



Blueprint for Enhancing Implementation Quality of *Criança Feliz* Program in Brazil: A Combined Program Impact Pathways-ERIC Approach

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Abstract

Brazil's *Criança Feliz Program* is one of the largest early childhood development home-visiting programs globally. After seven years of scaling up, implementation barriers across diverse municipality settings prevented the program from achieving the intended impact on parenting skills and child development. We conducted a program impact pathway analysis to generate a blueprint to enhance implementation quality by (1) identifying the critical quality control points that need to be monitored throughout the scaling up and (2) specifying implementation strategies for enhancing implementation quality. The program impact pathway analysis consisted of inductive and deductive coding of pre-existing retrospective (e.g. reports, and codebooks from in-depth interviews) and workshop with national team to identify the critical quality control points and corresponding implementation barriers and facilitators. The Expert Recommendations for Implementation Change taxonomy was used to specify implementation strategies facilitating the scaling up or opportunities to address barriers across critical quality control points. We identified seven critical quality control points: hiring municipal workforce; staff training; home visits; complementary multisectoral actions; municipal supervision; technical assistance and monitoring; and funding. Implementation strategies facilitating the scale-up were “providing assistance” and “supporting teams;” opportunities for enhancing implementation quality were “financial strategies” and “evaluative and iterative strategies.” Our analysis identified seven critical quality control points necessary to achieve the intended implementation and program outcomes. The combined use of the program impact pathway and the Expert Recommendations for Implementation Change taxonomy generated a meaningful blueprint of implementation strategies to enhance implementation quality, which may support the sustainability of a large-scale program.

Keywords Scale-up · Sustainability · Implementation theory · Quality improvement · Low-income settings

Introduction

About 250 million children under the age of five living in low and middle-income countries are at risk of not reaching their full childhood developmental potential due to factors like poverty (Black et al., 2017a, 2017b; Britto et al., 2017; Richter et al., 2017). Brazil is a large middle-income country in South America with nearly 4.14 million people living in poverty, of which 49.9% are children between the ages of 0 and 5 years (Cardin, 2024) live across 5,570 municipalities with sharp sociodemographic inequities (Buccini et al., 2022). The Nurturing Care Framework components – good health, adequate nutrition, responsive caregiving, opportunities for early learning, and safety and security (Britto et al., 2017); provide a roadmap to integrating programs and addressing inequities that prevent children from reaching

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their full developmental potential. In 2016, guided by the Nurturing Care Framework and supported by national legal statutes (Brasil, 1988, 1990, 2016), the Brazilian national government began the scale-up of the *Programa Criança Feliz* (PCF, or ‘Happy Child Program’) (Buccini et al., 2021).

The PCF seeks to provide (1) home visits based on the Care for Child Development curriculum to foster child stimulation and responsive parenting skills (Lucas et al., 2018), and (2) complementary multisectoral actions to mitigate socio-vulnerabilities of participating families. The PCF uses a multilevel implementation strategy across the three administrative levels of the Brazilian government. The national level is responsible for funding, articulating the multisectoral approach, and coordinating the implementation by developing protocols, training, and monitoring strategies. The state level provides technical support to municipal teams. At the municipal level, teams are responsible for home visits and complementary multisectoral actions (Buccini et al., 2021, 2024).

Scale-up refers to the expansion of program coverage to broader geographic areas, to maximize reach, effectiveness, and long-term impact (Bauer et al., 2015). By 2023, the PCF had been scaled up to 3,028 municipalities (representing 54% of all municipalities in Brazil) and exceeded 57 million home visits annually. After seven years of scaling up, a two-phase implementation evaluation documented implementation barriers that led to poor fidelity, and quality of home visits, as well as a lack of complementary multisectoral actions (Buccini et al., 2021, 2024). These implementation barriers, to a large extent, have prevented PCF from achieving the intended impact on parenting skills and child development under routine operating conditions (Santos et al., 2022).

As PCF begins the second scaling-up phase, we hypothesized that implementation science methods such as the program impact pathway (PIP) could inform quality improvements to optimize implementation strategies (i.e., activities used to enhance program adoption, implementation, and sustainability (Proctor et al., 2011)) that are not working well (Buccini et al., 2021, 2024). PIP is an approach to identify and monitor implementation pathways (i.e., the sequence of program activities and how they are expected to be delivered to achieve program impact (Scheirer, 1987)). The PIP analysis derives from “intimate knowledge of the program” obtained during interviews with implementers and program participants (Pérez-Escamilla et al., 2014). By expanding upon a dynamic logic diagram for program implementation, researchers and implementers can visualize from start to finish the pathways through which an effective program could be delivered (Avula et al., 2013; Buccini et al., 2019; Melo et al., 2022; Nguyen et al., 2014). The ultimate goal of the PIP analysis is to identify critical quality control points

(CQCP) that must be monitored to detect factors that promote or hinder a program from being delivered properly and achieving intended outcomes (Buccini et al., 2019). Thus, we conducted a PIP analysis to generate a blueprint to enhance PCF implementation quality by (1) identifying CQCPs that need to be monitored throughout the scaling-up, and (2) specifying implementation strategies for enhancing implementation quality of a large-scale program.

Methods

This qualitative case study assessing PCF implementation pathways received ethical approval from the Research Ethics Committee of the Health Institute of the São Paulo State Health Department (n. 3.320.733) and by the Institutional Review Board of the University of Nevada, Las Vegas (n. 1,702,327–2). Additional approvals were granted by the research committees of the participating municipalities and departments. All participants provided verbal informed consent following a description of the study’s purpose and design. We followed the Consolidated Criteria for Reporting Qualitative Studies (COREQ) to report the study findings in this manuscript (Online Resource 1).

Research Team Positionality

The research team consisted of two PhDs faculty researchers at U.S higher education institutions (GB, RPE) and three graduate research assistants (KC, RD, LG) receiving their training in public health. They all had prior training in qualitative and implementation science research and two of them have advanced training in early childhood development (GB, RPE). Additional information on the research team positionality is provided below.

Frameworks

Program Impact Pathways (PIP)

We used the PIP program evaluation approach to systematically map PCF implementation pathways by assessing the mediating activities between program inputs, delivery, and outcomes following a causal logic, while also accounting for the contextual factors that might influence the effectiveness of the intervention (Rogers, 2002). With input from key actors, the PIP diagram mapped the planned activities and conceptualized outcomes from the national, state, and municipal levels by which the PCF intends to achieve implementation, program, and impact outcomes. The logical sequence of the PIP diagram included five domains: (a)

Program initiation consists of the inputs or components that must be in place at the three levels of government (national, state, municipal) to start PCF implementation; (b) Program delivery involves the planned activities and processes to deliver the PCF; (c) Implementation outcomes entails conceptualizing short-term goals according to the implementation outcomes framework (Proctor et al., 2011); (d) Program outcomes focuses on conceptualized intermediate-term goals; and (e) Impact outcome encompasses long-term goals. Using the PIP framework, we identified CQCPs that should be monitored to detect challenges and address them in time to maximize the impact of the PCF. Barriers and facilitators related to CQCPs were systematically identified. The analytical approach is detailed below.

Expert Recommendations for Implementation Change (ERIC)

The ERIC taxonomy outlines a compilation of 73 implementation strategies grouped into nine content-related categories: using evaluative and iterative strategies; providing interactive assistance; adapting and tailoring to context; developing stakeholder interrelationships; training and educating stakeholders; supporting teams; utilizing financial strategies; changing the infrastructure; and engaging the demand side (Powell et al., 2015; Waltz et al., 2015). In our study, the barriers and facilitators within each CQCP were coded following the nine categories proposed by the ERIC (see definitions adapted to the context of the PCF in Online Resource 2).

Data Sources

Retrospective Data

Retrospective data included pre-existing (1) PCF official documents (e.g., legislation, regulations, laws, decrees, bills), national-level standard operational manuals (municipal implementation guide, training manuals, monitoring manuals) (see Online Resource 3); (2) reports from evaluations on PCF implementation commissioned by the Ministry of Citizenship including (i) an assessment of the PCF implementation in 15 municipalities across Brazilian regions, (ii) an assessment of PCF implementation in 9 municipalities across the state of Goiás, located in the Western-Central Brazil, and (iii) an assessment of management and monitoring practices within the PCF across Brazil; and, (3) databases on our team's two-phase implementation evaluation of barriers and facilitators to scale-up the PCF (Buccini et al., 2021, 2024). This included results from interviews with 22 with state-national level PCF team members conducted between October 2019 to January 2020 (Buccini et al., 2021), and

244 interviews with municipal-level PCF members ($n = 132$ supervisors/home visitors, $n = 17$ managers involved in the multisectoral implementation of the PCF, and $n = 95$ families participating in the program for at least 6 months) conducted between June 2021 to May 2022 (Buccini et al., 2024). In both evaluations, participants were eligible if they worked or participated in the PCF for at least 6 months. The individual interviews were conducted by two co-authors (GB and LG), who are trained in public health with experience in qualitative interviews and implementation science research. Participants were told the goals of the study and interviews lasted about 40–70 min each, were audio recorded with permission, and transcribed verbatim by a professional Portuguese speaking service. No participant refused to participate in the study. Data collection concluded when thematic saturation was achieved, which was defined as no new barriers and facilitators identified in four consecutive interviews. Barriers and facilitators were coded across the RE-AIM dimensions (Reach, Effectiveness or Efficacy, Adoption, Implementation, and Maintenance) (Holtrop et al., 2021). A full description of the participant characteristics, the interview guide, and the data management process are published elsewhere (Buccini et al., 2021, 2024).

Workshop Data

Workshop data included verbatim transcripts of one session conducted with a purposive sample of eight ($n = 8$) members of the PCF national coordination team working in different PCF departments (e.g., training, monitoring, articulation with states, and research). Eligibility criteria were (1) the member should have been working in the PCF implementation for at least six months, and (2) the member was available to participate in a four-hour workshop session.

Workshop is a participatory data collection approach that has been used successfully to consult and collaborate with implementers to generate reflection, and meaningful insights on program implementation pathways (Pérez-Escamilla et al., 2014). In this study, the workshop consisted of a highly iterative group discussion and feedback following a methodology previously used to engage participants in the PIP analysis (Pérez-Escamilla et al., 2014). In brief, one co-author (GB), who is a female faculty member and native Portuguese speaker, moderated the workshop. She had prior in-depth knowledge of the CF program as well as a prior professional relationship with some of the participants, which facilitated high attendance in the workshop session. Participants were explained the goals of the study prior to the workshop. The workshop began with a presentation of the PIP diagram to the national coordination team. After the presentation, participants were invited to provide feedback, followed by a discussion of the activities outlined. The goals of the discussion were to expand the group's understanding

of program implementation aspects, integrate diverse points of view, and reach consensus on program implementation needed generate the revised PIP. The virtual workshop took place in November 2020 and lasted four hours. The workshop was audio recorded and transcribed verbatim for analysis. After the workshop, a report with the revised PIP was shared with participants for further feedback. Participants reviewed the report and no new insights were elicited. Thus, one workshop session was deemed sufficient to develop the PIP diagram integrating the national implementation team's views on the program implementation.

PIP Analyses

The PIP analyses integrated retrospective and workshop data in four steps. The first two steps determined PCF implementation theory, and the last two determined PCF implementation pathways, including barriers and facilitators (Fig. 1).

Step 1–Initial PIP

Using an inductive approach, we coded retrospective information from PCF official documents across the five PIP dimensions defined in the framework section (see Online Resource 3). The coded material generated an initial PIP diagram.

Step 2–Revised PIP

Through a deductive approach, we coded retrospective PCF evaluation documents to expand, detail, and revise the dimensions of the PIP diagram. At this step, a narrative description of the PIP was developed.

Step 3–Identifying the CQCPs

Transcripts from the workshop conducted with the implementation team members were reviewed by two co-authors

(KC, GB). Using a combination of inductive and deductive coding approaches, we mapped the (a) CQCPs that need to be monitored to ensure the implementation quality of PCF services, (b) facilitators and barriers across CQCPs (see Online Resource 4), and (c) intended implementation outcomes guided by the dimensions of the RE-AIM framework (Holtrop et al., 2021). Any disagreements during the coding process were resolved by consensus.

Step 4–Opportunities for Enhancing Implementation Quality

Using the nine categories from the ERIC taxonomy (Waltz et al., 2015), facilitators and barriers within each CQCP were independently coded by two co-authors (LG, GB). At the end of this step, we described ERIC categories and discrete strategies facilitating as well as opportunities to address barriers that can help improve the implementation quality.

Results

PCF Implementation Analysis

Table 1 outlines the actors and planned activities across program components: (a) Program initiation begins with the responsibilities of the PCF National Coordination Team, which includes coordination and funding, as well as formulation of the initial PCF staff training based on the Care for Child Development curriculum through a training cascade. These components connect with activities developed at the state level, such as technical assistance to monitor the quality of municipal activities. At the municipal level, the Social Assistance Secretary develops a municipal-level implementation plan and applies for national funding; (b) Program delivery starts when the national funding is approved and the municipal team (municipal coordinator, supervisors, home visitors) is hired. Municipal resources are also allocated

Fig. 1 Steps to integrate mixed methods data into the program impact pathways (PIP) analysis

Steps to Integrate Mixed Methods Data into the Program Impact Pathways (PIP) Analysis

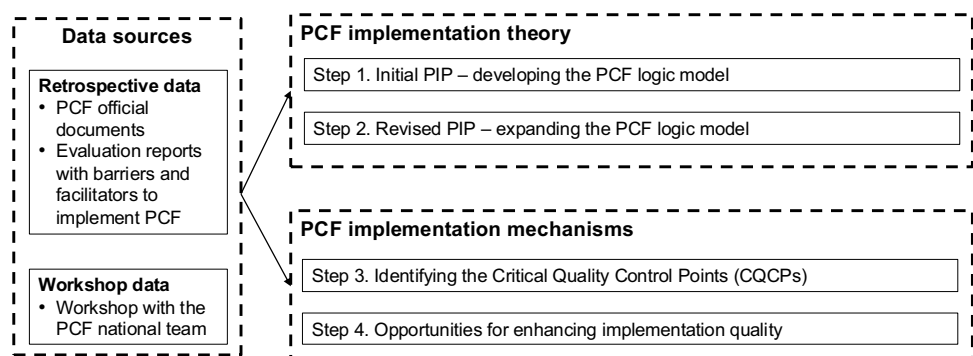


Table 1 Program impact pathway analysis: program components, actors, and planned activities

Program Components	Actors	Planned activities
Program Initiation	PCF national team National multisectoral committee State multisectoral committee PCF state team Municipal social assistance secretary Municipal multisectoral committee	Coordination, training, monitoring, dissemination, funding
		Initial funding to state and municipalities
		Monthly funding based on upon-agreed target goals
		Initial training curriculum (80-h)
		Initial and continuing education through a virtual platform
		Establish national standards for multisectoral approach
		State Multisectoral Actions Plan
		State provides technical assistance and monitors municipalities
		Municipality enrolls in the PCF by submitting an implementation plan and allocating municipal resources to deliver the program
		Hiring PCF municipal team, including coordinator (optional), supervisor, and home visitors
Program Delivery	National and state training cascade facilitators Municipal PCF coordinator Municipal PCF supervisors Municipal PCF home visitors Eligible families	Representation of diverse sectors and meeting regularly
		Develop multisectoral referral protocols and criteria
		Deliver and support the scale up of the initial training across municipalities in a timely manner
		Inputting data on the e-PCF monitoring system
		Supervisor reviews case notes and provides supportive supervision
		Supervisor supports home visitor to develop multisectoral actions and communicates with other social assistance services
		Home visitor delivers visits with high-fidelity
		Home visitor identifies family social determinants of health
Families enrolled in PCF		
Families receive an adequate number of home visits		

to the PCF, which may include transportation, coordination with other sectors, organization of training, delivery of home visits, multisectoral approach, and monitoring. The monthly agreed-upon home visit target goals were identified as a critical feedback loop for national funding and program continuation (see PIP diagram in Online Resource 5).

Implementation outcomes include the adoption of the PCF by municipalities, reaching the monthly home visit goals, high-quality training, high-quality home visits (fidelity and frequency), and effective coordination of complementary multisectoral actions. Program outcomes include decreasing family vulnerabilities while increasing parenting skills; finally the program impact goal is improving early childhood development (see Table 2).

Table 2 Program impact pathway analysis: intended outcomes by level, indicators, and definitions

Level	Indicators	Definitions	
Implementation	Adoption	Number of eligible municipalities adopting the PCF	
	Reach	Municipalities reaching monthly home visits target goals	
	Sustainability	Length of program continuation in years & plans for sustainability	
	Implementation		Timely initial training promotes desired skill set on the PCF municipal team
			High-quality supervision supports home visiting and multisectoral actions
Program	Effectiveness	Fidelity of home visits (high quality + adequate frequency of home visits)	
		Multisectoral plan to address social determinants of health of participating families	
		Decrease social determinants of health of participating families	
		Improvement in parenting skills	
Impact	Effectiveness	Perceived benefits and family satisfaction	
		Improve early childhood developmental milestones	

PCF Implementation Blueprint

Through the PIP analysis, we identified seven CQCP implementation pathways: hiring municipal workforce; staff training; home visits; complementary multisectoral actions; municipal supervision; technical assistance and monitoring; and funding (see PIP diagram in Online Resource 5). Facilitators across CQCP and corresponding ERIC implementation strategy categories are outlined in Table 3 (see narrative in Online Resource 4). The most common implementation strategy categories facilitating PCF scale-up were “providing assistance” ($n=4$) and “supporting PCF teams” ($n=4$). Examples of discrete strategies used within the PCF included providing supportive supervision to facilitate the delivery of high-quality home visits (CQCP 6) as well as on-the-job training and job aids to influence the knowledge and beliefs of supervisors and home visitors (CQCP 5) (see Table 3).

Barriers across CQCP and corresponding implementation strategies to address them are outlined in Table 4 (see narrative in Online Resource 4). Opportunities for enhancing implementation quality included the “use of evaluative and iterative strategies” ($n=4$) and the “use of financial strategies” ($n=4$ across) (Table 4). Examples of discrete strategies that could be used within the PCF to enhance implementation quality were the development of a formal implementation blueprint to clarify the role of each sector in the multisectoral approach (CQCP 4) and additional funds to hire and retain PCF municipal teams with higher salaries and better work conditions (CQCP 1). Strategies within the categories “changes in infrastructure” and “engaging consumer strategies” were not used during PCF implementation, but they were considered opportunities for enhancing the quality of the implementation (see Table 4).

The Fig. 2 summarizes the implementation strategy categories that were coded the most and the least across facilitators and opportunities to address program operational barriers.

Discussion

The PIP analysis laid the implementation pathways of a complex large-scale early childhood development intervention in Brazil, creating a robust map of the barriers and facilitators to implementation quality. Our approach of combining the PIP framework with the ERIC taxonomy was a suitable methodology for generating a tailored implementation blueprint to enhance the implementation quality of a large-scale program. Indeed, our approach responds to the call of implementation scientists by exemplifying accessible methods for tailoring implementation blueprints in interventions with complex implementation pathways (Lewis et al.,

2018). The application of ERIC allowed the identification of implementation strategies such as using evaluative iterative strategies, adapting and tailoring the delivery of the PCF to the local context, and utilizing financial strategies to address implementation barriers. Likewise, changing infrastructure and engaging the demand side were identified as underutilized strategies that could be employed to overcome persisting implementation barriers to PCF adoption and reach, respectively. Nonetheless, our study provides insights into how the purposive selection of implementation strategies can be used to address implementation barriers and enhance implementation quality, which may promote the sustainability of large-scale programs in lower-income settings.

Our findings suggested that seven CQCP implementation pathways including training, hiring, home visits, complementary actions, supervision, technical assistance and monitoring, and funding must be well coordinated to successfully scale-up the PCF. The CQCPs identified in our analysis are similar to the building blocks of implementation outlined in a recent scoping review on the scale-up pathways of nurturing care programs using the Care for Child Development curriculum in low- and middle-income countries (Buccini et al., 2023). Additionally, our PIP analysis is the first to intentionally define key implementation outcomes using the robust RE-AIM framework. The lack of specific, measurable, achievable, relevant, and time-bound (SMART) implementation outcomes challenges monitoring the progress toward success of efforts to implement programs (Proctor et al., 2011, 2023). This might explain why the PCF under real-world conditions did not achieve its intended long-term impact on responsive interaction and early childhood development (Santos et al., 2022). Moving forward, we strongly recommend that the PCF routinely tracks the CQCP implementation pathways through monitoring and evaluation systems guided by SMART indicators to sustain quality or make corrective actions in a timely way.

Matching barriers and facilitators with implementation strategies guided by the ERIC taxonomy helped elucidate why key implementation outcomes have not been properly achieved in the PCF. This approach helped identify opportunities to overcome persisting PCF implementation barriers. Specifically, the lack of intentional change in infrastructure identified in our study may explain initial barriers to adoption by the social assistance sector. On the other hand, using strategies from the ERIC categories such as “providing assistance” and “supporting PCF teams” may reflect efforts to address barriers to adoption at the municipal level. Adoption barriers were mainly due to the top-down approach and the lack of PCF integration in the social assistance sector (Buccini et al., 2021). The extensive use of these strategy categories helped to reduce resistance and promoted a smoother adoption of PCF by the social assistance staff (Buccini et al., 2024). Likewise, the lack of engagement with

Table 3 Critical quality control points in scale-up: facilitators

Critical quality control points (CQCP)	Facilitators	ERIC categories	Discrete implementation strategies
CQCP 1 Hiring municipal workforce	Demand from municipalities for technical assistance and monitoring Qualified workforce to meet population demand	Provide interactive assistance to PCF teams Support PCF teams	Centralize technical assistance Provide local technical assistance Revise professional roles
CQCP 2 TRAINING	Standardized 80-h training package and evidence-based manuals UNICEF/WHO CCD curriculum and the official home visiting guide Cascade training promotes efficiency and is cost-effective Training is provided in person and through a virtual platform	Train and educate PCF teams	Develop educational materials Distribute educational materials Use train-the-trainer strategies
CQCP 3 Home Visit	Supportive supervision is conducive to the delivery of high-quality home visit Home visitors' ability to adapt to the family context enlarging outlook Ability to strengthen community resources and connections	Provide interactive assistance to PCF teams Adapt and tailor to context Develop stakeholder interrelationships	Plan for and conduct training in an ongoing way Make training dynamic Provide supervision Promote adaptability Tailor strategies Build a coalition Promote network weaving Build a coalition Promote network weaving
CQCP 4 Complementary Multisectoral Actions	Integration with social services allows municipalities to strengthen community resources and connections through the social services reference center (CRAS) Continuity of care beyond home visits reinforces engagement among the sectors Coordination with existing early childhood programs Prioritize community needs and develop multi-sectoral actions High-quality supervision is conducive to referrals to other social services	Develop stakeholder interrelationships Support PCF teams Use evaluative and iterative strategies	Obtain formal commitments Develop resource-sharing agreements Conduct local needs assessment Develop and implement tools for quality monitoring

Table 3 (continued)

Critical quality control points (CQCP)	Facilitators	ERIC categories	Discrete implementation strategies
CQCP 5 Municipal Supervision	Qualified supervisors contribute to the fidelity of supportive monitoring and evaluation	Provide interactive assistance to PCF teams	Provide supervision
	On-the-job training and experience aids in the development of supervisor & home visitor knowledge and beliefs	Support PCF teams	Make training dynamic
	Real-time data collection on the level and quality of supervision reinforces long-term effectiveness on parenting and ECD outcomes		Facilitate relay of data to PCF teams
	Real-time data collection on family skills and child development		
CQCP 6 Technical Assistance and Monitoring	Monitoring and evaluation create opportunities for quality improvement and evaluations	Use evaluative and iterative strategies	Purposefully reexamine the implementation
	High-quality supervision is conducive to technical assistance and monitoring of home visits	Provide interactive assistance to PCF teams	Provide supervision
	Supervisor & Home Visitor’s self-efficacy, knowledge, and beliefs about PCF	Support PCF teams	Revise professional roles
	Defined process indicators to monitor implementation using the e-PCF system	Use evaluative and iterative strategies	Develop and organize quality monitoring systems Conduct local needs assessment
	Systematic monitoring of implementation and adaptations in the delivery of PCF due to different community’s needs		
	Creates opportunities for qualitative research and evaluation		Purposefully reexamine the implementation
CQCP 7 Funding	The municipal team monitors and evaluates the effectiveness of improvements in parenting skills and ECD outcomes		Develop and organize quality monitoring systems
	Federal funding	Utilize financial strategies	Access new funding
	Federal criteria to meet federal funding		Use capitated payments

Table 4 Critical quality control points in scale-up: barriers and opportunities

Critical quality control points (CQCP)	Barriers	Government Level	Opportunities to address barriers		Discrete Implementation Strategies
			ERIC Categories		
CQCP 1 Hiring Municipal Workforce	Underfund for hiring PCF municipal teams has led to low salaries and short-term contracts, and ultimately high staff turnover	Municipal	Utilize financial strategies	Fund and contract for the clinical innovation	
CQCP 2 Training	Training materials lack adaptation to the different needs across the training cascade Initial training delivery through training cascade and online platform is not monitored through standardized tools and their quality, fidelity, and effectiveness are unknown PCF municipal teams lack structure and resources such as access to computers and high-speed internet to access online training PCF municipal teams lack protected time to access online training platform courses PCF municipal teams are receiving initial training late initial due to high staff turnover Undertrained home visitors make short-cut adaptations to the CCD curriculum compromising the quality of home visits	National to municipal National to municipal Municipal Municipal Municipal Municipal	Adapt and tailor to context Use evaluative and iterative strategies Change Infrastructure Develop stakeholder interrelationships Train and educate stakeholders	Tailor strategies Promote adaptability Develop and implement tools for quality monitoring Develop and organize a quality monitoring system Change physical structure and equipment Organize protected time for training Conduct ongoing training Conduct educational outreach visits	
CQCP 3 Home Visit	Home visitors lack the means (e.g., transportation for long distances) to conduct home visits COVID-19 forced in-person home visits to be conducted virtually (e.g., WhatsApp)	Municipal National to municipal	Change Infrastructure Adapt and tailor to context	Change physical structure and equipment Tailor strategies Promote adaptability	

Table 4 (continued)

Critical quality control points (CQCP)		Barriers	Government Level	Opportunities to address barriers	Discrete Implementation Strategies
				ERIC Categories	
CQCP 4 Complementary Multisectoral Actions	Multisectoral Management Committees (MMC) are not functioning	National to municipal	Develop stakeholder interrelationships	Build a coalition Promote network weaving Recruit, designate, and train for leadership Use other payment schemes	
	Unclear role of each sector in developing complementary multisectoral actions	National to municipal	Develop stakeholder interrelationships Use evaluative and iterative strategies	Obtain formal commitments Develop a formal implementation blueprint	
	National and states have failed to support municipalities in developing their municipal multisectoral action plan	National and State	Provide interactive assistance	Provide local technical assistance Facilitation	
CQCP 5 Municipal Supervision	Municipal teams lack the skills and knowledge to identify social determinants of health	Municipal	Engage participants families	Involve patients/consumers and family members Prepare patients/consumers to be active participants	
	Supervisors are not conducting field supervision due to administrative burdens (e.g., weekly reports, input data into e-PCF)	Municipal	Adapt and tailor to context Train and educate stakeholders Provide interactive assistance	Promote adaptability Conduct educational outreach visits Provide local technical assistance Facilitation	
	Supervisors lack standardized checklists or data collection tools to document the quality of supervison	Municipal	Use evaluative and iterative strategies	Develop and implement tools for quality monitoring Develop and organize a quality monitoring system	
	The supervisor has a high caseload to supervise which makes effective supervision challenging	Municipal	Support PCF teams	Revise professional roles	

Table 4 (continued)

Critical quality control points (CQCP)	Barriers	Government Level	Opportunities to address barriers	
			ERIC Categories	Discrete Implementation Strategies
CQCP 6 Technical Assistance and Monitoring	Lack of process indicators to monitor and evaluate the scale up of the CCPs	National	Use evaluative and iterative strategies	Purposefully reexamine the implementation Develop a formal implementation blueprint
	The number of professionals in the state teams is limited to providing technical support to all municipalities	State	Utilize financial strategies	Fund and contract for the clinical innovation
	Lack of infrastructure, effective training, and technology (Wi-Fi, computer systems, etc.) needed to implement electronic monitoring system (e-PCF) e-PCF monitoring system instability and errors lead to delays in registering home visits	State and Municipal	Change Infrastructure	Change physical structure and equipment Change record systems
CQCP 7 Funding	Municipalities are expected to cofinance, which leads to inconsistent municipal funding and uncertainty about the sustainability of PCF	National to municipal	Utilize financial strategies	Access new funding Alter incentive/allowance structures Use other payment schemes
			Engage participants families	Increase demand

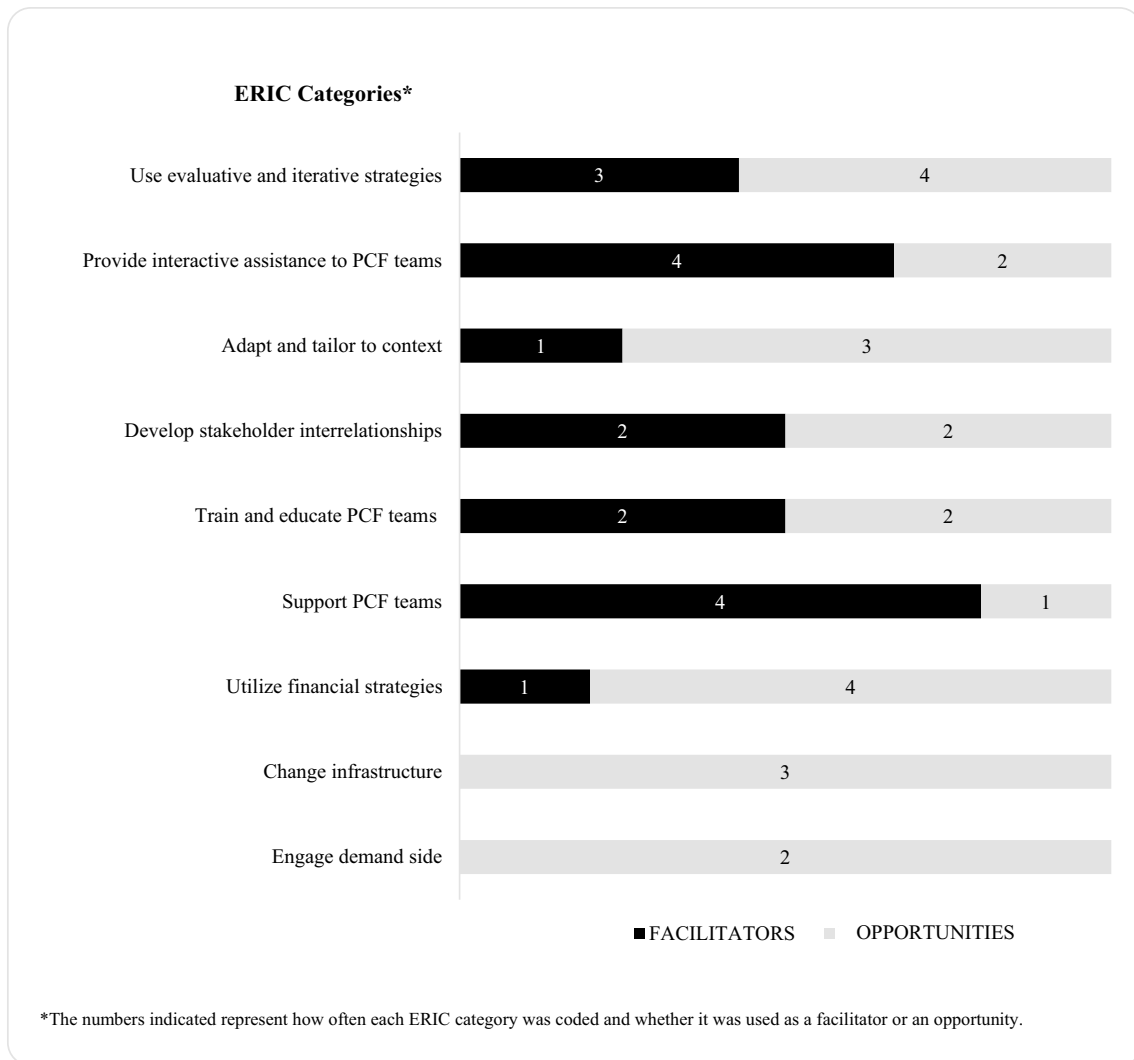
Implementation Facilitators and Opportunities for Quality Improvement Coded by the ERIC Categories.

Fig. 2 Implementation facilitators and opportunities for quality improvement coded by the ERIC categories

the demand side identified in our study may explain persisting barriers to reaching the target goals of participating families. Evidence suggests that early childhood development programs that do not engage with the demand side leave out critical contextual affordances of the environment in which a family lives, such as cultural norms and attitudes, family resources and barriers, disposition, education, and competencies (Hackett et al., 2021; Rojas et al., 2022). While the literature acknowledges that critical components of early childhood development programs can work across various contexts and cultures without major adaptations (Ahun et al., 2023; Britto et al., 2022; Buccini et al., 2023), engaging with the demand side and learning their characteristics may be key to enhancing uptake, engagement, and retention, which in turn are prerequisites to program scale-up (Britto et al., 2022; Buccini et al., 2023). In addition, our study identified

opportunities to address existing barriers, the intentional utilization of adapting and tailoring strategies to support consistent adaptations to different contexts considering the interplay between program supply and demand to support sustainability (Britto et al., 2022) and promote equity (Shelton et al., 2020).

Challenges to achieving the monthly agreed-upon home visits to meet the PCF targets were identified as critical for funding and program continuation. At the municipal level, not achieving the monthly agreed-upon home visits meant receiving lower funding resources, which in turn generated stress and pressure on supervisors and home visitors in two ways: first, the feeling of being blamed for not achieving the goals, and second, concerns about their contracts being terminated at any time. These stressors need to be addressed as they may contribute to high staff rotation, which is very

costly due to the additional training capacity and resources needed and may compromise the quality of home visits and the achievement of the monthly agreed-upon home visit goals. These findings corroborate studies documenting challenges in scaling up early childhood development programs in middle and low-income countries (Britto et al., 2014). Indeed, the lack of sustainable funding has been identified as the most reported barrier to sustainability for implementing early childhood development programs in low- and middle-income countries (Ahun et al., 2023; Buccini et al., 2023; Cavallera et al., 2019; Pérez-Escamilla et al., 2018; Torres et al., 2018).

Nonetheless, our analysis identified opportunities to address these implementation barriers by utilizing financial strategies, including the use of different payment schemes and the alteration of incentive/allowance structures to improve the sustainability of large-scale early childhood development programs. For example, the utilization of financial strategies along with facilitation strategies identified in our study, such as building local-level coalitions of multisectoral organizations to define roles and goals to address the social needs of vulnerable families, could facilitate cross-sectoral governance and build the nurturing care multisectoral approach missing in the PCF. Lack of multisectoral coordination has previously been identified as a major barrier to proper implementation and scale-up of early childhood development programs (Cavallera et al., 2019; Pérez-Escamilla et al., 2018; Torres et al., 2018). Therefore, purposely using implementation strategies to coordinate efforts across existing Brazilian programs could benefit the operationalization of the complementary multisectoral actions to mitigate socio-vulnerabilities of participating families, which has been a major barrier that undermines PCF effectiveness.

Strengths and Limitations

This study has strengths and limitations that should be considered when interpreting our findings. This in-depth case study of the PCF in Brazil triangulates data from several sources to understand how to improve its implementation at scale. The extensive retrospective data from interviews with key informants at the national, state, and municipal levels and the in-depth knowledge of the researchers gained over five years of engaging with PCF teams supported the identification of program barriers and facilitators using the ERIC taxonomy. Our data captured the perceived barriers and facilitators to participate in PCF from the perspective of 95 families across five municipalities (Buccini et al., 2024; Dos Santos et al., 2023), which is an important strength of the study. In the past, many implementation evaluations have overlooked the program participants' points of view, which

is unfortunate as the participants first-hand experiences with a program are essential for understanding effectiveness and identifying areas for improvement (Metz et al., 2024). Therefore, the combined use of retrospective and workshop data allowed the mapping of persisting barriers during PCF scaling up from multiple perspectives (Buccini et al., 2021, 2024).

Although our PIP analysis has been discussed and received feedback from the PCF team at the national level, it has not been formally discussed with teams at the state and municipal levels. Hence, the strategies to enhance implementation quality identified in our study should be interpreted cautiously. Especially because our findings are limited to the national rather than the local perspective in a large country characterized by sharp socio-demographic inequalities (Buccini et al., 2022). We acknowledge that implementing the PCF in different contexts such as the suburb of São Paulo, a Rio de Janeiro "favela", the rural interior of Goiás, or the hinterlands of Piauí would likely entail distinct implementation strategies. Indeed, the adaptation of ECD programs to the local context has been found a critical and dynamic component for successful implementation of ECD programs globally because it interacts, influences, modifies, and facilitates or constrains the scale-up and sustainability (Buccini et al., 2023). Since contextual features are not fully controllable or predictable, future studies could use our program implementation improvement blueprint as a guide to tailor implementation strategies to municipalities' context (e.g., rural vs urban, large vs. small population size, etc.) and empirically testing their feasibility and effectiveness.

Finally, we acknowledge that the exercise of coding barriers and facilitators within the ERIC taxonomy only captured the authors' perspective, as it has not been confirmed or discussed with key informants working on the program nor tested in the field under real-world conditions. Therefore, some strategies listed may not be feasible to be implemented due to contextual realities including the lack of funding for improving the implementation of early childhood development public policies in Brazil and beyond. We expect that our innovative methodology and findings can help improve the way large scale programs are implemented, monitored and evaluated in the future to maximize their resource use, impact, and sustainability (Habicht et al., 1999). Indeed, our PIP analysis yielded a rich and complex blueprint of implementation strategy categories for overcoming implementation barriers as well as facilitating implementation. This is responsive to what implementation scientists have argued before that targeting barriers and leveraging facilitators simultaneously is a more effective program quality improvement approach (Lewis et al., 2018). While this remains an empirical question, as part of our project written reports have been shared and debriefing meetings have been conducted to discuss

these findings have been conducted with key national and municipal PCF actors and their teams. Furthermore, prior to this study, our research team engaged with PCF teams for five years while conducting our independent evaluation of PCF's scale-up process. At each stage, our team shared the results first-hand with PCF teams to get their inputs before they were publicized. Because of this, we built a respectful and collaborative relationship with the PCF teams, despite the major changes in political and coordination leadership that occurred during this period. Thus, we expect that moving forward the implementation strategies identified in our study to be considered leverage points in the decision-making to improve the quality of the PCF as the second phase of its rolling out starts.

Although PIP analyses have been extensively used to evaluate public health and nutrition programs (Melo et al., in press), to our knowledge, this is the first study to use the PIP analysis in combination with the ERIC taxonomy to gain key insights into a blueprint of implementation strategies needed to enhance the implementation pathways of complex interventions by overcoming barriers on time. We encourage other researchers to use and build from our innovative implementation science approach to effectively scale-up and sustain large-scale programs in low-income settings.

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Authors' Contributions GB and RPE designed the research study protocol. GB and LG conducted the interviews and document review. KS and RD engaged in data interpretation and drafting of sections of the paper supervised by GB. GB conducted the analysis and wrote the final draft of the paper. RPE revised drafts critically for intellectual contribution to the final draft. All authors approved the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Data Availability The de-identified data that support the findings of this study are available on request from the corresponding author (GB). The data are not publicly available due to restrictions imposed by the IRB as they contain information that could compromise the privacy of research participants.

Declarations

Competing Interests The authors have no competing interests to declare that are relevant to the content of this article.

Ethical Approval The research reported in this article received ethical approval from the Research Ethics Committee of the Health Institute of the São Paulo State Health Department (n. 3.320.733) and by the Institutional Review Board of the University of Nevada, Las Vegas (n. 1702327–2). Additional approvals were granted by the research committees of the participating municipalities and departments.

Consent to Participate All participants provided verbal informed consent following a description of the study's purpose and design.

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