"I Wish I Knew This Before…": An Implementation Science Primer and Model to Guide Implementation of Simulation Programs in Medical Education

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10.1 Introduction

Recognizing that simulation-based education is a complex intervention, and like other complex interventions in medicine, needs to be evidence-based, Haji et al. (2014) proposed a framework for developing and evaluating research programs in simulation-based education. Based on the Medical Research Council's (MRC 2000) framework for the design and evaluation of complex interventions to improve health (Craig et al. 2008), Haji's

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framework calls for an iterative approach to developing, evaluating and implementing simulation programs, emphasizing identification of theory and existing evidence, modeling the program through piloting, and evaluating the program in both research and real-world settings.

Although Haji et al. (2014) provided substantive guidance for theory development, piloting, and evaluation, the framework falls short of informing on the implementation of simulation-based programs (i.e., the process of putting to use or integrating a program into a new setting; Rabin et al. 2010). One may question why implementation evidence should be carefully considered when implementing a simulation program with demonstrated effectiveness to a new setting. In short, the reason is that “implementation matters” (Durlak and DuPre 2008). In their review of over 500 implementation studies of behavioural health prevention and promotion programs, Durlak and DuPre (2008) demonstrated a significant positive relationship between implementation quality and program outcomes in 76% of studies, with better implemented programs yielding mean effect sizes that were 2–3 times larger than poorly implemented programs. This evidence illustrates that desired outcomes require more than program effectiveness; programs must also be well-implemented. “Quality implementation” is as important as quality of the program (Meyers et al. 2012).

To this end, implementation science, defined as “the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices” (Eccles and Mittman 2006, p. 1) is a critical evidence base in its own right for optimizing program implementation and achieving maximum impact. As such, various funders and research agencies are emphasizing the importance of evidence-based, quality implementation (e.g., National Institutes for Health, NIH, Centers for Disease Control and Prevention, CDC, in the United States of America; National Institute for Health Research, NIHR, in the United Kingdom) (Meyers et al. 2012). The NIHR, for instance, has funded Collaborations for Leadership in Applied Health Research and Care with the explicit purpose of increasing implementation capacity in healthcare by finding the best ways to translate implementation evidence to practice.

Similarly, various sectors such as education (Century and Cassata 2016; Halle et al. 2013), mental health (Proctor et al. 2009), prevention and promotion (Chinman et al. 2008), global health (Barwick et al. 2015; Ridde 2016), nursing (Van Achterberg et al. 2008), and emergency medicine (Bernstein et al. 2015; Carpenter and Lo 2015) are turning to implementation science for implementation guidance—that is, strategies, frameworks, tools and resources—to strengthen the implementation capacity and quality of their programs. Ultimately, the goal is to improve health and education outcomes and to maximize the return on research investments, education and healthcare services. This is becoming imperative given low patient benefits (e.g., patients in USA typically receive about 55% of the recommended care; McGlynn et al. 2003) relative to significant investments in health research (e.g., costs estimated to reach $100 billion dollars per year in North America; Brehaut and Eva 2012). Moreover, healthcare systems globally are increasingly resource-constrained (Bauer et al. 2015). Not paying attention to implementation is costly, and “we cannot afford to continue dealing with the business of program implementation and related technology transfer topics in a cavalier fashion” (Gendreau et al. 1999, p. 185).

The present chapter targets an implementation gap identified in the area of simulation-based medical education, where Program Directors are struggling with how to successfully implement simulation programs in the absence of best practices to guide their efforts (Kurashima and Hirano 2016). Specifically, in a recent systematic review of the implementation of simulation training in surgical residency curriculum, Kurashima and Hirano (2016) found that all of the studies described the nature of the simulation programs but there was a notable lack of information about how programs were actually implemented on the ground. Poor reporting for implementation studies is not uncommon, and standards are now available to remedy this (Pinnock et al. 2017a, b). The absence of implementation details in reporting suggests the absence of a systematic, evidence-based approach to implementation, over and above reports related to simulation education, (e.g., examination of implementation context; fit between implementation context and new program; of readiness for implementation; establishment of a data collection for monitoring implementation quality). Arguably, various implementation elements are ordinarily considered in the process (e.g., training), but the paucity of detail about program implementation makes it increasingly difficult to judge program effectiveness and inform future implementation.

Given the increasing complexity of simulation-based education over the past few decades (Roussin and Weinstock 2017) and the recognized absence of best practices for implementation (Kurashima and Hirano 2016), our chapter aims to provide guidance to program developers, practitioners, educators, researchers and evaluators for the implementation of simulation programs. To this end, we proposed an Adapted Implementation Model for Simulation, AIM-SIM. AIM-SIM is derived from existing implementation evidence by blending three complementary implementation models (process, determinant and outcome models) and adapting them to the simulation context. Our goals are to build implementation capacity in simulation-based health professions education and to increase the implementation quality of simulation programs to achieve optimal educational and health outcomes. In line with the distinction proposed by Greenhalgh et al. (2004) between "letting it happen", "helping it happen" and "making it happen", this chapter is intended to inform, support and optimize implementation of simulation programs by "making it happen" as opposed to letting it unfold haphazardly, which rarely happens effectively. It is important to note that elements of the implementation model described here have been utilized in the design and use of simulation programs (e.g., Chiu et al. 2017; MacRae et al. 2008), although not in a systematic and comprehensive way.

In what follows, we start by providing an overview of the definition and scope of the field of implementation science and make a case for the importance of using implementation evidence to inform implementation of evidence-based programs. We then review key findings in implementation science and propose an adapted implementation model to guide the implementation of simulation programs on the ground (see Tabak et al. 2012 regarding how to utilize and adapt models). The model is entirely derived from existing implementation models and emphasizes key activities such as thoughtful engagement with stakeholders, pre-implementation planning, and ongoing monitoring to iteratively collect data about implementation quality as well as the fit of the program with the context in which it is being transferred. In the initial overview of the existing implementation literature we will use the original nomenclature—for example, in the field of mental health people engaged in the implementation are mental health practitioners, clinicians or therapists and the outcomes are patient or client oriented. However, when describing our adapted model, we will use terms found in the field of education such as "educator" and "learner-oriented outcomes." This is because simulation-based education is a specialized set of educational activities and technologies, and, as such, it shares many elements with the general field of education.

10.2 Implementation Science and Practice

Over the last two decades there has been increasing attention to reducing the gap between research and practice and maximizing the value of healthcare (Grimshaw et al. 2012). Implementation science emerged as a field of inquiry to examine what happens when evidence-based programs are transported to new settings, and to study the methods that maximize their use into routine care. This investigation goes beyond measuring health or educational outcomes at the level of the patient or learner, to examining the implementation process (e.g., if the program is implemented as intended), the characteristics of the program that is implemented (i.e., cost, complexity, compatibility with the setting and existing programs), of the people implementing the program (e.g., their knowledge, beliefs, sense, of self-efficacy) and of the context in which it is being implemented (e.g., learning climate, leadership style, existing resources, and policies). The overall goal of implementation science is to develop generalizable knowledge about what works, for whom, how and in which context, knowledge that can be widely applied beyond the individual educational organization or system under study. With respect to simulation programs, examples of possible implementation research questions are: What is the relationship between implementation quality and simulation program outcomes? What contextual factors are associated with the implementation and educational outcomes? What are the most feasible and effective ways to measure if a simulation program is delivered as intended?

In contrast, implementation practice refers to the process of integrating evidence-based programs within a new setting. This process should be carried out by a skilled implementation team using effective implementation processes and strategies. Within the simulation literature, one published report describes in detail the use of an implementation coordinator (Chiu et al. 2017). Implementing evidence-based programs on the ground, in real-world settings, is a complex task that involves multiple components such as assessment of readiness and fit, planning, training, monitoring and feedback, and interactions among staff, leaders, and program developers (Mittman 2011). Within the context of simulation programs, evidence-informed implementation practice considerations would include: adaptation of simulation programs with demonstrated effectiveness to new settings; assessing readiness for implementation and the degree of fit between the simulation program and the new context; making decisions regarding the composition of implementation teams (e.g., learners, educators, leaders, human resources, and information technology staff), planning for implementation, training and consultation/coaching, assessment of implementation and educational outcomes, and maintenance and sustainability.

Implementation is an applied science that focuses on the development and testing of implementation methods, approaches, and outcomes. The practice of implementation applies the empirical evidence produced by implementation science to ensure that an evidence-based program (including simulation-based programs) fits the context or organization where it is intended to be used; utilizes existing infrastructure and human resources; seamlessly interfaces with existing programs, external and internal mechanisms and processes; and minimizes disruption to the system. Implementation science has, for instance, identified contextual factors that are consistently associated with implementation success, and this knowledge is then used in practice to inform implementation planning and evaluation.

10.3 Making a Case for Implementation Science

Program implementation necessarily requires distinguishing between two types of activities: program-related activities and implementation activities. Implementing a boot camp simulation surgical program, for instance, involves program-related activities such as selection of the most appropriate method of feedback delivery about the individual learner's performance, or the most optimal learner to instructor ratio. Implementation activities, on the other hand, include getting buy-in from stakeholders; creating an implementation team and plan; training and coaching staff; and monitoring how the program is implemented, etc.

In the 1980s, evaluation results began to show a relationship between implementation quality and intended program outcomes (Meyers et al. 2012). Consequently, careful consideration of implementation and implementation outcomes are now increasingly being proposed as necessary components of the design, dissemination, and evaluation of evidence-based programs. There are several benefits to focusing on implementation, as outlined below.

10.3.1 Program Design and Development

Understanding if and to what extent a program achieves the desired outcomes, for what segment of the population, under what conditions, as well as monitoring implementation quality, how it varies as a function of context, and the relationship between program outcomes and implementation quality has the potential to inform program design and development (Century and Cassata 2016).

10.3.2 Establishing Program Effectiveness

Assessing implementation fidelity is key to ascertaining program effectiveness. An effective evidence-based program that is poorly implemented can yield negative results and, conversely, positive results can emerge from implementing a program differently than the way in which it was intended. Focusing on how a program is implemented can help to eliminate type III errors (i.e., attributing poor outcomes to suboptimal program effectiveness when they result from poor implementation) and to accurately judge the value of a program (Allen et al. 2012; Durlak and DuPre 2008).

10.3.3 Addressing Early Implementation Barriers

Implementation is a complex, long, nonlinear process that commonly presents unanticipated barriers (Greenhalgh et al. 2004). Monitoring implementation from the early stages and throughout the implementation process allows for identifying barriers and facilitators and optimizing practice change by relying on evidence-based implementation practices and not merely letting the implementation happen (Durlak and DuPre 2008).

10.3.4 Preventing Program Drift

Even when program implementation has a smooth start, there are typically diminishing returns and a tendency for program drift as the implementation process unfolds (Durlak and DuPre 2008). Moreover, in the absence of active efforts to maintain practice change, practitioners tend to regress (Colditz 2012). Thus, assessing implementation effectiveness is essential for transferring and sustaining programs in new settings.

10.3.5 Understanding how Programs Behave in Different Settings

The absence of standardized approaches to implementation often means that program implementation is sub-optimal (Meyers et al. 2012) and characterized by "implementation gaps." Programs may be transferred with little attention to sustainability, and thus, fail to produce optimal benefits (Fixsen et al. 2005). Adaptation to program elements and/or to implementation approach are often warranted, and must be noted and continuously evaluated to ensure program outcomes can still be achieved.

10.4 Summary of Key Implementation Innovations

Over the last two decades, a significant body of evidence has accumulated to indicate convergence on the importance of the implementation process, the contextual factors shaping it, and the implementation outcomes that can be measured (Century and Cassata 2016). Several key innovations—highlighted below—combine to increase the likelihood of achieving implementation success.

10.4.1 Implementation Stages

There is general recognition that transferring evidence-based programs into new settings is a long process (estimates suggest 2–4 years for a program to reach full implementation; Fixsen and Blase (2009) that includes several stages (Aarons et al. 2011; Fixsen et al. 2005; Meyers et al. 2012). Although authors differ in terms of the number of stages proposed, implementation is largely conceived as a process (as opposed to an event or a one-time act) that includes a series of coordinated stages that do not occur linearly or independently. By example, the Active

Implementation Frameworks (Fixsen et al. 2005) propose four stages: exploration (assessing and creating readiness for change), installation (identifying sources of training and coaching; providing initial training for staff; establishing performance tools and ensuring that resources such as space and equipment are in place), initial implementation (when the program is being used for the first time in practice with the support of the implementation teams), and full implementation (when 50% or more of the practitioners and staff are using the program as intended and reaching the desired outcomes). Other process models include the four-phase model of the implementation process (i.e., Exploration, Adoption/ Preparation, Implementation, Sustainment (Aarons et al. 2011) and the 14-steps of the Quality Implementation Framework (Meyers et al. 2012).

10.4.2 Implementation Components

Zooming in, in addition to stages, an implementation endeavor must consider "core implementation components" or drivers which refer to the most essential and indispensable components of an implementation process (Fixsen et al. 2005). These components capture the commonalities of successfully implemented programs, and fall into three broad categories: competency drivers (staff selection, training, coaching and consultation); organizational drivers (establishing managerial and administrative structure and support for the implementation as well as a decision support data system); leadership drivers (setting goals, managing time and effort as well as identifying and resolving problems). Other authors proposed similar components. For instance, the Quality Implementation Framework (Meyers et al. 2012) includes 14 distinct steps or activities that largely map onto Fixsen's components: conducting a needs and resources assessment, a fit assessment and a capacity/readiness assessment; examining the possibility of program adaptation to the new setting; obtaining buy-in from stakeholders; staff recruitment and training; creating implementation teams; developing an implementation plan; technical assistance/coaching/ supervision; process evaluation and feedback mechanisms.

Although there are slight differences among the core implementation components or activities identified by various authors, overall there is significant convergence, suggesting that these activities can be planned to guide the implementation of a program in a new setting. For instance, creating implementation teams was shown to increase the success of an implementation effort (80% versus 14%, when implementation is let to happen, with no support from an implementation team; Fixsen et al. 2001). The precise composition and activities undertaken by an implementation team will depend on the program and the context in which it is implemented but typically includes frontline practitioners, program managers and leaders, information technology and human resources staff. Furthermore, the implementation teams are accountable for assuring that implementation efforts are successful and produce the intended outcomes, requiring members to develop expertise regarding the specific programs implemented, implementation science and practice, improvement cycles, and organization and system change methods.

10.4.3 Implementation Outcomes

When thinking about implementing a program, it is essential to distinguish between different types of outcomes (Fixsen et al. 2005; Proctor et al. 2011). Proctor et al. (2011) advance the concept of implementation outcomes as distinct from service outcomes (efficiency, safety, equity, patient centeredness, timeliness) and client outcomes (satisfaction, function, and symptomatology). Implementation outcomes are defined as the effects of activities undertaken to implement a program and include: acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability. By measuring implementation outcomes, one can separate very different scenarios (effective or ineffective programs that are well or poorly implemented) and thus more accurately interpret implementation success and make decisions about future implementations.

Among these eight implementation outcomes, fidelity—the extent to which a program is delivered as intended—has received significant attention (Carroll et al. 2007), with high fidelity being associated with better outcomes (Allen et al. 2012). This suggests that it is essential to put mechanisms in place for monitoring and supporting fidelity, ranging from providing standardized training to staff pre-implementation and booster sessions throughout the implementation process; ensuring that implementers have the requisite knowledge, skills and resources after training; using implementation protocols, program manuals, scripts, tools to help implementers follow the original program; measuring fidelity directly (trained observers using checklist or rating scales; supervisor, expert or staff ratings of audiotapes/videotapes of the performance) or indirectly (data from logs and diaries of the implementation; exit interviews with patients/clients who received the program).

In the simulation context, it is important to distinguish between fidelity as an implementation outcome and simulation fidelity, which is the degree to which the simulated experience resembles the real world. An example of fidelity as an implementation outcome would be measuring adherence to the pedagogical elements embedded in a surgical boot camp, such as progressive training, where all modules are taught in an order of increasing complexity (Brydges et al. 2010). Another important aspect of fidelity is measuring the quality of program delivery such as the fit between methods of feedback and debriefing and learner characteristics (Xeroulis et al. 2007).

10.4.4 Implementation Context

Implementation does not happen in a void and research to date has shown that there are multiple contextual factors influencing implementation quality and outcomes (Damschroder et al. 2009). In some cases, program effectiveness could be reduced by 50% as a result of a combination of contextual influences (Durlak and DuPre 2008). In line with these findings, the frameworks and theories developed in the field of implementation science over the last two decades, (e.g., The Consolidated Framework for Implementation Research, CFIR; Damschroder et al. 2009; The Quality Implementation Framework, QIF; Meyers et al. 2012; The Promoting Action on Research Implementation in Health Services, PARIHS; Rycroft-Malone 2004, and its revised version, i-PARIHS; Harvey and Kitson 2016), all highlight the crucial role that context plays when implementing an evidence-based program. PARIHS, for instance, proposes that implementation success is a function of the relationships among program evidence, context, and facilitation or implementation support.

The CFIR (described in detail at http://www.cfirguide.org/) builds on this by identifying 37 contextual factors that can potentially affect implementation success, organized under five main domains: program (e.g., evidence strength and quality; program cost); outer context (e.g., patient needs and resources); inner context (e.g., organizational culture; leadership engagement); implementation process (e.g., planning; evaluation; reflection and feedback); and people who implement the program (e.g., knowledge and beliefs, self-efficacy). Recent research using CFIR is working to refine the framework by identifying a subset of factors that are strongly associated with implementation success across a range of contexts, populations, and innovations, including relative advantage (stakeholders' perception of the advantage of implementing the program versus an alternative solution), tension for change (the degree to which stakeholders perceive the current situation as intolerable or needing change), patient needs and resources (the extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritized by the organization); relative priority (stakeholders' perception of the importance of the implementation within the organization); available resources (level of resources dedicated for implementation and ongoing operations including money, training, education, physical space, and time); and, planning (the degree to which a scheme or method of behavior and tasks for implementing a program are developed in advance) (Barwick et al. 2015;

Damschroder and Lowery 2013; Varsi et al. 2015). These findings can inform implementation planning and evaluation.

10.5 The Adapted Implementation Model for Simulation (AIM-SIM)

In a recent review of implementation models, Tabak et al. (2012) identified 61 implementation models and recommended that implementation researchers and practitioners use and adapt existing models to fit their context rather than develop new models. We have followed this recommendation in proposing an Adapted Implementation Model for Simulation (AIM-SIM) to guide the implementation of simulation programs. AIM-SIM draws primarily on three models: (1) the Consolidated Framework for Implementation Research, (CFIR; Damschroder et al. 2009), specifying which factors to pay attention to in program implementation; (2) the Quality Implementation Framework (QIF; Meyers et al. 2012), specifying four phases and 14 steps undertaken to implement a program; and (3) the Implementation Outcomes (IO; Proctor et al. 2011), specifying the implementation outcomes to be measured along the way. We propose certain adaptations to this blended model that incorporate process and content considerations for simulation programs. Similar implementation models have been proposed and shown to be effective in healthcare and mental health: the KIT (Knowledge Informing Transformation) program of the Substance Abuse and Mental Health Services Administration in the US (McMillen 2012); GTO (Getting to Outcomes), a toolkit to help communities implement and evaluate their prevention programs (Chinman et al. 2008).

AIM-SIM is intended to be a practical, evidence-based implementation guide and starting point for the field of simulation-based medical education. AIM-SIM is not a comprehensive, fixed model and we envision it can be further revised through evaluation and emerging implementation evidence. For instance, additional elements can be added to the model, such as methods for engaging stakeholders or assessing readiness and capacity for implementation (e.g., Hexagon Tool; Blasé et al. 2013), and approaches to program sustainability and scale-up (e.g., rolling cohort model, cascading dissemination model, and community development team; Chamberlain et al. 2012).

10.5.1 Overview of the Adapted Implementation Model for Simulation (AIM-SIM)

AIM-SIM includes three main implementation phases: (a) stakeholder engagement and context exploration, (b) pre-implementation planning, and (c) program implementation with monitoring and ongoing evaluation. Within each phase, the implementation team performs several tasks, gathers data using suggested tools, and, based on the data gathered, makes decisions about the course and effectiveness of the implementation.

The implementation evidence incorporated in AIM-SIM is bundled using a specific algorithm—a set of hierarchical diagrams (the Motor and Cognitive Modeling Diagrams; MCMD) that allow us to represent the implementation process at various levels of detail: phase, task and decisions. These diagrams are often used in the field of engineering to simplify the representation of complex processes. In simulation-based surgical education the MCMDs were first adapted to enable a graphical representation of complex minimally invasive surgical procedures (Cristancho et al. 2006) and to show the physical surgical steps within a procedure ("tasks"), the cognitive decisions made ("decisions"), and the logical flow ("gates"). In this chapter, we apply the MCMD diagrams to visually represent the AIM-SIM and, thus, go beyond a linear inventory of implementation phases and tasks. Figure 10.1 provides a general description of selected MCMD elements that will be used in Fig. 10.2 to illustrate AIM-SIM. The temporal order suggested in Fig. 10.2 is not fixed because implementation is dynamic and complex. Consequently, in some cases, tasks may be revisited, skipped or occur simultaneously.

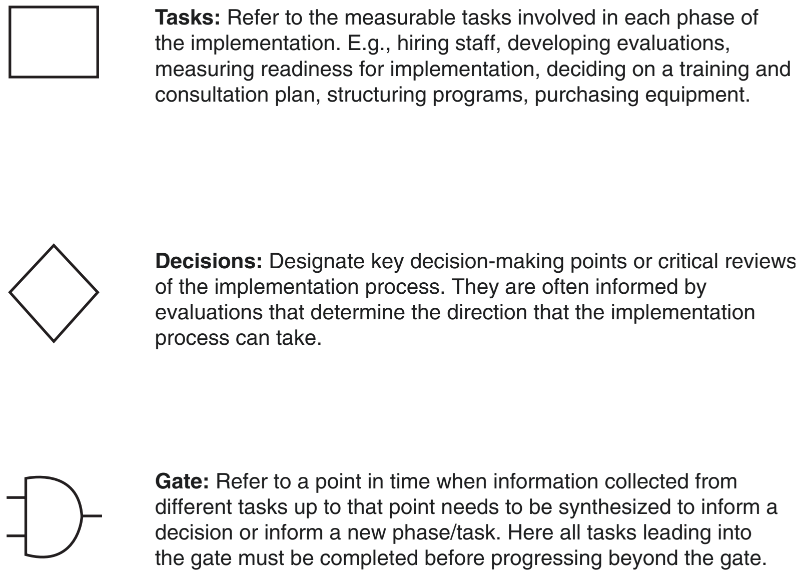

Fig. 10.1 MCMD elements and definitions

10.5.2 Phase 1: Stakeholder Engagement & Context Exploration

A typical scenario in simulation-based medical education is for an implementation endeavor to be initiated by a decision to bring in a new simulation program to meet a certain educational need. Whether the purpose is to implement a new program, or one that has been shown to be effective within another context, all relevant stakeholders must be engaged (Task 1) and the host context clearly defined (Task 2) (see Fig. 10.2a). These two tasks have been shown to increase implementation success by contributing to strengthening program ownership and buy-in, as well as planning quality (Damschroder and Lowery 2013; Meyers et al. 2012). The how of these two tasks will largely depend on various characteristics of the simulation program, such as learners' autonomy, type of skills learned, and where the simulation takes place (Roussin and Weinstock 2017).

To achieve these tasks, the implementation team should identify the stakeholders, programs and units that are relevant to the simulation program. The implementation team at this stage will likely involve the implementation initiator(s) such as the dean, chief of education, and/or director of simulation. In a recent paper, Chiu et al. (2017) describe the implementation of a longitudinal simulation educator curriculum where the implementation team consisted of the Medical Director of the Simulation Patient Safety Program, a program coordinator, and faculty with simulation expertise. Subsequently, the implementation initiator(s) should identify representatives from all relevant stakeholder groups. Evidence indicates that such broad inclusion of stakeholders fosters a collaborative working climate and buy-in, and optimizes the implementation process and leveraging of resources within and across organizations (Fixsen et al. 2005). When implementing a simulation program, possible stakeholder groups to be represented in the implementation team could include the directors and/or managers of the simulation centre, educators, clinician-educators, chairs of academic programs that are involved in the implementation, learners, IT, and HR staff. For stakeholders who choose not to engage in the implementation process, it is important to determine why—are the reasons related to the proposed program or external factors? Whenever possible and contextually appropriate, when exploring these reasons, the implementation team should ask for recommendations or "snowballing" of other stakeholders from their own or other programs, units or organizations in order to ensure engagement of all relevant stakeholders.

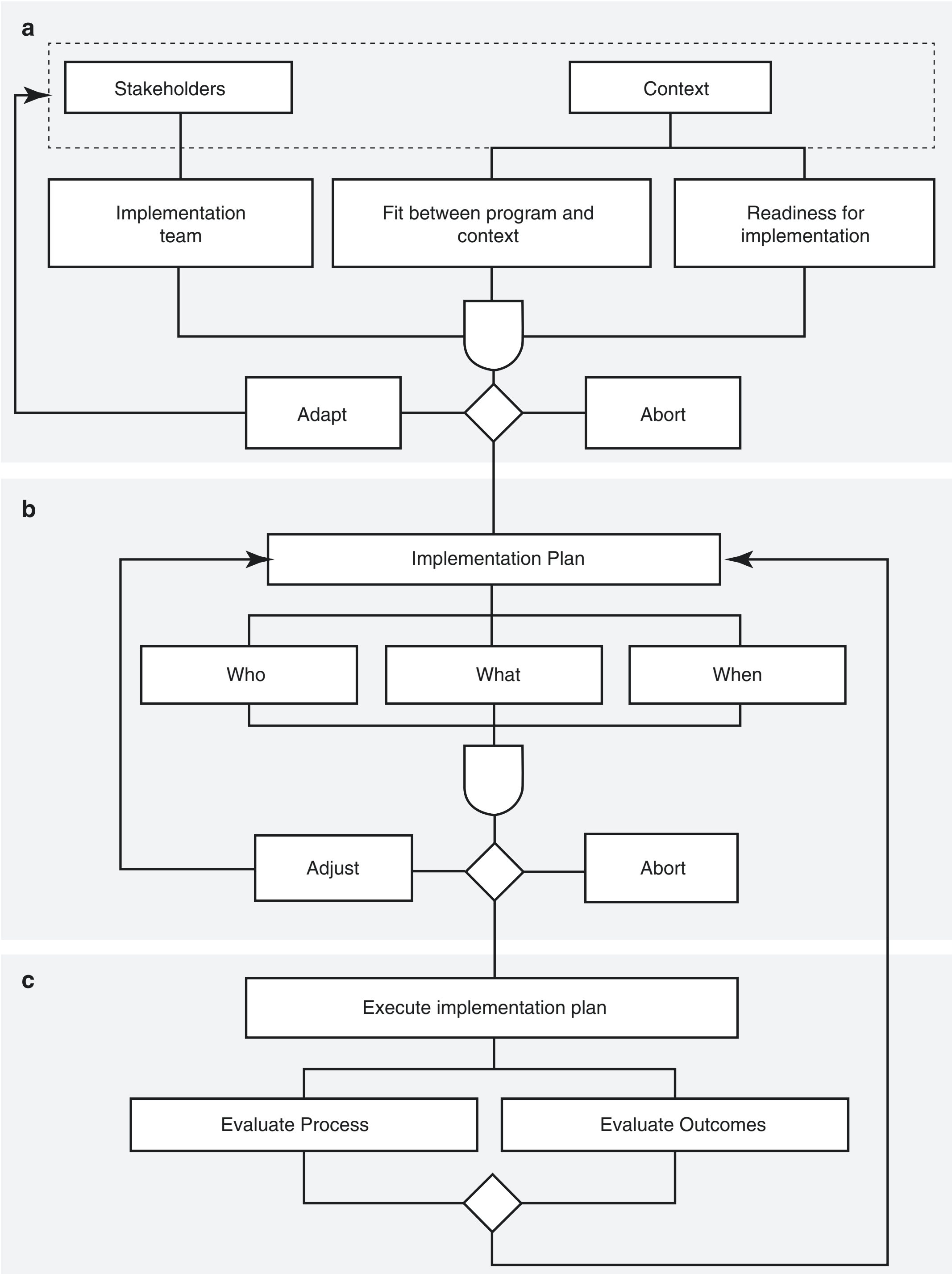

Fig. 10.2 Visual representation of the AIM-SIM, where panel A shows tasks to be completed during Phase 1 (Stakeholder engagement and context exploration), panel B shows tasks in Phase 2 (Pre-implementation planning), and panel C shows tasks in Phase 3 (Implementation monitoring and evaluation)

With the identification of stakeholders complete, the next task is to obtain explicit buy-in from the implementation team. To this end, the implementation initiator(s) will organize a face-to-face meeting(s) to: introduce the simulation program to be implemented to the larger group; provide a rationale regarding the desire to implement; explore buy-in from the core users of the program; seek their commitment; determine who will be responsible for leading the program implementation and assign various implementation roles and timeframes. Some of these roles for implementation, as outlined by CFIR (Damschroder et al. 2009), include:

- Formally appointed internal implementation leaders—people from within the organization who have been formally appointed with the responsibility of implementing the program as a coordinator, manager, team leader or other similar role;
- Opinion leaders—people in the organization who have influence on the attitudes and beliefs of their colleagues with respect to the program;
- Champions—people dedicated to supporting the program and overcoming possible barriers; and
- External change agents—people who are affiliated with an outside entity such as Ministry of Health, Colleges, who formally influence or facilitate decisions.

More guidance for this task comes from Quality Implementation Framework (QIF; Meyers et al. 2012, p. 469) in the form of questions to be considered:

- Do we have genuine and explicit buy-in for this program from:
  - Leadership in the organization (e.g., hospital, university)?
  - From front-line staff who will deliver the program?
- Can we identify and recruit champions?
  - Are there one or more individuals who can inspire and lead others to implement the program and the associated practices?
  - How can the organization assist the champion(s) in the effort to foster and maintain buy-in for change?
- Who will implement the program? (Initially, those recruited do not necessarily need to have knowledge or expertise related to the program; however, they will ultimately need to build their capacity through training and on-going support.)
- Who will support those who implement the program? (These individuals need expertise related to (a) the program, (b) its use, (c) implementation process, and (d) process evaluation so they can support the implementation effort effectively.)
- Do the roles of some existing staff need realignment to ensure that adequate person-power is put towards implementation?
- Who will have organizational responsibility and accountability for implementation?
- Can we develop a support team of staff to work with front-line workers who are delivering the program?
- Can we specify the roles, processes, and responsibilities of these team members?

The second key task is for the implementation team to document the host context. This entails assessment of the educational needs, resources, other existing programs, fit and readiness/capacity for implementation. The goal is to determine the degree of fit between the program and the host context, the possibility for program adaptation to ultimately inform the development of the implementation plan in the second phase. For example, when implementing a simulation boot camp program for junior general surgery residents, several questions to be considered are: Are there other boot camps in other surgical divisions that can be used to leverage the existing infrastructures, human resources, and time? Alternatively, are there any other programs that will deliver educational activities resulting in similar skills?

To guide this task, we again draw on CFIR (Damschroder et al. 2009) and QIF (Meyers et al. 2012, p. 470). In the case of simulation programs, CFIR could be used to explore the host context with the goal of informing implementation planning. Specifically, before the implementation starts, all or selected CFIR factors could be explored in a questionnaire, interview or focus group format with relevant stakeholders. This will identify aspects of the host context perceived as most likely to influence program implementation. Sample questions can be found at http://www.cfirguide.org/. Similarly, QIF could be used to complement CFIR by focusing on the "how to" of context exploration. Questions to be considered here are:

- Why are we doing this?
- What learning objectives and competencies will the program address (i.e., the academic/educational need for the program)?
- What part(s) of the organization and who in the organization will benefit from the program?
- Does the program fit the setting?
- How well does the program match:
  - The needs of the organization?
  - Organization's mission, priorities, values, and strategy for growth?
- Are we ready for this? Is the organization ready for change?
- To what degree does the organization have the will and the means (i.e., adequate resources, skills, and motivation) to implement the program?

Discussion among stakeholders at this initial phase could inform implementation outcomes such as acceptability (stakeholders' perception that the program is agreeable or satisfactory), appropriateness (stakeholders' perceived fit, relevance or compatibility of the program to the host context), feasibility (the extent to which a program is perceived as likely to be used or carried out within the host context), and cost of the implementation which is dependent on program complexity (Proctor et al. 2011), which will all inform the decision about program adoption. Thus, information gathered through completion of both tasks 1 and 2 (illustrated in Fig. 10.2a as a gate) leads to a decision about program adoption and a burgeoning plan for the process: to implement the program in its original form, to adapt it to fit the host context, or not to implement it at this point in time because of insufficient readiness, capacity, or fit.

10.5.3 Phase 2: Pre-Implementation Planning

The main task in phase 2 focuses on developing an implementation plan to inform the on the ground implementation of the simulation program happening in phase 3. To this end, the implementation team synthesizes and translates the information gathered in phase 1 into a detailed implementation plan. The contextual factors documented through CFIR can be divided into barriers and facilitators and aligned with phases in the development of the implementation plan. For instance, organizational resources, readiness, staff communication styles, program cost, staff knowledge and beliefs about the program could either facilitate or hinder implementation and need to be proactively addressed in the plan. Most of these activities are relevant to all phases of implementation, given that workflows, people, and organizations are not static and context is dynamic.

The implementation plan includes the "what, who and when" of the implementation, namely activities to be performed, schedules and milestones, and the people responsible for the completion of various activities. With respect to the "what," this plan entails identifying all of the activities related to implementation, such as frontline staff recruitment and training, procurement of equipment and infrastructure, provision of technical assistance and coaching, measurement of implementation process and outcomes. Moreover, the plan should include considerations for sustainability such as planning for staff turnover and new hires, ensuring that the resources required for program implementation continue to be in place, warranties on equipment, cost of consumables, wear and tear of the equipment and an equipment replacement plan. The "who" of the implementation includes identifying the people—frontline staff (e.g., clinician-educators), support team members who will work with the frontline staff (e.g., standardized patient educators, technicians), as well as those who are accountable for the implementation (e.g., director of simulation centre)—and their roles, processes and responsibilities. With respect to the "when," the plan needs to capture proper monitoring of adherence to the implementation schedule to inform the team regarding the implementation fidelity. For example, unanticipated delays may indicate potential institutional barriers and milestones reached on time or ahead of the schedule may indicate institutional strengths. Implementation work that proceeds either too slowly or too quickly can signal risk for failure (see Saldana et al. 2012).

QIF questions guiding this phase could include (Meyers et al. 2012, p. 470):

- Can we create a plan to provide sufficient training to teach the why, what, when, where, and how regarding the intended program?
- Can we create a plan to provide the necessary technical assistance to help the organization and frontline staff to deal with the inevitable practical problems that will develop once the program begins?
- Can we create a plan that includes specific tasks and timelines to enhance accountability during implementation?
- What challenges to effective implementation can we foresee that we can address proactively?
- Do we have a plan to evaluate the relative strengths and limitations in the program's implementation as it unfolds over time? Data are needed on how well different aspects of the program are being conducted as well as performance of staff implementing the program.
- Do we have a plan for a process through which key findings from process data related to implementation are communicated, discussed and acted upon?
- Do we have a plan for how process evaluation data will be shared with all those involved in the innovation (e.g., stakeholders, administrators, implementation support staff, frontline practitioners)

Given the complexity and length of the implementation endeavor, several common project management tools and resources could be used, such as:

- Gantt Charts—models for scheduling and for budgeting, and for reporting and presenting and communicating project plans and progress easily and quickly.
- Critical Path Analysis Flow Diagrams—a specialized method for identifying related and interdependent activities and events, especially where a big project may contain hundreds or thousands of connected elements.

Information about the "who, what and when" of the implementation plan must be all present in order to lead to a decision about continuing to phase 3 (i.e., implementation). If the "who, what and when" are not deemed to be sufficiently defined or feasible to proceed to phase 3, the implementation plan needs to be adjusted or aborted, as illustrated by Fig. 10.2b. More specifically, as illustrated in Fig. 10.2b by the "and" gate, the implementation team needs to check-in with the stakeholders until *all* conditions about the "who, what, when" are satisfactory. This implies that the final check-in with the group of stakeholders ensures that all conditions are met and the implementation plan is ready to move to phase 3.

10.5.4 Phase 3: Implementation Monitoring and Evaluation

Program implementation begins when the implementation team is tasked with executing the implementation plan, set in phase 2, while simultaneously collecting relevant data about both program outcomes (i.e., outcome evaluation) and how the program is being implemented (i.e., process evaluation). This differs from the predominant approach to the evaluation of simulation programs which focuses solely on program outcomes, with Kirkpatrick's (1998) model being the most commonly used. This model specifies monitoring outcomes at four levels:

- Level 1—learners' reactions about what they believed and felt about the program;

- Level 2—learners' knowledge or capability;
- Level 3—learners' behavior, defined as the extent of behavior and capability improvement and application to clinical practice; and
- Level 4—program results, defined as the effects on the clinical environment, practice, or system resulting from the trainees' performance.

Here, we propose to monitor both program outcomes and the implementation process. Doing so allows program implementers to measure, explain and contextualize program outcomes, and generate information for iterative program improvement (Alkin and Christie 2004; Dubrowski and Morin 2011). Without evaluating the process (i.e., are activities being implemented as planned and with process fidelity; do staff find program implementation feasible; is the program delivered as intended, with fidelity to the core program elements), it is difficult to understand what contributed to the program outcomes observed and if the program truly worked. For example, a good simulation program could be poorly implemented and thus result in suboptimal program outcomes. This highlights the importance of measuring implementation outcomes, in addition to program outcomes.

In the field of program evaluation, several process evaluation models exist that can be useful during this phase of implementation (Alkin and Christie 2004). For instance, Stufflebeam's CIPP Evaluation Model Checklist (Stufflebeam 2007) addresses evaluation of the program's context, input, process, impact, effectiveness, sustainability, and transportability. In the field of implementation science, process is typically evaluated by examining the degree to which activities are implemented as planned, in other words by measuring adherence to the implementation plan (e.g., The Stages of Implementation Completion tool; SIC; Chamberlain et al. 2011). In addition, CFIR could also be used to inform process evaluation. All or selected CFIR factors could be used in survey, interview or focus group formats, or to structure field notes in order to capture how various aspects of the host context are perceived to be linked to learning outcomes. This use of CFIR is different from phase 1 where context was examined to inform planning and address possible barriers by gauging stakeholders' opinions about factors important for the implementation.

Questions adapted from QIF to guide this phase should be applied periodically through phase 3 and could include (Meyers et al. 2012, p. 470):

- Are we following the "who, what and when" of the implementation plan as outlined in phase 2? And, are we doing so in a timely fashion—not too slowly, not too quickly?
- Are we following the process established in the implementation plan through which key findings from process data related to implementation are communicated, discussed, and acted upon?
- Are we continuously sharing process data on implementation with all those involved in the program (e.g., stakeholders, administrators, implementation support and frontline staff)?
  - This feedback should be offered in the spirit of providing opportunities for further personal learning and skill development.
- What lessons have been learned about implementing this program that we can share with others who have an interest in its use?
  - Researchers and developers can learn how to improve future implementation efforts if they critically reflect on their experiences and create genuine collaborative relationships with those in the host setting.

Information gathered through completion of both program outcomes and process evaluation in phase 3 (illustrated in Fig. 10.2c) is used to determine if the program works, if it is implemented with quality, as intended, and to inform possible revisions of implementation plan, as needed.

Upon completion of phase 3 evaluation, an abbreviated AIM-SIM should be used to continuously monitor the program (phases 1–3). The frequency of this monitoring will vary as a function of the program (new vs. established programs) and the context (e.g. likelihood of similar programs being offered). For instance, a surgical skills boot camp program designed to teach junior residents basic surgical skills will require modifications if a similar program is offered during clerkship. This is an example of a context change that is captured through evaluation in phase 1 and will inform possible revisions of the program and implementation plan.

10.6 Summary

According to Cook et al. (2008), the field of medical education, including simulation-based education, has moved through phases of descriptive scholarship, justification, and verification research, with the ultimate goal of generating evidence of the most effective and efficient use of simulation. To develop effective and efficient simulation programs, Haji et al. (2014) proposed a framework to guide verification research in the area of simulation-based education. However, having developed an effective, evidence-based program in a research laboratory setting does not guarantee the desired learning outcomes in a new, educational context. This is mainly because implementation quality and the fit between the program and the host context play a key role in this transfer and adoption process. To date, the focus of simulation-based medical education has been primarily on program development and effectiveness, with little attention to program implementation. Thus, the field is missing a similarly systematic and evidence-based approach to program implementation that would not only lead to rapid and sustainable implementation, but also generate information about program generalizability to other contexts.

Given the increasing complexity of simulation-based education over the past few decades (Roussin and Weinstock 2017) and the recognized need for best practices for implementation (Kurashima and Hirano 2016), in this chapter, we proposed an Adapted Implementation Model for Simulation (AIM-SIM). AIM-SIM is intended to practically guide institutions in their efforts to implement new simulation programs and is entirely derived from several established models of context (CFIR; Damschroder et al. 2009), process (QIF; Meyers et al. 2012), and outcomes (IO; Proctor et al. 2011), adapted to the context of simulation-based medical education. Our goal is to increase simulation-specific implementation capacity by offering a systematic approach to program implementation. As such, AIM-SIM is based on information from the emerging field of implementation science, which is increasingly used to optimize program implementation and maximize the desired outcomes. AIM-SIM is not intended to be a fixed model but rather a starting point that can be further revised based on evidence from implementation science as well as evaluation of the AIM-SIM model itself.

AIM-SIM includes three main implementation phases: (a) stakeholder engagement and context exploration, (b) pre-implementation planning, and (c) program implementation with monitoring and ongoing evaluation. Within each phase, the implementation team performs several tasks that inform planning and execution in the following phases. The implementation of simulation programs is typically a dynamic, complex and lengthy process. The speed with which implementers will move through these phases and tasks will likely depend on many factors, such as size of the educational institution, its resources, administrative complexity and collaborative climate, the skills and knowledge of the implementation team and frontline staff, as well as the complexity of the simulation programs themselves. Systematic gathering of data from process and outcome evaluations not only will inform the implementation team about the success of the program and the contextual factors associated with its success, but it will also contribute to building a body of generalizable knowledge to be used by institutions that intend to implement similar simulation-based programs.

The field of implementation science offers a whole menu of models, frameworks, and theories. The readers may thus wonder why it is necessary to add an implementation model to the field of medical education and simulation. We argue that the availability of such models in implementation science—a field distinct from medical education—does not guarantee their use by other fields. Also, as noted in the introduction, historically, this point has been demonstrated by the fact that fields such as education (Century and Cassata 2016; Halle et al. 2013), mental health (Proctor et al. 2009), prevention and promotion (Chinman et al. 2008), global health (Barwick et al. 2015; Ridde 2016), nursing (Van Achterberg et al. 2008), and emergency medicine (Bernstein et al. 2015; Carpenter and Lo 2015) have looked at implementation science and selectively adopted strategies, concepts, and models to fit their needs. This is precisely what we intended with this chapter by proposing to the field of medical education an *adapted* implementation model. Finally, this approach aligns with the position taken by Birken et al. (2017) in a recent article in Implementation Science, where they argue that "the underuse, superficial use, and misuse of [implementation science] theories pose a substantial scientific challenge […] and may relate to challenges in selecting from the many theories in the field."

This is one of the concluding chapters in a book describing a collection of boot camp simulation programs. Each program has a list of unique features, and exists in a unique environment. The programs also share a number of features and their host environments may have significant contextual overlaps. Documenting how programs are being implemented as well as similarities and differences in the programs and contexts may prove useful for future development and implementation of simulation programs. In addition, this chapter complements the others included here by focusing on the implementation process and addressing some of the questions that many program implementers ask: Why do some programs succeed and others do not? Can we predict which ones will be successful before implementation or during early implementation stages? What are the key implementation steps that need to be followed and the contextual factors that shape their implementation?

Key Learning Points

- An effective program, combined with quality implementation, increases the likelihood of achieving the desired outcomes. Emphasis should be placed on program selection and the evidence supporting the program and on how well the program is being implemented.
- Implementation needs to be informed by the science of implementation.
- Implementing a program is a long and complex process that needs to be properly executed in order to increase the chance of achieving desired learning outcomes.
- Implementing a program should be conducted by an implementation team, according to an implementation plan.
- The implementation plan should be informed by implementation evidence and careful examination of the host context.
- Data from program outcomes and process evaluation should be used to determine if the program worked, what contributed to its success or lack of success, and to improve future program planning and implementation.

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