

*From Research Training to Scientific
Advancement-Contributions from the
Implementation Research Institute: An
Introduction to the Special Issue*

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From Research Training to Scientific Advancement-Contributions from the Implementation Research Institute: An Introduction to the Special Issue

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Abstract

The special series is designed to provide examples of funded implementation research conducted by alumni of the first four cohorts of the Implementation Research Institute (IRI). The introduction links the six substantive papers to the conceptual and methodological challenges laid out in a 2009 publication in this journal which led to the IRI training program in the emerging science of implementation with a special focus on behavior health settings. The 7th paper in the series illustrates an innovative evaluative approach to design and measurement of IRI fellow publications and grants informed by the training program such as bibliometrics. The introduction also notes some elements identified in the 2009 foundational paper not represented in these papers such as costs as well as important developments and foci in the decade since 2009 such as de-implementation, sustainability, dynamic adaptation processes, and hybrid designs that need to be an integral part of training programs in implementation research.

Keywords Implementation science · Hybrid designs · Bibliometrics · De-implementation · Sustainability · Dynamic adaptation

Introduction to the Special Series

In 2009, this journal published an article we co-authored with colleagues, entitled “Implementation research in mental health services: an emerging science with conceptual, methodological, and training challenges,” (Proctor et al. 2009), in which we articulated the critical role of implementation science for quality of mental health care. The paper identified a set of key concepts that needed to be distinguished and measured in implementation science, presented a heuristic framework portraying relationships between those concepts, advocated for stakeholder engagement, and called for advances in research design to accommodate the inherently multilevel analysis required for this emerging field.

Asserting that “concerted efforts are required to advance implementation science and produce skilled implementation researchers” (page 24), we explicated foundational work that would guide a new training program, the Implementation Research Institute, or IRI. Through the award of a National Institute of Health (NIH) of a Research Education and Career Development Training Program R25 grant we launched training for early career investigators in the “emerging science” of implementation. A major goal of the NIH R25 mechanism is to develop competitive funding proposals that provide promise of advancing science in selected areas. A grant awarded in 2009 by the National Institute of Mental Health (NIMH) provided 5 years of funding to support four cohorts of IRI training fellows; the first cohort of fellows was selected in 2010.

This series offers examples of funded research conducted by alumni of the first four cohorts of the IRI to address the general challenges we laid out in 2009. Although outcomes of the IRI training program have been published since that time (Proctor et al. 2013), published reports have not reflected on the training experiences fellows perceived as particularly instrumental in the development, or further advancement, of funded research.

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Accordingly, the core faculty of the IRI extended an open call to IRI fellows to submit implementation science papers that grew out of or were explicitly informed by their IRI training experience. Each lead author is an IRI fellow from the first four cohorts; two co-authors were 2016 cohort fellows, as training continues under a NIMH second cycle of funding. Many of the co-authors were also IRI fellows. The request for papers asked the authors to describe the ways in which their IRI participation contributed to their successful research proposal. The original descriptions have been abridged and consolidated for the purposes of this introduction. The lead authors of the articles have reviewed and endorsed the characterization in this Introduction of their experiences in the IRI training as these related to the funded research projects upon which their article in this series was based. Next, we briefly describe the IRI approach to training. Then, we introduce the articles and the specific ways that each of them is linked to the challenges described in the 2009 paper and to aspects of the curriculum of the IRI training program designed to help address those challenges. To use a metaphor, our 2009 article is a “promissory note” for the training program that was built to address the challenges laid out. The papers in this series provide some concrete examples of how the promissory note has been fulfilled. We conclude the Introduction with reflections upon the evolution of implementation science over the past decade and implications thereof for training in implementation research.

Essential Elements of the IRI Training Program

The first NIH funded training program in implementation research, the IRI aims to (1) strengthen human capital in the field of implementation science to address the challenges of mental health care through the training of a new generation of implementation researchers, and (2) advance intellectual capital for the still-developing field through stimulating the production of scholarly products such as papers, books, and curriculum models (Proctor et al. 2013). Characterized as a learning collaborative of implementation researchers, IRI provides 2 years of training through experiential learning, didactic training, and faculty mentoring. Each fellow participates in 2 week-long summer institutes in sequential years at the Brown School of Social Work, Washington University in St. Louis. During these weeks, fellows receive training in selecting and applying conceptual frameworks, methods, and measures necessary to advance implementation science in mental health services; and, in crafting research proposals accordingly. Among activities designed to support the latter are written guidance (e.g., Proctor et al. 2012) and small group research proposal review and critique sessions. The training components and curriculum are described in further

detail elsewhere (Proctor et al. 2013). Travel support enables each fellow to complete a 1–2 day learning site visit to a federally funded implementation science research project, hosted by the experienced principal investigator who has granted access for the site visit.

In the first 5 years, the NIMH supported eight fellows per year; through grant supplements, the Veterans Health Administration Quality Enhancement Research Initiative (QUERI), the implementation science arm of the VA Health Services Research and Development service supported two fellows in each of the four cohorts and the National Institute on Drug Abuse provided supplementary funding to support two more slots for the 4th cohort.

The Papers in the Series: From Concepts and Methods to Promissory Note Payments

The papers in this special issue (1) reflect concepts and methods that map to specific curriculum elements in the IRI summer institute and (2) illustrate developments in the field of implementation science that have emerged in response to challenges raised in 2009. Moreover, the papers also reflect advances (such as hybrid designs and new measures) in the field beyond those foreseen in 2009. We now highlight these contributions.

The first paper in the series, “Characterizing shared and unique implementation influences in two community services systems for autism: Applying the EPIS framework to two large-scale autism intervention community effectiveness trials” (Brookman-Frazee et al. 2019) illustrates the use of a multi-level, four-phase conceptual framework (Exploration, Preparation, Implementation, Sustainment [EPIS]) developed explicitly for implementation science (Aarons et al. 2011) to guide the collection of data to better understand the influences on implementation of interventions in two large-scale effectiveness trials. The EPIS framework separates predictors of or influences on implementation processes into the outer and inner contexts of service delivery systems. The authors used this implementation framework to guide the collection of data beyond that collected in the originally funded studies. The Proctor et al. (2009) paper emphasized the need for conceptual models to guide implementation science, and especially emphasized the importance of considering multiple levels in understanding implementation processes and outcomes.

The influence of several aspects of IRI training is evidenced in several ways in this article by Brookman-Frazee and colleagues. Each week-long summer institute includes sessions on implementation science models. Throughout the week, small group critical reviews of research proposals are convened, and in this context, fellows are challenged to select frameworks best suited to their proposed

implementation research. In addition, methodologies for collecting implementation data are the foci of both didactic and small group proposal development and review experiences. For both projects described in this article, IRI training in implementation frameworks and methodologies to collect data pertinent to constructs in those frameworks strongly influenced methods of collecting implementation data in the context of the effectiveness trials (one each for Dr. Stahmer and Dr. Brookman-Frazee). Consequently, both of these IRI fellows' projects had sufficient preliminary data to facilitate understanding of multi-level factors influencing the effectiveness of EBP training in the community settings as reported in this series paper. These data were the basis for two linked trials testing multi-level implementation strategies in Autism Spectrum Disorders (ASD) services (Brookman-Frazee and Stahmer 2018).

Second, each IRI fellow uses the summer institute week to advance a particular project that is shaped by feedback from faculty and fellows. Dr. Brookman-Frazee (IRI cohort 2010–2011), the PI of the first trial described in the manuscript developed the AIM HI effectiveness study as her IRI project. Although Dr. Stahmer's (IRI cohort 2012–2013) trial had been funded prior to her joining IRI, she subsequently integrated implementation measures into the effectiveness trial based on her formal training in implementation methods during her IRI fellowship.

Third, the summer institute is designed to foster scientific networking among fellows and faculty using several methods of social network analysis as reported in Luke et al. (2016). The close collaboration forged between these two fellows resulted in a plan for prospective collection of the data presented here. They developed common interview questions, facilitated by an IRI core faculty member, to capture data on evidence-based practice adoption decisions and sustainment from stakeholders (leaders, providers) as well as prospective accounts of implementation processes from research team members as the purveyors of the interventions. This IRI-facilitated collaboration resulted in subsequent funding of linked R01s aimed to test a multi-level implementation approach for addressing ASD across two types of providers (therapists, teachers) and service settings (mental health, education) (Brookman-Frazee and Stahmer 2018).

The next two papers illustrate the strong emphasis of IRI on research methods, specifically design and measurement. The 2009 paper characterized the methodological challenges of implementation research as "formidable" and echoed an NIMH report, *Advancing the Science of Implementation* (Chambers 2008) in calling for advances in design and measurement. Accordingly, each summer institute features a dedicated "methods day." "Scaling implementation of collaborative care for depression: Adaptation of the Stages of Implementation Completion (SIC)" (Saldana et al. 2019) describes the adaptation of a previously developed

measurement method for use with a novel target population, condition, and service setting. Two IRI fellows, Lisa Saldana (cohort 2011–2012) and Ian Bennett (cohort 2012–2013) collaborated in the adaptation. The SIC was originally developed for a large scale multi-site child mental health implementation study to better understand the nature and sequencing of factors that impact whether an EBP actually gets implemented in real world service systems (Brown et al. 2014). This empirically-derived measurement tool is congruent with the four stage EPIS model deployed in the first paper in this issue, by Brookman-Frazee et al. (2019).

This article reflects the benefits of cross-cohort collaboration between IRI fellows who shared a goal of increasing the adoption of evidence-based practice (EBP) for common, and yet treatable, disorders. The project drew upon two distinct disciplines—mental health and primary care, and two distinct content areas—measurement and intervention delivery. Prior to their meeting through IRI, Saldana had begun to conduct research to expand the SIC to a broader range of EBPs; and, to develop the Cost of Implementing New Strategies (COINS: Saldana et al. 2014) with the support of IRI mentorship. Saldana's collaboration with Bennett resulted in his test of strategies for the implementation of collaborative care for depression. The site for Bennett's R01 is also an outgrowth of an IRI activity—the learning site visit each fellow makes to a federally funded implementation research project. Dr. Bennett visited Dr. Unutzer at the University of Washington for his IRI Learning Site visit, resulting in a pilot study whose outcomes provided preliminary data for this R01 study. A more dramatic result of the learning visit was Bennett's subsequent recruitment to the faculty of University of Washington, where he continues to work with Unutzer and conducts multi-site studies of the implementation of collaborative care for perinatal depression care.

The next article "The Connectedness of Mental Health Providers Referring Patients to a Treatment Study for Post-traumatic Stress: A Social Network Study" (Elwy et al. 2019) illustrates the influence of the 2009 article on the need for research focusing on "implementation strategy," as distinct from intervention strategy. The Elwy article advances this line of research and exemplifies three methodological elements beyond those identified in the 2009 paper: (1) mixed methods which refers to the use of both qualitative and quantitative data collection processes and is increasingly being employed in implementation science studies in order to better facilitate interpretation of quantitative evaluation findings in implementation research (Palinkas and Cooper 2018), (2) hybrid design (Type 1), which was introduced in a seminal 2012 article led by Curran (Curran et al. 2012) and refers to incorporation of both effectiveness and implementation aims in a single study and design, and (3) social network analysis which is one of the critical system science methodologies (including agent based modeling, and

system dynamic modeling) that are playing an increasingly important role in implementation research for the purpose of better understanding the complex, dynamic, and systemic structures and processes that drive implementation outcomes across organizations and communities (Luke et al. 2018).

Elwy's paper also illustrates the influence of IRI in social network analysis (SNA, Palinkas and Cooper 2018). Several IRI summer institutes have introduced fellows to SNA as an important methodology for implementation science, and the Core Faculty employ SNA to map and analyze collaboration among the IRI network of fellows and faculty, as described in a prior publication (Luke et al. 2016). In March of 2013, Dr. Elwy conducted a field-based site visit to the University of Southern California (USC), to meet with IRI expert faculty member and social network analysis expert Dr. Larry Palinkas, and his colleague, Dr. Tom Valente, a leading authority on social network interventions. As Dr. Elwy's IRI mentor, Dr. Brian Mittman joined the field-based meeting at USC to discuss how SNA could help capture the influence of provider networks on whether mental health patients were offered new clinical treatments during the course of their care and whether SNA could predict who in the network would be likely to refer to a randomized clinical trial of these treatments. Combining methods from anthropology and communication science, the team of Drs. Elwy, Mittman, Palinkas and Valente submitted a proposal to VA's Quality Enhancement Research Initiative (QUERI) to develop a social network implementation survey tool, to be used as a formative evaluation method to develop tailored, site-specific implementation strategies prior to any implementation.

The next two articles in this series share a common theme of the importance of understanding the role(s) of multiple stakeholders in the implementation process. As observed in 2009, "Because implementation research necessarily occurs in the 'real world' of community based settings of care, implementation research..must partner with community stakeholders" (page 31). Accordingly, one full day of each IRI summer institute addresses methods of building stakeholder partnerships.

"Research community collaboration in observational implementation research: Complementary Motivations and Concerns in the study of Implementation as Usual" (Lau et al. 2019) is co-authored by two IRI fellows-Lau and Brookman-Fraze, both from the 2010–2011 cohort but from different but nearby academic institutions-Los Angeles and San Diego- who first met at the IRI and developed the idea for a dual PI R01 at the IRI summer institutes. These fellows incubated the 4KEEPS study "Measuring the Sustainment of Multiple EBPs Fiscally-Mandated in Children's Mental Health Services", out of IRI discussions about LA County's recent system transformation involving a fiscal mandate for multiple EBP implementation.

The 4KEEPS study is designed to identify predictors of the sustainment of multiple EBPs implemented in a large system-driven reform of public children's mental health services (Lau and Brookman-Fraze 2016).

The contexts of system wide implementation typically include simultaneous implementation of multiple EBPs and involve stakeholders at multiple levels (e.g. system-leaders, third-party payers, agency-leaders, front-line providers, and EBP developers and purveyors). The network for this project came together based on a shared interest in system-driven implementation efforts and complementary areas of expertise in a large-scale mixed qualitative and quantitative study (e.g., implementation theory, design, measures). Senior IRI faculty (Landsverk, Aarons, Palinkas) and fellows (Hamilton, Wiltsey-Stirman, Dorsey) contributed methodological and substantive expertise as Co-Is and consultants and also provided instrumental support in terms of network introductions that permitted the initial formation of the research-community partnership that was subsequently maintained and extended through the activities described herein. Lastly, the implementation research theoretical framework, design and measures were also significantly shaped by the formal training experiences provided to investigators at IRI. The knowledge shared in the IRI helped the investigators to situate this naturalistic implementation effort within the appropriate theoretical framework and identified gaps in the research on sustainment of multiple EBPs.

In keeping with the community collaboration theme, a critical player in the study and series paper co-author Debbie Innes-Gomberg is Deputy Director for Adult Systems of Care, Mental Health Services Act Implementation and Outcomes Division, Program Support Bureau, in the Los Angeles County Department of Mental Health. Their article addresses the challenge of engaging stakeholders in observational studies of EBP Implementation-as-Usual, drawing upon the first 3 years of experiences of partnering to conducting the "4KEEPS" study.

Also addressing stakeholder engagement is, "Skills for developing and maintaining community-partnerships for dissemination and implementation research in children's behavioral health: Implications for research infrastructure and training of early career investigators" (Gopalan et al. 2019). This article was authored by three IRI alumni from separate IRI cohorts Gopalan (2012–2013), Bunker (2013–2014), and Powell (2016–2017 in IRI-2). Behavioral health organizations often struggle to implement treatment innovations successfully due to a variety of professional, organizational, system, and policy barriers. Strong community partnerships can yield substantial gains for both implementation science and practice, yet can be challenging to maintain, as exemplified in the two case studies reported in this paper. The authors detail their successes, challenges, and strategies for

developing and maintaining research partnerships in two case studies that involved community and agency settings.

In the first case study, IRI was helpful by providing access to a network of intellectual capital in implementation science as well as mentoring in the art of developing competitive proposals for NIH funding. The 2-year training period allowed for multiple reviews of initial and developing ideas, consultation with NIMH program officers, and mentorship from IRI faculty that helped to shape the R21 grant proposal. These activities anticipated potential areas of criticism and how to proactively address them. The network of mentors was helpful with finding solutions for problems occurring throughout the project, as well as normalizing the challenges and pitfalls with implementation research. Specifically, when authorization for this study was rejected in the first site, Gopalan received the suggestion to recruit from a different state while concurrently addressing concerns from the first site, and allowed the investigators to continue this project past Phase I. While preparing intervention modifications to re-submit to the first state's child welfare authority, contact was initiated with the second state's child welfare authority as a "Plan B." Thus, when ultimately refused authorization in the first state, Gopalan was able to begin Phase II in the second site shortly afterwards, thus limiting the risk of further project delays. Moreover, her dismay at the prospect of the project being derailed was alleviated somewhat when hearing from IRI mentors that such challenges were all too common in implementation research.

The next article, "Usual care among providers treating women veterans: Managing complexity and multimorbidity in the era of evidence-based practice" (Hamilton et al. 2019) reflects several themes presented in the 2009 article and IRI training. First it is based on an implementation study in the VA health care system and demonstrates a focus on provider stakeholder perspectives. The EMPOWER QUERI Center focuses on the development of a national 5-year implementation science program to improve women veterans' health and health care. The project was funded in 2015 with a total budget of \$4.15 million over 5 years. Dr. Hamilton tapped her network of IRI and other colleagues to strategize about how to craft the required elements and how to lead this ambitious undertaking. She engaged Wiltsey-Stirman (Cohort 2010–2011) and Finley (Cohort 2012–2013); Dr. Kirchner (IRI faculty), a prominent and seasoned VA QUERI leader, was critical in encouraging Dr. Hamilton to lead the initiative. Dr. Mittman (IRI faculty) and a highly-regarded QUERI leader, supported Dr. Hamilton throughout the 7-week development of the proposal, and now is a member of the Strategic Advisory Group.

This author team exemplifies the challenge to researchers to work across fields and disciplines we offered in the 2009 article, recognizing that "implementation research is necessarily multi-disciplinary and requires a convergence of

perspectives" (page 30). The lead author Hamilton, a cultural anthropologist and IRI fellow (Cohort 2010–2011) led the study with two additional IRI fellows, with an IRI core faculty member Mittman.

This article also exemplifies use of mixed methods, based on a 2011–12 qualitative study whose findings were then paired with a quantitative study of the fiscal year 2012 VA administrative data. The pairing of qualitative and quantitative data to address the mental health needs and conditions of women veterans receiving VA health care would now be characterized as a mixed-methods design which has become an increasingly important approach to implementation science research.

This special issue concludes with, "Evaluation of the Implementation Research Institute: Trainees Publication and Grant Productivity" Baumann et al. 2019) led by IRI research coordinator Dr. Ana Baumann, who developed the bibliographic approach to measuring productivity outcomes for the training program, and co-written by IRI leaders, including the two of us. Although a prior publication (Proctor et al. 2013) reported positive training outcomes for the IRI, it did not address the extent to which the IRI facilitated scholarly productivity in the implementation field compares to other non-formal D&I training. The final article in this series reports results of a comparative evaluation design for the IRI (selected vs. non-selected applicants) that is made possible by publicly available records for scholarly products. Its design enables both a pre-post and a selected vs. non-selected comparison of IRI applicants' scholarly publications. This evaluation thus responds to the recommendations of the 2008 NIMH Investing in the Future Report (National Institute of Mental Health) that training programs implement rigorous methods of monitoring and outcome assessment.

The article also reviews a small body of published literature that has emerged over the past decade, describing the training and evaluations of several training programs in implementation science in the United States, including two 2016 publications that review existing training programs and identify gaps, particularly in pre-doctoral research training and in training for implementation practitioners (Chambers et al. 2016) and a field-wide perspective on training in dissemination and implementation research (Proctor and Chambers 2016). These publications note that rapid development of implementation research methods poses a training challenge that is both foundational and responsive to new developments in this fast evolving field.

Conclusion

The articles in this series exemplify some of the ways in which elements of the IRI scientific training program informed implementation research studies led by IRI

fellows. Insofar as the IRI was designed to address the challenges we articulated in 2009, the articles can be characterized as promises kept within the metaphor of the 2009 article being a “promissory note.”

We also note several caveats. The papers are illustrative but not necessarily representative of the full body of funded research projects led by the IRI fellows who contributed to the series, nor by the larger group of IRI fellows, and that full body was the basis of the quantitative outcomes reported in the evaluation article. Subsequently, IRI fellows have conducted over 110 grants funded by just the NIH alone. In addition, some elements we identified in 2009 are not represented in any of the articles. For example, we identified cost as a critical issue to understand and address, but with the exception of the brief mention of the COINS methodology in the article co-authored by Saldana and Bennett and their colleagues, research on costs is not reflected in this group of articles. Also, we would note that important developments and foci in implementation science in the decade since 2009 are not reflected in any of these articles. This includes, for example, the nature and importance of de-implementation, sustainability, and dynamic adaptation processes; of complexity of intervention and of implementation; and of specifying mechanisms as well as strategies in order to better understand implementation outcomes. The expanding use of hybrid designs first formally presented in the 2012 seminal article led by Curran has no foreshadowing in the 2009 publication, but is represented in one of the six reports in this series. Clearly, the 2009 paper was important to lay out the challenges of training investigators to conduct implementation research; but as the field matures, the bar will continue to be raised for subsequent training efforts.

Since the 2009 publication, we have come to appreciate more fully the complexity of the phenomenon we address. Improving service delivery requires change through the adoption, sustainment and scale up of evidence-based practice. These processes occur at multiple levels of service delivery systems, require two interventions—a new practice intervention and an implementation strategy, and rarely produce linear change. Evidence shows that implementation requires use of multiple implementation strategies (Proctor et al. 2019; Rogal et al. 2017, 2019), raising methodological challenges for measurement, data reduction, and analysis in order to understand their unique and combined effects. Multiple types of outcomes require measurement, and few outcomes central to implementation science can be extracted from clean codes in medical records (Proctor et al. 2011). The real-world environment in which implementation research is conducted increases relevance but poses formidable challenges for rigor: confounders and contextual factors are not ruled out, but rather measured and analyzed to capture mediating and moderating effects. While

implementation science seeks theory-informed generalizable knowledge, local effects must be recognized and measured.

Work conducted by fellows in the first four IRI cohorts addressed many of the conceptual and methodological challenges identified in the 2009 Proctor et al. paper. Subsequently, eight cohorts of IRI fellows have been trained in the IRI, a training program that continues to identify and equip researchers to address new challenges. To shape the improvement of mental health service delivery, implementation science must develop an evidence base about implementation strategies. That evidence needs to inform which strategies work in specific contexts and in particular phases of implementation, via which mechanisms, and to achieve which particular implementation outcomes. That evidence should provide answers to questions such as: how much will implementing this new practice cost? How long will the implementation process take? How much can interventions be adapted to best fit local context? What strategies help scale up effective interventions, thereby extending access to high quality care and reducing disparities. Developing this evidence will require refinement of emerging designs and methods. IRI alums and current fellows are advancing user-centered designs, simulation, agent-based modeling, innovative computational methods, measures to capture complex interventions, rapid ethnographic methods, and innovative approaches to partnered research. These advances demonstrate that the IRI continues to evolve its training to meet and to help shape a still evolving field—one with unique potential to transform the treatment of mental illness.

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