59. Integration and Implementation Sciences: How it relates to scientific thinking and public health strategies

Linda Neuhauser[1]

Gabriele Bammer's book is a major contribution to address the critical area of applying scientific knowledge to successful action. In my view, the so-called 'know–do gap'[2] is the single most important barrier to addressing the world's seemingly intractable problems—from poverty to climate change. Integrative applied research has become an area of intense interest and debate. In my view, this is partly because so many efforts to solve difficult problems have failed, and partly because of major shifts in scientific thinking and processes over the past 50 years. I2S aligns well with the new scientific paradigm and offers a welcome approach to reduce the gap between knowledge and action.

In my own work, I have similarly focused on working across disciplines and sectors, especially on health-related problems. In addition, I have been involved in transforming university training so that students will have an appreciation of these issues and the skills to do better. In this commentary, I use a public health perspective. Public health is one of the most interdisciplinary disciplines, both in the university and in real-world settings, and provides an excellent platform on which to build and test the I2S concepts. In this chapter, I comment on the scientific basis for Integration and Implementation Sciences, relevant I2S thinking and action in public health, my experiences heading a UC Berkeley centre that incorporates I2S strategies, and on training students, researchers, practitioners and policy makers in this area.

The Case for Advancing Integration and Implementation Sciences

Bammer argues convincingly for the value of I2S, both theoretically and from her own research experiences. Narrow disciplinary and abstract thinking have had little impact on solving complex global problems. Maintaining rigid disciplinary perspectives not only limits our knowledge about the determinants

1 Linda Neuhauser was invited as a 'senior scholar who has made significant contributions to thinking about research translation'.

2 WHO (2004).

of issues, but also constrains our ability to apply research findings towards the development of solutions. While there is little evidence about the uptake of research for effective action, Jensen[3] estimated that, in the health area, even the most successful interventions rarely reach more than 1 per cent of the target population. Our challenge is to develop a research approach that actively integrates knowledge from many disciplines and uses it to promote effective action within the cultural norms and organisational processes of specific settings.[4]

Although Bammer notes that the book is 'based on practice rather than philosophy' (Chapter 2), her thinking reflects the major shifts in the philosophy of science. Before the mid-twentieth century, the dominant 'positivist' view was that 'truth' is knowable and generalisable, and the focus was on discovering the unchanging laws that govern the physical world. In the newer paradigm, 'critical realists' posit that it is impossible to fully perceive the real world and its ever changing causal forces, and that claims about reality should be subjected to the widest possible examination.[5] These now dominant thinkers recommend using multiple theoretical frameworks and methods in diverse settings, and many interpretations of evidence—a process known as 'critical multiplism'.[6]

In this scientific era, 'human sciences' that seek to better understand the seeming unpredictability of people's perceptions and behaviours and 'design, or artificial, sciences' that are concerned 'not with how things are, but with how they might be'[7] have become increasingly important. These sciences draw on theoretical models from many disciplines, and employ a mix of quantitative, qualitative and iterative strategies to investigate phenomena. They are frequently primarily issue or problem based, rather than theoretically driven at the outset. For this reason, they are particularly useful to understand complex problems and invent ways to address them. For example, when developers create novel electronic health communications that include artificial intelligence applications (such as virtual coaches for patients), they usually lack robust models to guide their work. Instead, they typically rely on the heuristics (experience-based approaches to problem solving and discovery) inherent in design sciences to iteratively find a solution by working closely with the intended users.

Bammer's three-domain framework that advocates obtaining knowledge from multiple disciplines and stakeholders, understanding and managing uncertainty, and providing research support for policy and practice action mirrors the major shifts in scientific thinking and processes. The kinds of research questions and

3 Jensen (2003).
4 Bammer (2005); Green and Glasgow (2006); Sussman et al. (2006).
5 Cook (1985); Cook and Campbell (1979).
6 Cook (1985).
7 Simon (1996); see also commentary by Cram (Chapter 41).

diverse methods she proposes acknowledge that reality is complex, fraught with unknowns and changeable. Her comprehensive, step-wise model of engaging researchers, policy makers, practitioners and other stakeholders emphasises that knowledge needed for action is affected by different stakeholder viewpoints and contexts, and is only revealed through an intensive process of engagement. I appreciate her recommendation to build I2S using an inductive, problem-based approach—rather than defining an initial theory to test that is not necessarily a good fit with the complexity of this work.

Understanding and adopting the newer scientific paradigm are challenging and, in my view, Bammer's approach aligns well with that goal. It is not surprising that she uses the term 'Big Science' for the ambitious effort to define and implement the I2S work plan.

I2S as a Discipline

As a scientific practice, I2S has indisputable value, but as a number of contributors have commented, it is not yet a 'discipline'. To rise to this level, I2S would need a stronger theoretical foundation, better-defined methods and rigorous testing in multiple contexts. Because I2S is currently a primarily practice-oriented endeavour, there is still a long way to go before it can be considered a discipline. Bammer's proposed I2S Development Drive to build I2S would certainly help catalyse that process.

There is an obvious 'cognitive dissonance' in attempting to create a single discipline that integrates thinking and methods from many disciplines. Bammer suggests that statistics is analogous to how I2S functions as a discipline. The idea is enticing, given that statistics supports research in many individual disciplines, as well as across disciplines, for interdisciplinary work; however, statistics is a field with well-defined theoretical frameworks, methods and a long history of testing. It is more supportable to say that, from a practice point of view, statisticians and the proposed I2S specialists would share some similarities in their interdisciplinary approaches.

I2S in Public Health

A key step in the proposed I2S Development Drive is to gather existing concepts, methods and case examples. I suggest that a focus on I2S elements in public health would be a fruitful way to begin this process. Public health is one of the most interdisciplinary disciplines both within and outside the university. Schools of public health include faculty trained in medicine, sociology, public

policy, business, psychology, anthropology, biology, communication, education, economics, law, environmental science, architecture, city planning, government and many other fields, and joint appointments with other disciplinary schools are common. In addition, many public health academics have expertise not only in research, but also in practice with government, communities, policy institutes and/or the private sector. Public health can provide a rich 'laboratory' in which to investigate I2S issues, models and strategies.

Because public health problems intersect biological, behavioural, environmental and other domains, they are inherently complex to understand and to address. Efforts over the past 30 years to examine disciplinary integration and implementation efforts in public health research and interventions[8] could greatly inform I2S development.

The most commonly accepted 'overarching' models in public health are currently social-ecological models that encompass a broad range of disciplinary domains and span all sectoral levels—including individual, family, community, organisations and society.[9] These are also systems models that encompass interactions among components of the model (for example, how smoking policy decisions affect individuals and healthcare institutions, or how community actions impact on the environment).

Definitions and Models of Integration and Implementation in Public Health

The cross-disciplinary definitions 'multidisciplinary', 'interdisciplinary' and 'transdisciplinary' used in public health are similar to those in Bammer's book. Frequently 'interdisciplinary' and 'transdisciplinary' have been used interchangeably; however, there is a general view that transdisciplinarity requires that people from different disciplines work together from the outset and create a new joint concept, theory and/or method. Since 2000, public health efforts in the United States to integrate disciplines have tended to advocate the goal of transdisciplinarity.

In public health, 'implementation' has generally been referred to as 'research translation', which can be defined as '[a]n extended process of how research knowledge that is directly or indirectly relevant to health or well-being eventually

8 Neuhauser et al. (2007b).
9 Stokols (2000).

serves the public'.[10] 'Translation' is sometimes referred to as 'dissemination': 'an active and strategically planned process whereby new or existing knowledge, interventions, or practices are spread'.[11]

In the initial public health efforts related to disciplinary integration and implementation/translation, most models focused on either one or the other. For example, Best and colleagues[12] traced the evolution of thinking about translational health. The earliest models portrayed knowledge as a 'product' to be passively transferred from researchers to practitioners to users. The latest translational models emphasise knowledge 'integration' in which knowledge is tightly woven within priorities, culture and contexts. This whole-system perspective means that relationships at all levels are important to assure that scientific findings are effectively adopted.

More recently, public health models that include both disciplinary integration and implementation/translation have started to emerge. Stokols' 'transdisciplinary action research'[13] matrix describes how transdisciplinary research needs to be integrated into a collaborative action (implementation) cycle with three dimensions: analytic scope (biological to policy), organisational scope (intra-organisational to intersectoral) and geographic scope (local to global). Sussman and colleagues' model[14] proposes how cross-disciplinary researchers and practitioners might collaborate at multiple translational phases to transform science into action. These models could provide rich guidance for I2S development. For example, Stokols' use of analytical, organisational and geographic dimensions could be considered to enhance the I2S model. Similarly Sussman and colleagues' emphasis on cyclical phases of interdisciplinary and implementation activity could help refine I2S. Synergistically the proposed I2S approach could help build current public health models and strategies.

In the United States, the National Institutes of Health (NIH) has contributed hundreds of millions of dollars to transdisciplinary and translational research. This funding has helped develop science centres that bring together researchers from multiple disciplines to move science to action.[15] Evaluations of this work could help inform I2S efforts.[16]

10 Adapted from Sussman et al. (2006).
11 Kiefer et al. (2005, p. 14).
12 Best et al. (2008).
13 Stokols (2006).
14 Sussman et al. (2006).
15 National Institutes of Health (2005).
16 Stokols et al. (2005).

Linking Research and Practice: The Health Research for Action model

Both Bammer and the commentators cite fundamental challenges to forging strong relationships between researchers from various disciplines and the policymakers and practitioners they are to support with integrative applied research. These include the perceived importance of separating research activities from direct implementation, as well as the differing perceptions, work styles, time, budget constraints and motivations of these groups. The book identifies excellent ways to strengthen researcher–stakeholder relationships; however, my views—shaped by shifts in scientific thinking and by my own experiences—differ from those presented in a number of important areas. I will start with what I have learned from doing integrative applied research.

Twenty years ago, I was involved in creating what is now known as the Health Research for Action Center at the University of California, Berkeley School of Public Health.[17] The impetus to develop the centre came from recognising that many public health efforts have been unsuccessful and that doing better will involve a broader understanding of cross-disciplinary factors that influence health and more powerful strategies to translate research into effective interventions. We designed the centre to include researchers, practitioners and policy makers who would work together on health issues and interventions. The idea was to concurrently bring together academics from multiple disciplines and have them engage with stakeholders from many sectors (including policy makers, representatives of community organisations, individuals and families affected by the issues, media experts and other groups). We chose to use highly participatory processes to ensure that we were tightly connected to the affected audiences as well as to the many relevant stakeholders—to understand issues and act on them.

Having researchers, practitioners and policymakers working together in one physical space and reaching out to many stakeholders in local communities, States, nationally or internationally has helped us reduce the common I2S barriers among these groups. We have learned that closely linking researchers across disciplines and stakeholders in many sectors is critical to produce rigorous, meaningful research and successful interventions. Interestingly although we did not have the benefit of the detailed I2S guidance in this book, we have experimented with and adopted many of the I2S engagement practices recommended in the book, such as scoping, involving stakeholders in advisory

17 <http:www.healthresearchforaction.org> (accessed 14 February 2012).

committees, holding 'executive sessions' for policy makers, and focusing on communication. Our integrative applied research approach is central to our success in large-scale interventions.[18]

In light of these experiences, I suggest that I2S advocates more boldly for closer connections between researchers and stakeholders. For example, consider this statement in Chapter 17:

> For researchers, this involves performing at least four important functions—namely
>
> 1. making available what is known, including what has worked and has not worked, so that policy makers and practitioners can develop effective actions
> 2. providing a digest of remaining unknowns to help policy makers and practitioners take these into account in their decision making, as well as to reduce, or at least be better prepared for, unintended consequences of their initiatives
> 3. providing critique of current and proposed policy and practice
> 4. providing new ideas for policy and practice.

I argue that knowledge is not a product delivered by researchers to stakeholders to implement, but is created by both groups working together synergistically from the outset. Likewise, that partnership should ideally extend to jointly developing and implementing interventions. For example, our centre staff was involved with both research and implementation of a parenting education kit for 500 000 parents in the United States.[19] A major reason for the success of this program was the highly participatory process among researchers, policy makers, practitioners and parents. Research findings iteratively influenced the design and refinement of the project, and stakeholders helped define research issues and interpret the results.

Current scientific thinking also supports the view that researchers and stakeholders should work closely from the outset—so that the phenomena studied are truly understood, and so that interventions and policies are successful. Human and design sciences provide good guidance about such collaborative processes. Obviously, it is difficult for researchers to transition from the traditional approach of providing study findings *to* stakeholders who are expected to implement them, to one in which researchers and stakeholders are intimately bound up in both investigation and change. The book provides

18 See Neuhauser (2010); Neuhauser et al. (2009).
19 Neuhauser (2010); Neuhauser et al. (2007a).

strong guidance about integrating researchers across disciplines, but not enough about engaging stakeholders in the research process. In my view, the processes to integrate stakeholders must be as explicit as those for researchers.

Training in I2S: A UC Berkeley model

Bammer's book advocates strongly for training a cadre of I2S specialists, including different levels of training for: 1) leaders, 2) disciplinary specialists, 3) other integrative applied research team members, and 4) policy makers and practitioners. She recommends that leaders be adept at managing the processes and that they have a detailed understanding of the many relevant barriers and facilitators; that disciplinary experts have a good understanding of concepts and processes and specific understanding of case examples; that other team members have a general understanding of I2S; and that policy makers and practitioners have a similar appreciation of I2S and what research teams can offer.

Some commentators in this book had concerns about the feasibility of training cross-disciplinary experts, given the tenacious hold of disciplines on research. I agree with these concerns, but suggest a more optimistic path forward from my own experience. Like all universities, UC Berkeley is organised around disciplines. A notable exception is our School of Public Health, which focuses on cross-disciplinary issues, has faculty from varied disciplines and many intersectoral partnerships, as mentioned earlier.

School leaders have recognised the need to train students in high-level skills to integrate knowledge across disciplines and implement it in real-world settings. Similarly, for the past two decades, US public health leaders and national mandates have called for training of transdisciplinary scientists and researcher-practitioners.[20] Educator Ernest Boyer proposed that university education should foster a stronger link between research and its translation into action.[21] His view of an 'engaged university' that would integrate knowledge across disciplines and focus on collaborative approaches to solve important problems is well aligned with I2S goals. A major challenge has been to translate theoretical guidance into practical curricula.

In 1996, our school decided to create a Doctor of Public Health (DrPH) program that would include all the public health sub-disciplines and connect with many other disciplines on campus.[22] The program was launched in 2000 and has an explicit transdisciplinary and problem-based orientation to research,

20 Nash et al. (2003); Stokols (2006).
21 Boyer (1990).
22 For details, see Neuhauser et al. (2007b).

and an emphasis on translating research to action in multiple sectors. Admitted students are required to have a graduate degree in a field relevant to health (such as medicine, sociology, statistics, education, and so on), professional experience and evidence of leadership qualities. Each student cohort is selected to have a mix of disciplinary backgrounds and interests. Students are trained in cross-disciplinary areas, multi-method research, and in leadership and communication skills. Their dissertation research typically is problem based, rather than limited to testing theory. Students do a field residency to address practical health issues with stakeholder groups. The program has been very effective and DrPH graduates are successful in finding senior-level work in academia, government, community organisations, policy institutes, consulting, and often in combinations of these areas.

There are intriguing parallels between this program and skills advocated for I2S leaders and disciplinary specialists. My view is that it may be hard to train I2S specialists who do not have some kind of disciplinary home, because they need university support and a practical career path. An alternative route is to begin training I2S experts within disciplines that have strong interdisciplinary connections and a practice base. I also suggest that such training be highly problem based, rather than just focused on a skill set. My experience has been that people only learn these skills when engaged in addressing specific issues. The Berkeley DrPH program is one such promising model of I2S training.

Suggestions to Move Forward with I2S

In summary, Bammer's book takes on the very important areas of advancing integrative applied research to address complex problems and creating an I2S discipline. I appreciate that Bammer has begun with a practice orientation to develop I2S—a pragmatic approach that should ensure that this field meets researchers', practitioners' and policy makers' needs as it evolves.

I2S represents a radical change in the traditional approach to research, but one that is well supported by current scientific thinking. Overall, I like the proposed I2S framework. My main suggestion is that there is a stronger emphasis on the importance of a very close collaboration between researchers and stakeholders, and more explicit guidance about strategies to engage stakeholders. Both groups have important and, ultimately, equal roles in creating knowledge and applying it to address problems. I also recommend that all aspects of this work be as problem oriented as possible, to ground and motivate those engaged with it, and to build a 'business case' about its value.

The proposed I2S Development Drive is certainly ambitious, but warranted by the seriousness of the problem it intends to address. If such a 'Big Science' effort

were not possible to fund, smaller incremental efforts would still be valuable. In fact, given the iterative nature of I2S work, it might be preferable to allow more time for reflection and refinement of this emerging field. As a next step, I suggest finding support for: 1) several meetings of people interested in I2S to discuss selected Drive issues and refine a two-year work plan; 2) synthesis of available information about I2S in several discrete areas; and 3) experimental training of I2S in a university or field setting. No matter which directions are taken to develop I2S, it is time to move ahead with this important work.

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Brief Biography

Linda Neuhauser DrPH is Clinical Professor of Community Health and Human Development at the University of California, Berkeley School of Public Health. Her research, teaching and practice are focused on using participatory approaches to translate research findings into improved health interventions that are relevant to people's needs and social contexts. She is principal investigator of the UC Berkeley Health Research for Action Center that works with diverse groups to research a broad range of health issues and to 'co-create' effective solutions. She helped design the current UC Berkeley Doctor of Health Program that trains students in integrative applied research. She was previously a US health officer in West and Central Africa.

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