

Perspective Article

Use of the Forging Alliances in Interdisciplinary Rehabilitation Research (FAIRR) Model to Develop an Intervention Using a Mixed Methods Approach

Simone V. Gill¹, Christine A. Helfrich²¹College of Health and Rehabilitation Science: Sargent College, USA;²American International College, Division of Occupational Therapy, USA**Abstract**

Creating interventions benefits from an interdisciplinary team with varying types of expertise. Novelty in intervention creation can be extended beyond the addition of new technologies to include innovations in methodologies used to create interventions. The purpose of this paper is to use and expand a previously introduced model to sustain new interdisciplinary research collaborations: Forging Alliances in Interdisciplinary Rehabilitation Research (FAIRR). In this paper, we propose to expand FAIRR by incorporating theories and frameworks central to intervention creation, altering inputs (resources necessary to construct interventions), modifying activities (tasks that teams undertake to create interventions), and including the iterative nature of the relationship among the components of the model. A case application is used to underscore how the FAIRR model can be applied to creating an intervention using a mixed methods approach.

Keywords: Interdisciplinary, Rehabilitation**Introduction**

Creating multi-faceted interventions requires a strong interdisciplinary team with expertise in rehabilitation science and theories supporting rehabilitation approaches¹⁻⁴. Building teams to construct interventions needs a nuanced approach, especially when rehabilitation teams are tackling populations that we know little about^{5,6}. It is critical to ensure that novelty in intervention construction extends beyond technologies and includes both the methods and the interdisciplinary team members the team chooses to include. Expanding our view of innovation in intervention construction can lead to obtaining a more complete picture of how to improve patients' lives.

The purpose of this paper is to implement and

extend a model previously introduced¹ to construct new interdisciplinary research collaborations: Forging Alliances in Interdisciplinary Rehabilitation Research (FAIRR). We will: 1) demonstrate the use of the FAIRR model in constructing and implementing a fall prevention intervention for people living with HIV, 2) illustrate how our interdisciplinary team used the model in constructing an interdisciplinary team and intervention, and 3) illustrate our use of the model and its expansion with our case application.

FAIRR Model: Theories and Frameworks

The FAIRR logic model includes inputs, activities, outputs, outcomes, and impacts¹. Since we are focusing on the construction of a new intervention, in this paper we will discuss theories and frameworks that guide the research (Figure 1A), inputs (Figure 1B), and activities (Figure 1C), which are nested within the selected theories and frameworks. The relationship both within and between inputs and activities is active and iterative (Figure 1D).

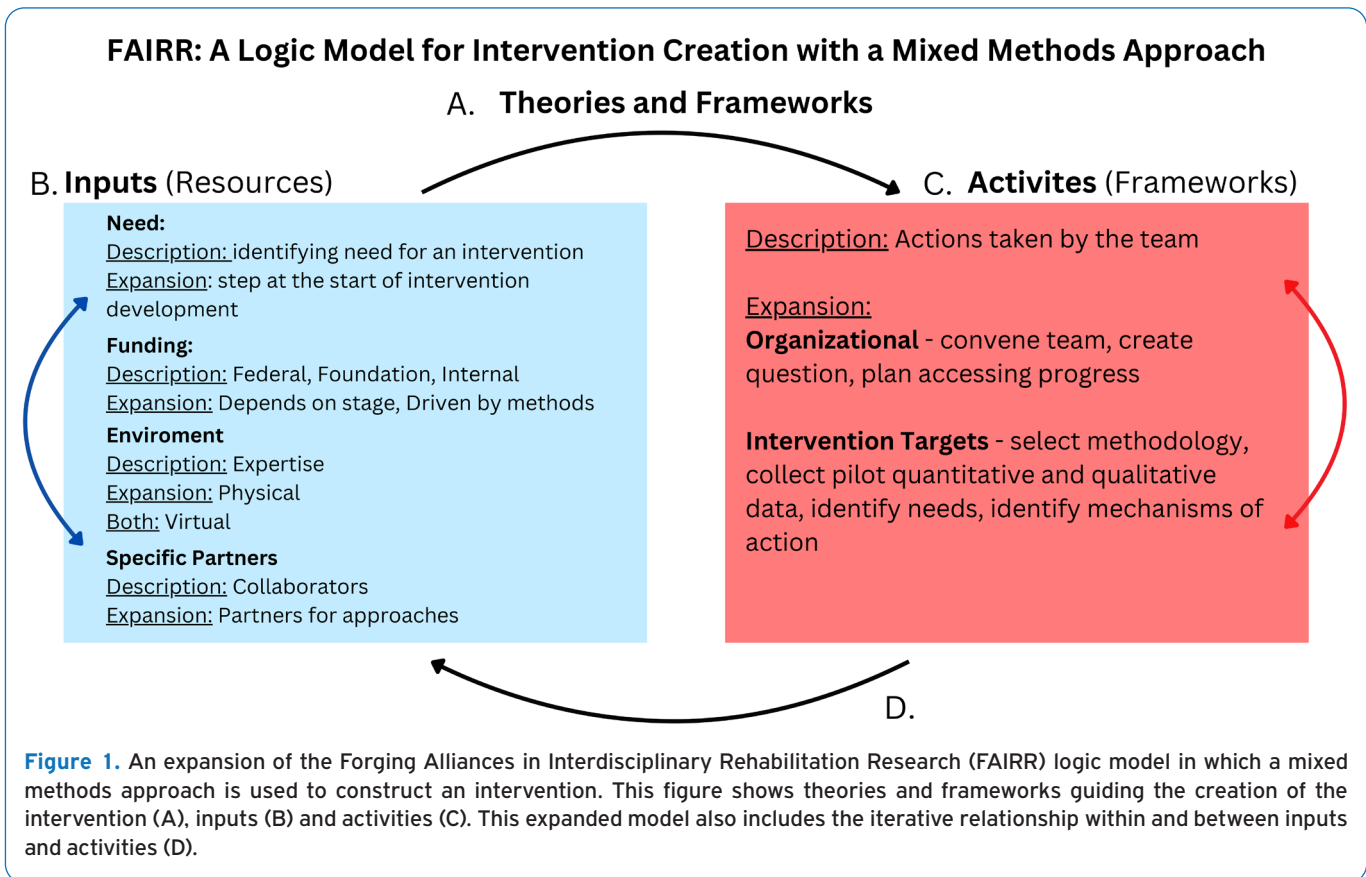
Rehabilitation scientists have a specific lens that allows them to have a broad view of how to approach creating interventions for patients⁷. That broad view relies on theories at the heart of rehabilitation scientists' research

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Corresponding author: Simone V. Gill 111 Cummington Mall, Boston, MA 02215, USA
E-mail: simvgill@bu.edu

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questions. Interventions need to center on what challenges patients are experiencing secondary to conditions and how we can choose intervention components that address multiple challenges that patients' conditions pose⁸. Mixed methods study designs are poised to fill the need for client-centered approaches to creating interventions⁹⁻¹¹. When pulling in both quantitative and qualitative methodologies with a mixed methods design, it is especially important to consider theories and frameworks that can be used to unify the approaches and streamline the interpretation of outcomes. Many theories and frameworks in the rehabilitation sciences can be considered. For example, the International Classification of Functioning, Disability, and Health (ICF)^{12,13} is a biopsychosocial model that captures multiple aspects of a health condition that could be measured both quantitatively and qualitatively (e.g., body functions can be measured with standardized assessments and captured via patients' experiences from a focus group); Figure 1A.

FAIRR Model: Inputs

Inputs are defined as the resources that are required to assemble a team and to conduct research activities: funding, environment, and specific partners (Figure 1B)⁴.

An extension of our model includes examining the need for an intervention.

Need

Prior to garnering funding, establishing an environment, and gathering specific partners, the need for an intervention should be identified^{14,15}. Information on the need for the intervention can stem from a variety of sources such as examining the literature for prevalence or incidence of a challenge in a particular population (e.g., rate of falls) or from clinical expertise in which rehabilitation specialists identify problems experienced by a population for which an intervention is needed.

Funding

Medical conditions are complex and may require multifaceted but costly approaches for treatment. Thus, financial resources are needed to create and test the efficacy of interventions. The amount of funding needed depends on both the stage of the intervention and the chosen methodology. Earlier stages of intervention construction can be completed with small foundation grants or with internal sources of funding^{16,17}. However, the methodology that the

Table 1. Examples of Data Collected in Physical and Virtual Environments.

Environment	Type of Data	Considerations
- Physical (in-person)	<ul style="list-style-type: none"> - Assessments with hands-on techniques (e.g., manual muscle testing) - Activities with special equipment (e.g., walking while collecting three-dimensional motion analysis) 	<p><u>Advantages:</u></p> <ul style="list-style-type: none"> - Visually assess responses in person - Control of constructing study space - Access to equipment <p><u>Disadvantages:</u></p> <ul style="list-style-type: none"> - Travel and participation time - Up-front travel costs
- Virtual (online)	<ul style="list-style-type: none"> - Self-report assessments - Activities that can be observed on video - Semi-structured interviews - Focus groups 	<p><u>Advantages:</u></p> <ul style="list-style-type: none"> - No travel time - No travel cost - Increase participant access - Can use face time or video conferencing <p><u>Disadvantages:</u></p> <ul style="list-style-type: none"> - Dependent on internet access and video conferencing - Potential lack of familiarity with video conferencing - Privacy & confidentiality

team chooses might require larger funding sources (e.g., the National Institutes of Health). In particular, mixed methods study designs, which incorporate both quantitative and qualitative methodology require larger sums of funding to execute for two main reasons. First, use of a mixed methods design requires including salary effort for both quantitative and qualitative experts¹⁰. Second, participants must be financially compensated for taking part in quantitative testing (e.g., assessments of physical functioning) and qualitative components (e.g., semi-structured interviews). Albeit costly, mixed methods designs can lead to the development of interventions that are more appropriate and comprehensive than interventions constructed using either method in isolation.

Environment

The original FAIRR model conceptualized the environment to be the research experience, clinical competencies, and career stages reflected in the team⁴. Other types of environments can be considered as inputs in the context of creating an intervention such as physical and virtual environments.

Physical Environments

Gathering data from participants to inform intervention construction traditionally occurs in a research laboratory at a university or medical center. In-person visits are advantageous for obtaining measures that need a hands-on

approach (e.g., measuring joint angles), being in control of the study layout, and accessing specific equipment. Taking measurements in-person is often required for quantitative assessments, especially those focusing on body functions and structures in which special equipment is needed¹⁸. The drawback of relying on physical environments is that in-person visits require patients to devote considerable time and up-front travel costs to participate^{19,20}. For qualitative approaches such as focus groups, scheduling in-person visits can be challenging as researchers must align multiple patients' schedules for visits. Therefore, many studies that primarily rely on in-person visits often include highly resourced participants who have the time and money to travel to research laboratories. This limits the generalizability of study results and the extent to which the intervention will be accessible to patients without the time and money to participate. Both decrease the external validity of the intervention.

Virtual Environments

In recent years, video conferencing has made it possible for researchers to interact with participants virtually. This was especially critical during the COVID-19 pandemic when in person lab visits were not permitted^{3,21}. Although assessments requiring hands-on techniques cannot be administered virtually, researchers found there were unexpected advantages to virtual environments. Virtual visits can ameliorate problems with travel time, childcare, and costs to participating in studies. Virtual

environments allow the inclusion of populations that are often unintentionally excluded from research such as people from low-income backgrounds^{22,23}. Despite concerns that not all participants will have internet access and video conferencing capabilities on their devices, in our work with unhoused individuals we found this was rarely the case. There may also be concerns about ensuring that participants have the privacy to participate virtually to protect their confidentiality. However, we found that being able to participate in a study via phone allowed individuals to join a focus group during a lunch break from work or while their child played in the same room. Ideally, combining both physical and virtual environments can mitigate the disadvantages and augment the advantages of each approach²⁴. Table 1 shows examples of data that can be collected in physical and virtual environments for creating interventions and incorporating a mixed methods approach.

Specific partners

Research teams conducting novel studies on topics that are new to them may require additional partners (i.e., collaborators) to address their research questions²⁵. This is particularly true when using a mixed methods approach. The use of mixed methods is still relatively new²⁶, so many researchers who wish to use this approach must expand their research study teams. Since there are several ways in which quantitative and qualitative approaches can be combined, it is critical to include all research team members at the start of planning and creating an intervention. For example, researchers could choose to conduct qualitative and quantitative approaches in separate sequences (e.g., using findings from semi-structured interviews and to select which physical functioning assessments to administer to patients). In this instance, researchers can start with a quantitative approach and follow up with qualitative data (explanatory sequential mixed methods) or start with a qualitative approach and then use quantitative data collection (exploratory sequential mixed methods)²⁷. In contrast, researchers could collect qualitative and quantitative data in tandem (convergent parallel mixed methods)²⁷. In collecting both together, one approach may illuminate findings from the other (e.g., participants' low physical activity measures from accelerometry may have been due to reports in participant focus groups of feeling stigma while wearing the accelerometers in public). Including all partners at the outset can help in being deliberate and intentional on what approaches to use in constructing interventions.

FAIRR Model: Activities

The activities that researchers chose to move forward with in creating their intervention are informed by their theoretical framework and inputs related to the need for the intervention (Figure 1C). Because there are typically multiple methodologists involved, there often needs to be

an intentional discussion of which theories are compatible or complimentary. Some activities may be organizational in nature while others may entail deciding on intervention components to target.

Organizational Activities

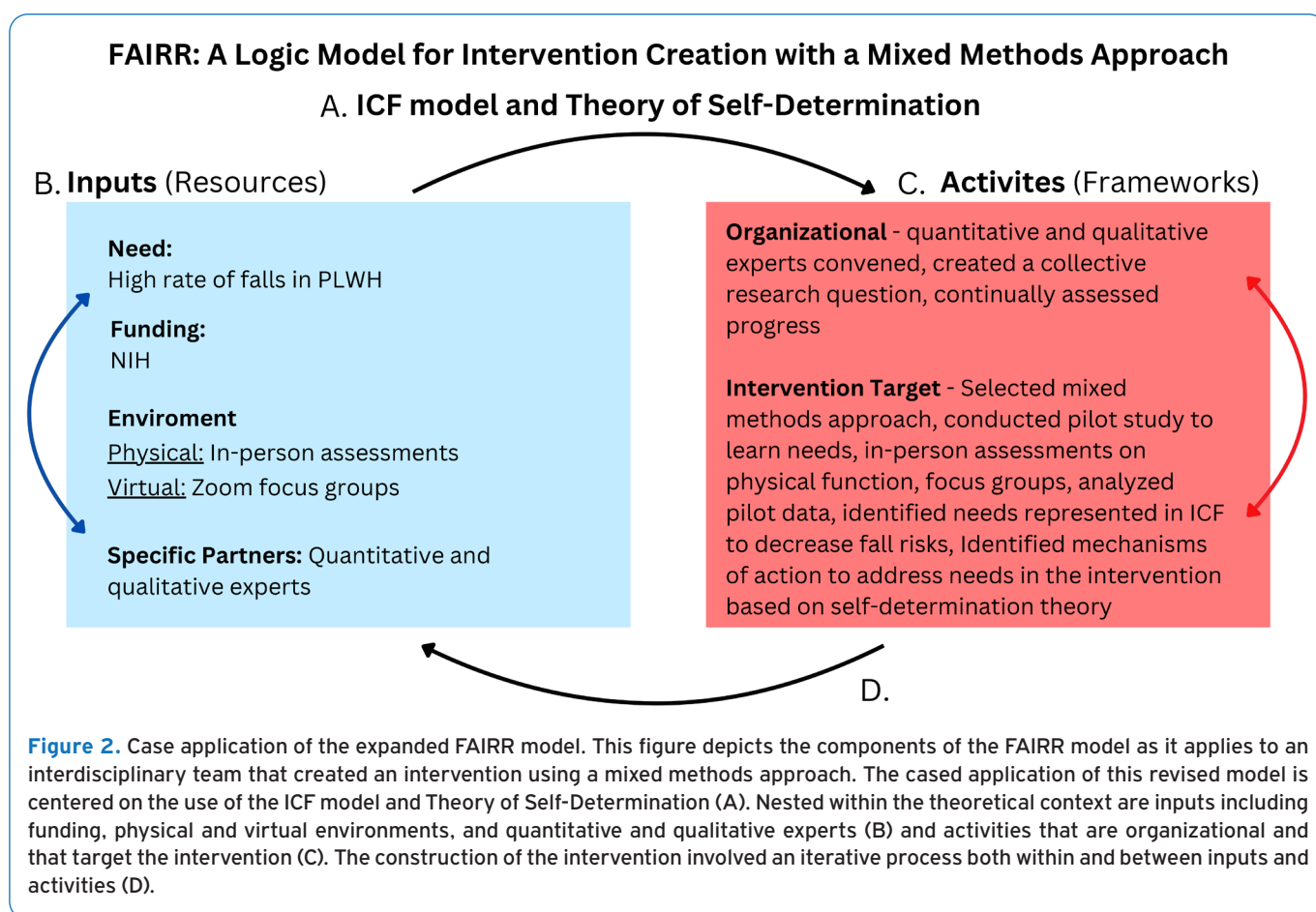
The organizational activities that occur may include several items. Once the study team has been identified (e.g., Principal investigators, Co-investigators, and other specific partners), the team must convene to discuss each person's potential role and contribution. One strength of interdisciplinary teams is their ability to construct studies that answer larger questions. However, interdisciplinary teams require more coordinating than teams in which all members are from the same discipline²⁸; team members from various disciplines may view the same problem from different theoretical viewpoints and have bits of information that do not overlap with other team members' information. It is also important to understand how each team member operationalizes the problem, which defines the need for the intervention. Therefore, another organizational activity may include taking time to vet through the team's knowledge base and language to develop a collective research question to pursue. The team can also create a plan for assessing their progress. All organizational activities can be iterative. For instance, after discussing the research question, the team may decide that an expert from another field needs to be added.

Intervention Targets

A separate set of activities can be directed at solidifying what areas to target in the intervention that address the challenges faced by patients²⁹. After the need has been established, the research team can begin by determining what methods, procedures, and protocols will be used to structure the intervention. With a mixed methods approach, both quantitative and qualitative methods must be included. Further discussion among the team can include how data will be gathered for the needs assessment (e.g., via observation or direct assessment; via semi-structured interviews or focus groups). Conducting a needs assessment using participatory methods is especially critical when working with new or unfamiliar populations. With input from the target population, the team can use their theoretical and specialized knowledge to design a more acceptable and relevant intervention that can be pilot tested. Pilot testing can then assess the acceptability, feasibility, effectiveness and outcomes of the intervention. The entire team needs to understand how the intervention strategies will lead to the outcomes of the intervention.

Case Application of Inputs and Activities Nested Within Theory

The FAIRR model can be used to illuminate inputs and activities nested within a theoretical lens when constructing



interventions. For example, Figure 2 depicts the theoretical lens, inputs, activities, and the iterative nature of the model from the culmination of a large NIH center grant aimed at designing and implementing a pilot randomized controlled trial. This case application exemplifies how the theoretical framework drove the selection of the original inputs and activities conducted. At the start of the study, the aim was to use previously collected quantitative data on physical function to create a fall prevention intervention for people living with HIV (PLWH), which relied solely on in-person visits. These data confirmed that PLWH were experiencing a high rate of falls establishing the need for a fall prevention intervention. However, an additional collaborator believed that the creation of the intervention should include the experiences of PLWH because they represented a vulnerable population with little known needs in relation to reducing falls. Consequently, that collaborator advocated to include yet another partner with qualitative and participatory methodological expertise. The addition of the qualitative expert led the team to reconsider the previously identified input and activities being used to construct the intervention (Figure 2A & 2B). We used the quantitative data on physical

function as planned. However, we also incorporated qualitative methodology via key informant interviews with PLWH who had experienced falls to explore their perceptions of what caused their falls. Then, focus groups were conducted to gather input on the format and content of a potential fall prevention intervention with additional PLWH. Although the focus of the current paper is on using the FAIRR model to develop the intervention, the use of the FAIRR model also drove the kinds of outcomes that we measured after planning the intervention. For example, originally, we would have focused solely on measuring aspects of participants' physical function (e.g., grip strength) after the intervention. In contrast, the use of the FAIRR model led us to incorporate gathering participants' perspectives during the group discussions to track changes in their perceptions over the weeks of the intervention.

The planning environment was both physical and virtual; we measured physical function with assessments and conducted interviews with key informants in person, and we conducted focus groups virtually due to limitations on in-person activity during the COVID-19 pandemic. Our methodological activities shifted due to the change in our

specific partners which included both quantitative and qualitative methodologists.

The activities were both organizational and directed at intervention targets (Figure 2C). We convened the team, constructed a collective research question, and iteratively assessed and modified our progress. We designed an intervention based on both quantitative and qualitative findings with a mixed methods approach by collecting pilot data with in-person assessments on physical function and focus groups of PLWH who had fallen in the past. The additional in-person key informant interviews, which identified unanswered questions allowed us to include more input through the cost-effective and efficient use of virtual focus groups. The results of the pilot data revealed that patients had the following needs: to increase grip strength and balance, to meet their needs for adaptive equipment using items found in their environments, to address structural barriers due to being under-resourced and/or unhoused, and to feel supported by an intervention with both group and individual components. Guided by the International Classification of Functioning, Disability, and Health (ICF), we centered our intervention components around four ICF areas: body functions/structures (grip and balance), personal factors (structural barriers), environmental factors (adaptive equipment), and participation (group and individual intervention). Self-determination theory³⁰ was used to define mechanisms of action to meet patients' needs with our intervention. Each domain of self-determination theory was included in the intervention components: Autonomy (targeted via the mechanism of Creating Goals); Competence (via Improving Skills); and Relatedness (via Behavioral Regulation and group interaction). Each area of need gathered from the pilot data was reflected in the intervention via patients creating individual goals, practicing movements to improve their skills, and regulating their behavior in group discussions. Each of these components was evaluated iteratively both within and between our inputs and activities (Figure 2D). We were also careful to document unexpected outcomes and lessons learned to inform future interventions. Since the field of rehabilitation sciences is very interdisciplinary, it was advantageous to use the ICF model to describe factors impacting health conditions: the ICF model cuts across interdisciplinary fields and serves as a unifying framework in the rehabilitation sciences. In the context of intervention research, multiple frameworks are typically required to fully conceptualize the mechanisms of action at play. Self-determination theory was the best fit for our intervention given the focus on motivation to help participants to create goals, to improve their skills, and to regulate their behavior.

Limitations

There are several limitations to our application of the expanded FAIRR model. First, logic models offer a means for organizing collaborations and team activities. However, logic models are linear in nature, which may create a false

sense of control and rigidity in thinking and in creating goals. Consequently, our expanded model acknowledges the dynamic and iterative nature of the components of the FAIRR model. Second, how researchers implement mixed model approaches is being explored and refined. Third, there are also limitations to using the FAIRR model in non-academic or in lower-resourced settings due to its focus on research and the resources required to conduct intervention-based research. Last, the FAIRR model may also be challenging to apply in settings where the use of a mixed-methods approach conflicts with real-time planning. Despite these limitations, the use of a mixed model approach ensures that patient perspectives are included, which improves the feasibility and acceptability of adopting the intervention.

Conclusion

This expansion of the FAIRR model provides a framework for researchers from different disciplines to collaborate on intervention development. The model allows an interdisciplinary research team to use diverse theories and mixed methods to develop an intervention; it is encompassing enough to include multiple inputs that may be contradictory in nature yet lead to better outcomes. In essence we argue that the FAIRR model is dynamic and malleable while still providing enough structure to guide a complicated and multifaceted project: designing a theoretically based, mixed methods community-based intervention.

Authors' contributions

SG completed the initial draft the manuscript, SG and CH completed the final version of the manuscript and the revision; SG is responsible for study design and literature search; SG and CH were responsible for data collection and data interpretation. All authors read and approved the final version of the manuscript.

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