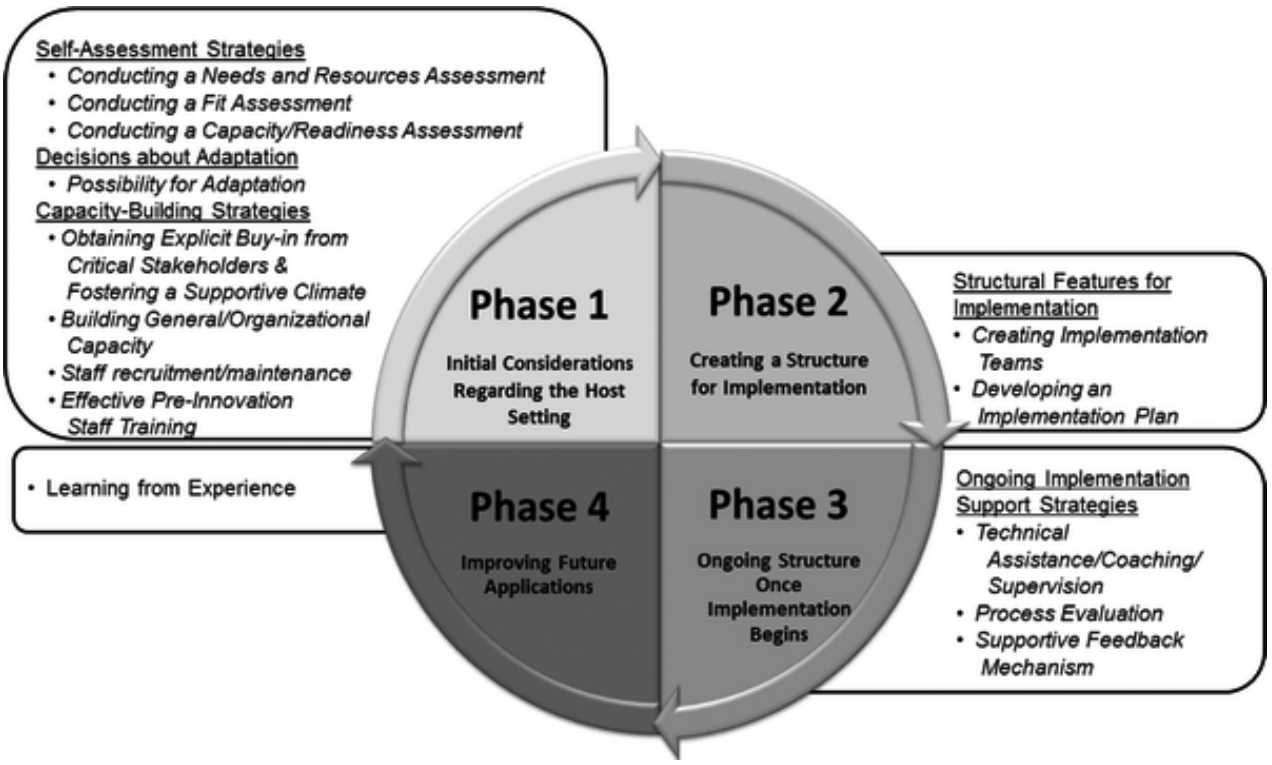

Figure 3. The Quality Implementation Framework: critical and practical steps in the implementation process. Reprinted with permission from Springer Publishing.[41]

activity or program of known dimensions."[2] In other words, implementation refers to how a service or intervention is operationalized for routine and systematic use in a real-world setting.[44] As such, it is foundational to the practice of implementation. Implementation exists along a continuum and should be conceived as an ongoing process, from exploration to full implementation.[13, 27] In its simplest form, successful implementation requires an innovation supported by evidence and usable in practice, a context that is receptive to change, and use of active implementation strategies to facilitate and support use.[44]

Although implementation practice should be tailored to the needs of each setting, there are common activities that span a wide range of frameworks and are used by implementation practitioners. Based on a review of 25 frequently used implementation frameworks, Meyers and colleagues[17] created a useful road map for implementation practice, the Quality Implementation Framework (QIF). The QIF outlines 14 key steps for the implementation process across four temporal stages (Figure 3). Another example is the Implementation Change Model, a process model that outlines a recommended order of steps for systematically introducing a novel evidence-based intervention into routine practice.[36] Both of these examples of process models distill essential elements of the practice of implementation into a sequential set of actions for consideration by implementers.

These steps can be completed through use of implementation strategies. Implementation strategies constitute the how-to of changing health care practice.[51] They are defined as the methods or techniques by which adoption, implementation, and sustainability of an intervention are enhanced.[45] These strategies range in complexity from discrete single-component approaches (e.g., training) to multifaceted interventions (e.g., training with follow-on coaching). Examples of implementation strategies include identifying early adopters at a local site to learn from their experiences with the practice innovation; having leadership declare the innovation as a priority; developing and supporting teams of clinicians who are implementing the innovation and give them protected time to reflect on the implementation effort, share lessons learned, and support one another's learning; and monitoring progress and adjusting clinical practices and implementation strategies to continuously improve the quality of care. A list of the 73 strategies used in implementation science is

available elsewhere.[30] Although selecting appropriate implementation strategies can be a complex task, it should be guided by a comprehensive implementation road map and understanding of implementation stages.[37, 41, 42]

About Implementation Research

Implementation research focuses on understanding how and why interventions work or fail to work in real-world settings, with the goal of producing generalizable knowledge.[20] A key factor contributing to the creation of generalizable knowledge is the use of rigorous research designs and standard indicators of implementation progress and success.

Implementation Research Designs

Although there are no discipline-specific research methods, some research designs are particularly useful to the implementation researcher. Commonly used designs include but are not limited to randomized designs, such as the innovative stepped wedge[52] and SMART (adaptive) designs[53]; nonrandomized designs, such as the controlled before-and-after studies, time series, and observational studies; and the increasingly popular hybrid designs that combine elements of implementation and clinical effectiveness research. Selection of a particular design is guided by the research question of interest. We provide some insights here into the emergence of hybrid designs; detailed accounts of these and other designs commonly used in implementation research are available elsewhere.[19, 40, 54]

Hybrid effectiveness-implementation designs take a dual focus a priori in assessing clinical effectiveness and implementation concurrently.[38] There are three types of hybrid designs. Hybrid type 1 designs test effects of a clinical intervention, usually randomized at the patient level, on relevant outcomes while observing and gathering information on implementation. The observational component is usually a descriptive process evaluation of implementation delivery conducted during the clinical effectiveness trial to collect valuable information on "implementability" in preparation for subsequent implementation research trials. Hybrid type 2 designs deploy dual testing of clinical and implementation interventions. In this case, interventions in both the clinical and implementation spheres are tested simultaneously. Both the interventions in question do not need to be tested with randomized fully powered designs. In fact, the most commonly used hybrid type 2 design is one in which a randomized controlled trial at the patient level is nested within a nonrandomized pilot study of an implementation strategy.[38] Hybrid type 3 designs test one or more implementation strategies while observing and gathering information on the impact of the clinical intervention on relevant outcomes. This design can be useful in a situation when a prevailing health policy dictates or encourages implementation of a clinical intervention that is, to varying degrees, still in question from an effectiveness perspective. Further, this design is useful when the goal of the study is to determine how fidelity of implementation to the clinical practice or treatment is related to clinical effectiveness outcomes.

In the pharmacy practice implementation science literature, controlled implementation trials are uncommon but on the rise.[55, 56] There are far more quasi-experimental and purely descriptive observational studies of implementation. The accumulation of studies using these "less rigorous" designs generate learnings and tools that are foundational for replication and scaling of interventions. They also lay the groundwork for future more controlled research.[57]

Implementation Outcomes

Monitoring and evaluating implementation success (in addition to the more traditional evaluations of clinical effectiveness) is important for three reasons. First, ensuring that the service is implemented well will increase the likelihood of achieving the intended patient, clinical, and economic outcomes. Second, it facilitates the identification of implementation strategies that successfully move evidence-based interventions into clinical settings. Finally, should an intervention not reach the desired clinical and economic outcomes, it allows stakeholders to determine the reason for failure (is this failure due to the intervention itself being ineffective or to poor implementation?).

Measuring implementation progress and success involves examination of implementation outcomes. Implementation outcomes are defined as "the effects of deliberate and purposive action to implement new treatments, practices, and services."[29] As such, they have three important functions: they are indicators of implementation success (i.e., was the implementation successful?); they can serve as proximal indicators of

implementation processes (i.e., how is the implementation progressing?); and they are necessary precursors to achieving the traditional effectiveness outcomes (e.g., quality, utilization, cost) associated with the intervention.

Proctor and colleagues[29] outlined eight core implementation outcomes: acceptability, appropriateness, adoption, feasibility, fidelity, implementation cost, penetration, and sustainability. Table 2 defines these implementation outcomes. Selection of appropriate implementation outcomes depends on the research questions of interest, the implementation stage, and relevance to the stakeholders involved with the implementation process. These outcomes can be assessed using surveys, interviews, focus groups, documentation, or administrative data, at the individual, team, or organizational level. Although validated implementation outcomes surveys and measures exist,[58] they usually must be tailored to the specific intervention and implementation context. Early efforts to create, adapt, and validate implementation outcome measures for pharmacy practice include published work[59] and work in progress by three of the authors of this article.

Table 2. Implementation Outcomes to Evaluate Success[a]

Outcome	Definition
Acceptability	The perception among implementation stakeholders that a given innovation is agreeable, palatable, or satisfactory.
Adoption	The intention, initial decision, or action to try or use an innovation.
Appropriateness	The perceived fit, relevance, or compatibility of the innovation for a given practice setting, provider, or consumer, and/or perceived fit of the innovation to address a particular issue or problem.
Cost	The cost impact (incremental or implementation cost) of an implementation effort.
Feasibility	The extent to which an innovation, can be successfully used or carried out within a given setting.
Fidelity	The degree to which an intervention was implemented as it was prescribed in the original protocol or as it was intended by the program developers.
Penetration	The integration of an innovation within a service setting and its subsystems. For example, the number of eligible persons who use a service divided by the total number of persons eligible for the service.
Sustainability	The extent to which a newly implemented treatment is maintained or institutionalized within a service setting's ongoing stable operations.

[a]Core implementation outcomes from reference 29.

Regardless of whether one's interest is rigorously evaluating, studying, and generating knowledge to advance effective implementation or more practically capitalizing on implementation science learnings to facilitate or enhance the likelihood of successful adoption and implementation of an innovation, implementation research has yielded useful insights into the implementation process.

Implementation Science Applied to Pharmacy: Current Insights and Future Directions

Table 3 lists recommended foundational readings in implementation science. In addition, the May–June 2017 issue of *Research in Social and Administrative Pharmacy* (RSAP) provides a collection of articles and resources on applications of implementation science to advance pharmacy practice. We encourage readers to peruse this themed issue of RSAP to gain an appreciation for the work ongoing across the profession. As an example, the Comprehensive Medication Management (CMM) in Primary Care Study funded by the American College of Clinical Pharmacy[60] uses principles of implementation practice and research to improve use of CMM in primary care practices with embedded pharmacists. This study seeks to define, implement with fidelity, and evaluate CMM, to begin building the business case for scaling and sustaining this service. As detailed in the RSAP article, the project team used and operationalized the AIFs to guide the implementation and improvement of CMM in primary care medical practices to optimize medication use and improve care for patients.[42] This article specifically illustrates the application of an implementation science framework to pharmacy practice. In addition, through this study, the project team has been able to develop and tailor numerous implementation science instruments, processes, and tools that will be foundational for replication, sustainability, and scaling of CMM. Examples of these outputs include: the development and validation of a multifaceted fidelity assessment tool for use throughout the profession; the operationalization of implementation outcomes for pharmacy practice medication optimization interventions; the creation of a document that defines and operationalizes the CMM patient care process; and exploration of strategies to monitor implementation progress and successes such as use of

Table 3. Key Recommended Resources

Topic	Resource
Overview of implementation science	Durlak JA, DuPre EP. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol 2008;41 (3–4):327–50.
	Ogden T, Fixsen DL. Implementation science. A brief overview and a look ahead. Z Psychol 2014;222(1):4–11.
	Mittman B. Implementation science in healthcare. In: Brownson R, Colditz G, Proctor E, eds. Dissemination and implementation research in health: translating science to practice. New York, NY: Oxford University Press; 2012:400–18.
Implementation practice	Fixsen DL, Blase KA, Metz A, Van Dyke, M. Implementation science. In: Wright, J. ed. International encyclopedia of social and behavioral sciences, 2nd ed. New York, NY: Oxford University Press; 2015:695–702.
	Meyers DC, Durlak JA, Wandersman A. The Quality Implementation Framework: a synthesis of critical steps in the implementation process. Am J Community Psychol 2012;50 (3–4):462–80.
	Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. Implement Sci 2013;8(1):139.
Implementation frameworks	Nilsen P. Making sense of implementation theories, models and frameworks. Implement Sci 2015; 10(1):53.
Implementation research	Brown CH, Curran G, Palinkas LA, et al. An overview of research and evaluation designs for dissemination and implementation. Annu Rev Public Health 2017;38(1):1–22.
	Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. Medical Care 2012; 50(3):217–26.
	Proctor E, Silmere H, Raghavan R, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Heal Ment Heal Serv Res 2011;38(2):65–76.

improvement cycles. All of these resources have applications to both implementation practice efforts as well as implementation research.

Numerous opportunities to implement or improve implementation of evidence-based interventions or services exist or are emerging across the profession. Most of these efforts would benefit from the application of implementation science to not only help ensure quality implementation, thereby increasing the potential impact of an intervention, but importantly advance the adoption, replication, sustainability, and scaling of that intervention. Examples of efforts that could make use of the science of implementation can be found in virtually all facets of the practice of pharmacy, and include: the adoption and implementation of pharmacogenomic testing to enable precision dosing; antimicrobial stewardship programs to minimize antimicrobial resistance; data analytics to drive patient-centered quality care; wearable technologies to improve adherence and clinical outcomes; evidence-based clinical protocols and practice guidelines to close clinical care gaps and improve care; and new care delivery models, such as care transition programs.

Conclusion and a Call to Action

Health care delivery systems are increasingly called on to adopt evidence-based interventions that improve quality, control costs, and maximize value. This creates a tremendous opportunity to accelerate the implementation of clinical pharmacy services, interventions, and programs aimed at optimizing medication use to improve patient care. Efforts to ensure the adoption, scale, and sustainability of such services will require change including the de-implementation of ineffective and inefficient programs and services as well as a commitment to implement evidence-based innovations more thoughtfully and systematically.

The results of efficacy and effectiveness trials alone do not lead to widespread adoption or quality implementation of evidence-based practices. Likewise, systems and people do not change by themselves. Interventions of known benefit require focused efforts on implementation and evaluation of those implementation efforts to produce effective and lasting changes in complex health care systems.[61] Although the practice of pharmacy would benefit from rigorous research focused on the implementation and effectiveness of well-implemented evidence-based interventions and services, it should also make more widespread use of frameworks and strategies designed to facilitate successful applied

implementation efforts. By providing a comprehensive set of frameworks, strategies, methods, outcomes, and insights by which to optimize medication use, implementation science represents a critical path for accelerating practice transformation to improve health care delivery and, ultimately, patient care.

References

1. **Green LW, Ottoson JM, García C, Hiatt RA.** Diffusion theory and knowledge dissemination, utilization, and integration in public health. Annu Rev Public Health 2009;30(1):151–74.
2. **Fixsen DL, Naoom SF, Blase KA, Friedman RM, Wallace F.** Implementation research: a synthesis of the literature. Components 2005;311712:1–119.
3. **Wolfe A.** Institute of medicine report: crossing the quality chasm: a new health care system for the 21st century. Policy Polit Nurs Pract 2001;2(3):233–5.
4. **The PEW Charitable Trusts.** A scientific roadmap for antibiotic discovery. *Report* 2016;May:1–47.
5. **Morgan SG, Hunt J, Rioux J, Proulx J, Weymann D, Tannenbaum C.** Frequency and cost of potentially inappropriate prescribing for older adults: a cross-sectional study. C Open 2016;4(2):E346–51.
6. **Zhi M, Ding EL, Theisen-Toupal J, Whelan J, Arnaout R.** The landscape of inappropriate laboratory testing: a 15-year meta-analysis. PLoS ONE 2013;8(11):e78962.
7. **National Center for Health Statistics.** Health, *United States, 2015: With Special Feature on Racial and Ethnic Health Disparities*. Hyattsville, MD; 2016. doi: 76-641496.
8. **Ferrell B, McCabe MS, Levit L.** The Institute of Medicine report on high-quality cancer care: implications for oncology nursing. Oncol Nurs Forum 2013;40(6):603–9.
9. **Bray BD, Cloud GC, James MA, et al.** Weekly variation in health-care quality by day and time of admission: a nationwide, registry-based, prospective cohort study of acute stroke care. Lancet 2016;388(10040):170–7.
10. **Friedberg MW, Chen PG, Van Busum KR, et al.** Factors affecting physician professional satisfaction and their implications for patient care, health systems, and health policy. Rand Health Q 2013;3:1.
11. **Colditz GA.** The promise and challenges of dissemination and implementation research. In: Brownson RC, Colditz GA, Proctor EK, eds. Dissemination and implementation research in health: translating science to practice. Oxford, UK: Oxford University Press, 2012:3–22.
12. **Eccles MP, Mittman BS.** Welcome to implementation science. Implement Sci 2006;1(1):1.
13. **Ogden T, Fixsen DL.** Implementation science. A brief overview and a look ahead. Z Psychol 2014;222(1):4–11.
14. **National Implementation Research Network.** Implementation Science Defined, 2015. Available from http://nirn.fpg.unc.edu/learn-implementation/implementation-science-defined. Accessed November 21, 2017.
15. **Wensing M.** Implementation science in healthcare: introduction and perspective. Z Evid Fortbild Qual Gesundhwes 2015;109(2):97–102.
16. **Tabak RG, Khoong EC, Chambers DA, Brownson RC.** Bridging research and practice: models for dissemination and implementation research. Am J Prev Med 2012;43(3):337–50.
17. **Meyers DC, Katz J, Chien V, Wandersman A, Scaccia JP, Wright A.** Practical implementation science: developing and piloting the quality implementation tool. Am J Community Psychol 2012;50(3–4):481–96.
18. **Bauer MS, Damschroder L, Hagedorn H, Smith J, Kilbourne AM.** An introduction to implementation science for the non-specialist. BMC Psychol 2015;3(1):32.
19. **Brown CH, Curran G, Palinkas LA, et al.** An overview of research and evaluation designs for dissemination and implementation. Annu Rev Public Health 2017;38(1):1–22.
20. **Lynn J, Baily MA, Bottrell M, et al.** The ethics of using quality improvement methods in health care. Ann Intern Med 2007;146(9):666–73.
21. **Institute for Healthcare Improvement (IHI).** Science of improvement. Available from http://www.ihi.org/about/Pages/ScienceofImprovement.aspx. Accessed July 21, 2017.
22. **McCormack L, Sheridan S, Lewis M, et al.** Communication and dissemination strategies to facilitate the use of health-related evidence. Evid Rep Technol Assess 2013;213:1–520.
23. **Macoubrie J, Harrison C.** The value-added research dissemination framework. OPRE Report # 2013-10. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services; 2013.
24. **Fixsen DL, Blase KA, Timbers GD, Wolf MM.** In search of program implementation: 792 replications of the teaching-family model. Behav Anal Today 2007;8(1):96–110.
25. **Balas EA, Boren SA.** Managing clinical knowledge for health care improvement. In: Bemmel, J, McCray, A, eds. *Yearbook of medical informatics 2000: patient-centered systems*. Stuttgart, Germany: Schattauer; 2000:65-70.
26. **Green LA, Seifert CM.** Translation of research into practice: why we can't "just do it." J Am Board Fam Pr 2005;18(6):541–5.
27. **Durlak JA.** What everyone should know about implementation. In: Durlak JA, Domitrovich CE, Weissberg RP, Gullotta TP, eds. Handbook of social and emotional learning: research and practice. New York, NY: The Guilford Press, 2015:395–405.
28. **Durlak JA, DuPre EP.** Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. Am J Community Psychol 2008;41(3–4):327–50.
29. **Proctor E, Silmere H, Raghavan R, et al.** Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Heal Ment Heal Serv Res 2011;38(2):65–76.
30. **Powell BJ, Waltz TJ, Chinman MJ, et al.** A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. Implement Sci 2015;10(1):21.
31. **Rittel HWJ, Webber MM.** Dilemmas in a general theory of planning. Policy Sci 1973;4(2):155–69.
32. **Van Meter D, Van Horn C.** The policy implementation process: a conceptual framework. Adm Soc 1975;6(4):445–88.
33. **Mittman B, Salem-Schatz S.** Improving research and evaluation around continuous quality improvement in health care, 2012. Available from https://www.rwjf.org/en/library/research/2012/11/improving-research-and-evaluation-around-continuous-quality-impr.html. Accessed November 1, 2017.
34. **Cochrane AL.** Effectiveness and efficiency: random reflections on health services. London, UK: Nuffield Provincial Hospitals Trust, 1971:138.
35. **Sackett DL, Rosenberg WMC, Gray JM, Haynes RB, Richardson WS.** Evidence based medicine: what it is and what it isn't. Br Med J 1996;312(7023):71–2.
36. **Grol R, Wensing M.** Effective implementation of change in healthcare: a systematic approach. Improv Patient Care Implement Chang Heal Care 2013;29(8):2205–14.
37. **Gaglio B, Glasgow R.** Evaluation approaches for dissemination and implementation research. In: Brownson R, Colditz G, Proctor E, eds. Dissemination and implementation research in health: translating science into practice. New York, NY: Oxford University Press, 2012.
38. **Curran GM, Bauer M, Mittman B, Pyne JM, Stetler C.** Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. Med Care 2012;50(3):217–26.
39. **Palinkas LA, Aarons GA, Horwitz S, Chamberlain P, Hurlburt M, Landsverk J.** Mixed method designs in implementation

research. Adm Policy Ment Heal Ment Heal Serv Res 2011;38 (1):44–53.
40. **Brownson R, Colditz G, Proctor E**, eds. *Dissemination and implementation research in health: translating science to practice*, 1st ed. New York, NY: Oxford University Press, 2012.
41. **Meyers DC, Durlak JA, Wandersman A.** The Quality Implementation Framework: a synthesis of critical steps in the implementation process. Am J Community Psychol 2012;50 (3–4):462–80.
42. **Nilsen P.** Making sense of implementation theories, models and frameworks. Implement Sci 2015;10(1):53.
43. **Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC.** Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci 2009;4 (1):50.
44. **Fixsen D, Blase K, Metz A, Van Dyke M.** Implementation science. In: Wright J, ed. *International encyclopedia of the social and behavioral sciences*, 2nd ed. Oxford: Elsevier, Ltd., 2015:11:695–702.
45. **Glasgow R, Vogt T, Boles S.** Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health 1999;89(9):1322–7.
46. **Robins LS, Jackson JE, Green BB, Korngiebel D, Force RW, Baldwin LM.** Barriers and facilitators to evidence-based blood pressure control in community practice. J Am Board Fam Med 2013;26(5):539–57.
47. **Shoemaker SJ, Curran GM, Swan H, Teeter B, Thomas J.** Application of the consolidated framework for implementation research to community pharmacy: a framework for implementation research on pharmacy services. Res Soc Adm Pharm 2017;13(5):905–13.
48. **Patterson J, Holdford D.** Understanding the dissemination of appointment-based synchronization models using the CFIR framework. Res Social Adm Pharm 2017;13:914–21.
49. **Blanchard C, Livet M, Ward C, Sorge L, Sorensen TD, McClurg MR.** The active implementation frameworks: a roadmap for advancing implementation of comprehensive medication management in primary care. Res Social Adm Pharm 2017;13:922–9.
50. **RE-AIM.** Re-aim planning tool. Re-AimOrg. 2010;10:1–5. Available from http://www.re-aim.org/resources_and_tools/measures/planningtool.pdf%5Cnpapers3://publication/uuid/2E492B97-F943-463F-87CD-7BEC717B6095.
51. **Proctor EK, Powell BJ, McMillen JC.** Implementation strategies: recommendations for specifying and reporting. Implement Sci 2013;8(1):139.
52. **Krass I.** Quasi experimental designs in pharmacist intervention research. Int J Clin Pharm 2016;38(3):647–54.
53. **Kilbourne AM, Almirall D, Eisenberg D, et al.** Protocol: Adaptive Implementation of Effective Programs Trial (ADEPT): cluster randomized SMART trial comparing a standard versus enhanced implementation strategy to improve outcomes of a mood disorders program. Implement Sci 2014;9(1):132.
54. Grol R, Wensing M, Eccles M, Davis D, eds. Improving patient care: the implementation of change in health care, 2nd ed. West Sussex, UK: Wiley Blackwell, 2013.
55. **Watkins K, Wood H, Schneider CR, Clifford R.** Effectiveness of implementation strategies for clinical guidelines to community pharmacy: a systematic review. Implement Sci 2015;10 (1):151.
56. **Bacci JL, Coley KC, McGrath K, Abraham O, Adams AJ, McGivney MS.** Strategies to facilitate the implementation of collaborative practice agreements in chain community pharmacies. J Am Pharm Assoc 2016;56:257–65.e2.
57. **Stafford R, Thomas J, Payakachat N, et al.** Using an array of implementation strategies to improve success rates of pharmacist-initiated medication therapy management services in community pharmacies. Res Soc Adm Pharm 2017;13(5): 938–46.
58. **Lewis CC, Fischer S, Weiner BJ, Stanick C, Kim M, Martinez RG.** Outcomes for implementation science: an enhanced systematic review of instruments using evidence-based rating criteria. Implement Sci 2015;10(1):155.
59. **Moullin JC, Sabater-Hernández D, Fernandez-Llimos F, Benrimoj SI.** A systematic review of implementation frameworks of innovations in healthcare and resulting generic implementation framework. Heal Res Policy Syst 2015;13(1):16.
60. **American College of Clinical Pharmacy.** ACCP Report (September). 2017. Available from https://www.accp.com/docs/report/0917.pdf. Accessed November 3, 2017.
61. **Plsek P.** Redesigning health care with insights from the science of complex adaptive systems. In: *Crossing the Quality Chasm*. Washington, DC: The National Academies Press; 2001: Appendix B. https://doi.org/10.1300/j022v19n03_03.