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Human resources and curricula content for early child development implementation: multi-country mixed-methods evaluation

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ABSTRACT

Background: The World Health Organization recommends responsive caregiving and early learning (RCEL) interventions to improve early child development (ECD), and to achieve the Sustainable Development Goals' vision of a world where all children thrive. Implementation of RCEL programmes in low- and middle-income countries (LMIC) requires evidence to inform decisions about human resources and curricula content.

Methods: We undertook a mixed-methods evaluation of RCEL projects within the Grand Challenges Canada® Saving Brains® ECD portfolio. Quantitative data were collected through standardised reporting tools. Qualitative data were collected from ECD experts and stakeholders and analysed using thematic content analysis, informed by literature review.

Results: We evaluated 32 RCEL projects across 17 LMIC on four continents. Overall, 2,197 workers delivered ECD interventions to 25,909 families. Major themes regarding human resources included; worker characteristics, incentivisation, retention, training and supervision; and regarding curricula content; need for flexible adaptation of content and delivery, maintaining fidelity, and intervention duration and dosage. Lack of a universally agreed standard ECD package contributed to project heterogeneity, while need for contextual adaptation of curricula content, human resources management, and service delivery was highlighted. Incorporation of ECD into existing services may facilitate scale-up but overburdened workers plus potential reductions in service quality remain challenging. Supportive training and supervision, inducement, worker retention, dosage and delivery modality emerged as key implementation decisions.

Conclusions and implications: This mixed-method evaluation of a multi-country ECD portfolio identified themes for policymakers and programme leaders to consider in implementation of RCEL interventions in diverse LMIC settings, especially through routine government systems. Although this is the largest portfolio analysed to date, the level of scale remains limited, at ~25,000 people. High-quality process and costing evaluations in larger scale populations with comparable data are required to further inform decisions for implementation of RCEL projects at national and regional scale.

ARTICLE SUMMARY

Strengths and limitations of this study

- Scale-up of responsive caregiving and early learning (RCEL) interventions, a key domain in the WHO/UNICEF/World Bank Nurturing Care Framework, requires evidence to inform decisions about human resources and curricula content for implementation.
- This is the first paper to report on workforce data from the large multi-country Saving Brains® child development portfolio. We analysed data from 32 RCEL projects based in 17 low- and middle-income countries, including a total of 2,197 frontline workers who delivered early child development (ECD) interventions to over 25,000 children and parents.
- A lack of universally agreed standard package for ECD interventions contributed to project heterogeneity within the portfolio. The importance of contextual adaptation of curricula content, human resources management, and service delivery strategies was highlighted. Development of more standardised RCEL curricula and training content for scaling would address project heterogeneity and adaptation to context.
- Incorporation of ECD into existing services may allow for wider scale-up, but challenges related to already high workloads plus potential reductions in service quality remain.
- Rigorous evaluations are required to inform decisions for implementation of RCEL projects at scale. There are almost no cost data to plan services and we found no data on materials for workers' use.

BACKGROUND

Optimal early child development (ECD) is central to the Sustainable Development Goals' (SDG) vision of a world in which children can *thrive*.(4, 5) ECD programmes have the potential to transform human capital across the life course, and scale-up of responsive caregiving and early learning (RCEL) is advocated by the World Health Organisation (WHO), UNICEF and World Bank, as a key part of the Nurturing Care Framework (NCF) launched in 2018 (see Panel 1).(1, 6-9) Programmes promoting RCEL have been found to be effective for ECD and related to longer term outcomes, including educational attainment and adult earnings.(1, 10)

Panel 1: ***Terms for responsive care & early learning for early child development***

Multiple terms are used to describe interventions that promote early child development. The WHO, UNICEF & World Bank's Nurturing Care Framework refers to a spectrum of requirements necessary for reaching full developmental potential, including: good health, security and safety, nutrition, responsive caregiving, and early learning.

In this paper, we use the concept of nurturing care, and specifically the term 'responsive care and early learning' (RCEL). RCEL describes the promotion of ECD through learning, play, and caregiving that is responsive to children's needs.(1-3) Similar terms include 'responsive care/caregiving', 'responsive stimulation', 'nurturing care', 'psychosocial stimulation', 'early learning' and 'play'.

However, there are limited data to guide practical implementation of RCEL programmes at scale, and a particular lack of data regarding human resources and curricula content.(11-13) Additionally, guidance for contextual adaptation of projects is crucial but complex for RCEL which involves sectors beyond health. These gaps present challenges to decision-makers and may result in small-scale projects making design choices that limit the potential for sustainable scaling.(1, 14, 15) Thus, analysis of implementation factors for scaling of RCEL projects, particularly human resources and curricula content, is needed.(11)

The *Lancet* series 'Advancing Early Child Development: from Science to Scale' (16) and the *Annals of the New York Academy of Sciences* series 'Implementation Research and Practice for Early Childhood Development' (17) described gaps in the literature relating to ECD programming. The *Archives of Diseases in Childhood* series 'Informing design and implementation for early child development programmes' (18-22) provided evidence from the Grand Challenges Canada® (GCC) Saving Brains® portfolio for decision points related to ECD programming but did not specifically address human resources and curricula content. This paper responds to this gap, building on *Radner et al*'s exploration of lessons learned on scaling

from the Saving Brains portfolio to explore human resources and curricula content in a diverse range of RCEL programmes from the same portfolio,.(23) We predominantly use a health sector perspective, and contextualise our findings within learning from multi-country evaluations of community-based maternal and newborn care and evaluations of mental health and nutrition programming.

Aims & objectives

This paper aims to describe human resources and curricula content for implementation of RCEL projects across diverse low- and middle-income countries (LMIC), using data from the Saving Brains portfolio. We will address *who* delivers the project, including training, supervision and inducement; and *what* the specific curricula content is, including materials, intensity, quality, fidelity and adaptation. Objectives are to:

1. Quantitatively analyse human resources and curricula content for RCEL projects in the Saving Brains portfolio.
2. Qualitatively analyse programme design and implementation decisions, focusing on themes related to human resources and curricula content.
3. Synthesise lessons learned and implications for future design and implementation of RCEL programmes at scale.

METHODS

We took a mixed-methods approach, incorporating quantitative data from an evaluation of projects in the Saving Brains portfolio alongside qualitative data from in-depth interviews (IDI) and focus group discussions (FGD) with ECD experts and Saving Brains project leads.

Overview of the Saving Brains Portfolio evaluation

An evaluation of the portfolio was undertaken in 2016-2017 by a team from the London School of Hygiene & Tropical Medicine in collaboration with the Saving Brains Platform team of experts, led by TruePoint Center/Harvard University and the WHO.(24) The team evaluated 39 Saving Brains Seed and Transition-To-Scale (TTS) grants awarded between 2012 and 2016 to project leads from LMIC with variable design and implementation approaches. Seed grants focused on demonstration of 'proof of concept' over 18-24 months while TTS grants focused

on progression towards scale in partnership with other organisations over 3 years. The portfolio evaluation used a conceptual evaluation framework (Web Appendix Figure A), based around the Medical Research Council Guidance on Evaluation of Complex Interventions and was developed around a portfolio-level 'theory of change' to systematically describe and assess human resource and curricula content implementation factors (Web appendix Figure B).(25)

Objective 1. Quantitative data sources and analyses

Quantitative data sources

Quantitative data on project design and implementation were collected from GCC pre-specified data collection tools (Web Appendix Table A). Service Delivery Forms (SDFs) comprised data regarding human resources and RCEL curricula and the Results-based Management and Accountability Framework (RMAF) comprised data on numbers of recipients and beneficiaries, child growth and development outcomes, parental and home environment outcomes, and funding, coverage and context of projects. Data were extracted from SDFs and RMAFs and imported into Microsoft Excel for cleaning, management and analysis (May-Nov 2016).

Quantitative analysis

Descriptive statistics relating to frequency and mode of outcome measurement across the portfolio were generated using Stata 14 and Microsoft Excel. Data on occupation of workers delivering the RCEL projects were classified according to the International Standardised Classification of Occupations (ISCO 2008).(26) For quantitative analysis, projects were grouped to highlight differences in implementation design factors. Groupings were as follows i) all RCEL projects ii) standalone RCEL projects and iii) integrated RCEL projects, where 'integrated projects' were integrated with another domain of the NCF (other than RCEL) and 'standalone projects' were not.

Objective 2: Qualitative data sources and analyses

Literature review and topic guides

IDI and FGD were facilitated using topic guides, which were developed based on a literature review guided by the Consolidated Criteria for Reporting Qualitative Research (COREQ). The review explored implementation experiences relating to human resources and curricula content amongst ECD experts and Saving Brains project leads. Thematic areas of enquiry (Web Appendix Table B) were established based on the literature, stakeholder consultation, and analysis of written project proposals and progress reports submitted by project leads to GCC (Web Appendix Table A). Our analysis was also informed by examples from the literature of similar efforts to support decision-making for implementation in other maternal and newborn health (MNH) projects in LMIC.

Medline and Embase were searched, with the following MeSH terms; 'Child development' OR 'Developmental Disabilities' AND 'Developing Countries'. Additional articles were retrieved through reference lists of identified articles and publications from the Saving Brains community. Grey literature was searched via websites of major multilateral organisations engaged in ECD programming including the WHO, UNICEF, Save the Children Fund, the World Bank, World Vision International, other related organisations, and Google.

Qualitative data inputs from key informant interviews and focus group discussions

Key informants (n=19) were ECD experts implementing ECD programmes in LMICs (Web Appendix Table C). ECD experts were purposively selected from professional networks including national and international programmers and policy makers, ECD researchers, Saving Brains project leads, and members of the Saving Brains Platform and GCC. All key informants were invited to participate by email. IDI were conducted with key informants and FGD with Saving Brains project leads, with between 4 and 10 participants per FGD. All participants provided verbal informed consent and data collection was concluded once saturation was reached.

IDI and FGD were conducted in English (Jun-Oct 2016) and were audio recorded or transcribed by a member of the evaluation team. Each IDI lasted approximately 60 minutes while each FGD lasted between 60 and 90 minutes. All IDI and FGD were conducted face-to-face or via an online video link. Meetings of Saving Brains innovators and partners on prioritising research in ECD and strategies for implementation of interventions were audio recorded and/or

transcribed. Audio recordings of IDI, FGD and meetings were submitted to a third party for transcription. Members of the Saving Brains evaluation team conducted IDI (MKL, KMM and VC) and facilitated FGD (CT, KMM, VC) alongside members of the Saving Brains platform.

Qualitative data also included Saving Brains project progress reports; written narratives on implementation challenges and mitigation strategies.

Qualitative analysis

Written project documents and transcribed IDI and FGD were de-identified, imported and coded in NVivo 11. Data were independently coded line-by-line by two members of the evaluation team (MKL, KMM). An inductive approach was used to create a coding framework, and thematic content analysis undertaken to explore themes related to human resources and curricula content until saturation was reached. Inter-rater coding reliability was high on review of NVivo 11 coding reports.

Patient and Public Involvement

This evaluation was conducted without direct patient involvement and they did not contribute to the interpretation of results or writing and editing of this document. However, families were frequently involved in different aspects of the design and interpretation of individual projects within Saving Brains including, but not limited to, the materials used in intervention delivery and methods for incentivising participation.

Ethics approval

The study was approved by the London School of Hygiene & Tropical Medicine Ethics Committee. Individual Saving Brains projects had relevant ethics approval to conduct their project.

RESULTS

Overview: quantitative and qualitative results

32 of the 39 Seed and TTS projects included some aspect of RCEL (Figure 1); the 7 non-RCEL projects were not included in this analysis. Of these 32 projects, 35% (n=11) projects were

standalone RCEL interventions and 66% (n=21) were integrated with interventions in 'health and nutrition' (10 projects), 'security and safety' (9 projects) or both (2 projects) (Figure 1).

IDI were conducted with 66% (n=21) of Saving Brains project teams including all TTS projects. Saving Brains TTS project leads provided quantitative data on themes emerging from IDI and FGDs (Table 1). Emergent themes from the qualitative analysis are presented in Table 2.

Table 1: Description of the Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of human resources and curricula content (N=4 projects)

Project Name		**Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improved malnourished children's development**	**An integrated intervention targeted at deprived pre-school children in rural areas**	**Home visiting programs to improve early child development and maternal mental health**	**Saving Brains, Changing Mindsets**
Lead Institution		**International Centre for Diarrhoeal Disease Research (ICDDR,B)**	**Universidad de los Andes (UDLA)**	**Faculdade de Medicina da Universidade de Sao Paulo (USP)**	**Mobile Crèches for Working Mothers' Children (MC)**
Country		**Bangladesh**	**Colombia**	**Brazil**	**India**
Site		Dhaka area: Narsingdi and Kishoreganj. Rural	Central rural regions: Boyacá, Cundinamarca, Santander	Sao Paulo, urban slums in western area	Delhi area, Bangalore, Ahmedabad, Chandigarh
Vision/ Goal/ Objectives		Integrate RCEL intervention for poor, underweight children into routine government health services	Improve quality of a pre-existing public parenting programme in a scalable fashion	Evaluate the efficacy and cost-effectiveness of two alternative platforms for home visiting programme	Demonstrate scalability of workplace-based childcare for children of migrant construction workers
No. participating children		1,597	2,134	800	4,845
HUMAN RESOURCES					
Type		Assoc Health Professional	Lay community member as paraprofessional	CHW and CDA	Personal care worker
Pre-existing / novel cadre		Pre-existing	Pre-existing	CHWs pre-existing, CDAs novel cadre	Pre-existing
Incentivisation, including remuneration		Occasional small gifts.	Remunerated by government	30% elevated salary pre-existing CHWs, salary-matched CDAs	Salaried
Qualification/ skill / competence		Technical qualification	Secondary education	No qualification needed	Primary & Secondary education
Gender of workers		Majority female	Majority female	Exclusively female	Majority female
Length of training		15 days	85 hrs over 3.5 weeks	40 hrs initial (Reach Up) & 32 hrs refresher	36 days
No. of workers recruited (completing training, delivering project)		354 (320, 168)	171 (171, 171)	15 (15,13)	139 (83, 67)
Frequency of supervision		Minimum once per month.	Every six weeks.	Once per week.	Six months rigorous, then monthly.
CURRICULA CONTENT					
Group vs individual		2 or 4-5 dyads	80% grp, 20% individual	All individual	70% grp, 30% individual
Duration of intervention		12 months	11 months	12 months	3 months
Average length of sessions		50 mins	1 hr	1 hr	8 hrs (full creche day)
Number of sessions		25	55	24	75
Freq. of contacts per month		2	3	2	25
Materials		Play materials	Books, puzzles, images, and toys (recyclable materials)	Books, puzzles, images and toys (recyclable materials)	Play materials, blocks, puzzles, big picture books, toys (low cost)
Curriculum		Adaptation of Reach Up	Adaptation of Reach Up	Adaptation of Reach Up	Thematic curriculum on school readiness skills
Use of digital media		None	None	None	None
Mechan-ism of behaviour change	*Mentoring*	Yes	Yes	Yes	Yes
	Problem-solving	Yes	Yes	-	-
	Didactic	-	-	-	-
	Demonstrations	Yes	Yes	Yes	Yes
	Service mapping	-	-	-	-
	Empowerment	Yes	Yes	Yes	Yes
	Peer support	Yes	Yes	-	-
	Media	-	-	-	-
	Materials	Yes	-	Yes	-
Published references		(23, 27, 28)	(23, 29)	(23,25)	(23, 30)

CDA=Child Development Agents, CHW=Community Health Worker

Table 2: Themes and sub-themes from quantitative and qualitative data analysis for 32 Saving Brains projects, and 19 key informant in-depth interviews regarding human resources and curricula content for ECD programming

	Themes	Sub-themes
Human Resources	1. Characteristics / selection of worker	1.1 Health vs other sector
		1.2 Integration with existing programmes
		1.3 Pre-existing government worker vs novel worker
		1.4 Professional vs lay worker
		1.5 Qualities and qualifications
	2. Inducement and retention	2.1 Modalities of incentivisation
		2.2 Impact on pre-existing workers
	3. Training and supervision	3.1 Content of training
		3.2 Flexibility vs fidelity
		3.3 Education theory
		3.4 Supportive relationships
Curricula content	4. Content and components	4.1 Defining critical components
		4.2 Formative work and adaptation
		4.3 Flexibility vs fidelity
		4.4 Behaviour change
	5. Delivery, duration and dosage	5.1 Adapting delivery to local context
		5.2 Intervention duration and dosage
		5.3 Retention of participants

Human resources in ECD projects: themes and sub-themes

Three major human resources themes and eleven sub-themes were identified (Table 2).

1. Characteristics / selection of workers

Variation in workforce across the Saving Brains portfolio is summarised in Figure 2. The use of health or associate health professionals, such as community health workers (CHW), was common. Health professionals commonly delivered projects that included health and nutrition domains (Figure 2a). Lay community members were also common as frontline workers across all project types.

Integrating ECD projects into existing programmes was identified by informants as a key challenge.

> *"Early child development is harder than anything because of its integrated nature…. ...we all decided that services had to be fully integrated….and this has imposed an operational burden that is very complicated."* – Saving Brains TTS project lead

Approximately one third of workers (34% n=11/32) had either only primary school-level or no education (Figure 2b). Tertiary-level education of workers was more common for RCEL projects which included health and nutrition domains (42%, n=5) (Figure 2b), likely reflecting the greater representation of healthcare professionals delivering these integrated interventions.

Soft skills including interpersonal and communication skills were identified as important by project leads.

> *"We have learned a lot about the type of person that can fill the health promoter role. It is important that he/she is committed to the project, responsible, and loves working with kids, especially this age group."* – Saving Brains Seed project lead

> *"Having a champion in the field is crucial for success…combination of strength and kindness; excellent interpersonal skills; problem solver; works with all stakeholders."* – Saving Brains TTS project lead

A key choice in ECD implementation was whether to use established or novel cadres of worker. In some projects, novel cadres of worker were recruited to support quality of implementation. However, limitations of this approach were acknowledged with regards to sustainability.

> *"…even after identifying and training them there is no assurance that the government will take up the process."* – Saving Brains TTS project lead

Conversely, while a number of projects used pre-existing frontline workers, key informants also expressed concerns regarding direct control over recruitment, incentivisation, supervision, and training when shared with a partner organisation (Web Appendix Table D, ICDDR,B & USP). The increased burden, change in focus, and challenge in coordination for pre-existing salaried workers was also highlighted by experts and project teams.

> "*It's a big challenge…you take a health worker and add a 24th task to her 23rd task, which are requested by six different funders with no coordination between any of them.*" - ECD Lead for an International NGO

> *"They think [to themselves], 'I'm dealing with dengue and Zika and you expect me to play with a child for an hour.'"* – Saving Brains TTS project lead

2. Provision of incentives based on performance (inducement)

Overall, most (61%) project workers were salaried (Figure 2c). However, lay community members were the least frequently remunerated worker type, with 20% of projects offering them no incentives, and a further 20% offering only a contribution to expenses (Figure 2c). Key informants expressed a range of opinions about remuneration of CHWs. Some cited elevated status within the community and personal satisfaction as a non-financial incentivisation. In contrast, concerns were expressed regarding sustainability and human rights implications of implementation models that relied on voluntary workers, who were often socially disadvantaged women. However, all health and most allied health professionals were salaried and financial remuneration for these groups was considered a key part of inducement.

> *"Asking clinic staff to conduct the sessions meant additional tasks for them and they had to spend longer hours in the clinic. They therefore had expectations to be paid some wages for this extra task, but our goal was to integrate the activity into their daily routine hours to make it sustainable."* – Saving Brains TTS project lead

Staff recruitment and retention was a major recurring theme. Of the 2,598 workers recruited to deliver ECD interventions across the Saving Brains RCEL projects, 2,473 (95%) completed initial training and, of those trained, 2,197 (85%) ultimately delivered the intervention (Figure 2d). Across the portfolio, retention was most challenging amongst salaried staff who were mostly health staff with 67% of salaried workers trained delivering the intervention (Figure 2d). Specific reasons for drop-off were not available from existing data.

During programme planning, several teams described strategies including 'over-recruitment' to allow for anticipated staff attrition.

"In this next phase, we trained many more promoters than we needed, approximately twice as many as we originally needed in order to have a healthy resource base." – Saving Brains Seed project lead

"It was hard to get [the staff], but we were very successful in keeping them. … We paid them well which is something that I don't know that the government will be able to do. They also had a lot of support and a lot of training. They really appreciated all that they received from our team…" – Saving Brains TTS project lead

3. Training and supervision

A wide variation in supervision frequency, duration and ratios, and training structure and duration was seen across projects (Table 3).

Table 3: Supervision and training of workers delivering responsive care and early learning Saving Brain projects

	Median	**Range**	**Inter-quartile range**
Number of days in training (N=31)	10	0-90	5-13.6
Number of trainees per workshop (N=31)	10	0-50	5-20
Frequency of supervision (N=28)	2 per month	0-10	1.5-4
Duration of supervision (N=27)	2 hours	0-8	1-4
Ratio of supervisor to trainee during training session (N=20)	3:20	0.04-2	0.1-0.2

*Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data for 1 project on number of days in training and number of trainees per workshop, 4 projects did not report on frequency of supervision and 5 projects on duration. 12 projects did not report on the ratio of supervisor to trainee.

Training and supervision emerged as major themes during qualitative analysis (Table 2). Within training, the need to not only address details of ECD curricula but also a diverse range of related issues including pedagogy, strategies for managing the emotional load of work and administrative requirements, communication skills, and problem-solving abilities were identified. Several key informants also highlighted the value of observational supervision.

"…not only to see that content is delivered but that it is delivered in a way that parents will be responsive to." – Saving Brains TTS project lead

The importance of flexible training and supervision protocols that were feasible for staff who had multiple roles and were likely to be sustainable with scale-up was also emphasised.

> "*Ongoing training including proficiency evaluations and feedback build confidence in participating community health workers to apply the tools and methodologies to deal with mothers and children. We have learned this over the years of work with community health workers and plan to systematize the work into teaching protocols as part of the transition to scale phase.*" – Saving Brains TTS project lead

Key informants highlighted the need to develop formal structures for high-quality supportive training and supervision at all staff levels; this was particularly important in maintaining fidelity during intervention scale-up (Web Appendix Table D). In addition, discussions emphasised the importance of peer support amongst workers (Web Appendix Table D).

Curricula content: themes and sub-themes

Two major themes and seven sub-themes were identified with respect to curricula content (Table 2).

4. Content and components

Improved understanding of the critical components of RCEL interventions was a major theme identified by key informants as crucial to sustainability and scale-up.

Many projects provided general descriptions of content (e.g. parenting programme, responsive parenting, nutrition) or the original curriculum from which their project was developed (commonly the established Jamaican 'Reach Up' curricula) (Table 1). (21) However, for many the critical components were less well defined and described. Specifically, details of activities for different ages or developmental stages, child health or nutrition components, behavioural change approaches used, pedagogy, and materials were typically limited. Lack of an established and standardised framework for describing curricula content was identified by key informants as a barrier to improved reporting and understanding design factors responsible for impact.

The importance of formative research and piloting for development and adaptation of interventions to setting was highlighted.

> "*Project development is also really important…these projects are not 'off-the-shelf' 'ready-to-go'.*" – ECD expert

Additionally, the importance of balancing project flexibility, fidelity and content heterogeneity with clear, specific and structured curricula was emphasised.

> "*The other determinant of success I would say is… we were able to develop a contextualized project, delivery product and processes.*" – Saving Brains Seed project lead

Specific materials and activities often required guided cultural adaptation to maintain fidelity (Web Appendix Table D). However, it is important to note that key informants placed equal emphasis on behaviour change mechanisms as well as on specific curricula activities and materials.

> "*Key components [were] inspiration, confidence… empathy, attachment of mothers and children to the deliverer…assessment for change.*" – Saving Brains Seed project lead

5. Delivery, duration and dosage

The importance of project delivery, duration and dosage emerged as a major theme in the analysis. Figure 3 summarises the method and duration of delivery of ECD interventions. The proportion using groups to deliver the intervention was highest amongst standalone RCEL projects and lowest amongst integrated approaches (Figure 3a). Duration of sessions generally lasted longer for groups than individual visits (Figure 3b).

ECD investigators reported that the decision regarding group or individual delivery approach was influenced more by context, efficiency, and feasibility than effectiveness.

> "*Our problem…was trying to do something that we thought was evidence based, but that was not a good fit with the socio-political structures and the way people are comfortable in trying new things.*" – Saving Brains Seed project lead

Key informants highlighted 'dosage' of the intervention as an important design decision. The median number of project sessions delivered, length of sessions, and length of intervention, ranged broadly (Table 4).

Table 4: Summary of project sessions including duration and intensity amongst responsive care and early learning Saving Brain projects (n=32)

	Median	**Range**	**Inter-quartile range**
Number of project sessions (N=29)	24 sessions	2-192 sessions	11-37 sessions
Total length of intervention (N=26)	12 months	1-24 months	8-12 months
Length of sessions (N=26)	1 hour	10 mins-8 hours	45-90 minutes

Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data on number of project sessions for three projects, and on total length of intervention and length of sessions for six projects.

The majority (60%, n=19) of projects were primarily targeted at the child or caregiver level as opposed to targeting families or the community more broadly. Geographical, political and economic factors were important in engaging target populations.

> *"…some mothers find it difficult to come to the clinics for the fortnightly sessions. The reasons were lack of time, distance from the clinic, not allowed by the father or grandparents of the child and occasionally travelling outside the area."* – Saving Brains TTS project lead

Project teams used a range of methods to incentivise caregivers to attend sessions. One TTS team trialled both provision of oil supplementation and 'motivational meetings' (Table 1, ICDDR,B); both methods were found to be effective but motivational meetings were adopted due to sustainability.

DISCUSSION

This is the first paper to report on workforce data from a large multi-country child development portfolio, including 32 RCEL projects with 2,197 workers delivering interventions across 17 LMIC. This analysis addresses human resources and curricula content for implementation at scale; it is noted that these factors do not stand in isolation but interact with each other and other programme design factors as well as with local contexts. We build on the Saving Brains portfolio exploration by *Radner et al.*, which highlights that workforce decisions around delivery of RCEL programmes can have substantial bearings on programme

sustainability and impact, to further probe specifics of workforce choices in ECD programme implementation, particularly from a health sector perspective.(13, 23) Resultant themes and sub-themes resonate with and extend existing literature regarding workforce choices, particularly the community health workforce, for programme implementation in LMIC settings.

Workforce factors are one of the most critical impediments to implementation at scale. This is well recognised for ECD programmes, especially given intersectoral complexities. Our results suggest that whilst challenges exist for integrating ECD into existing services, introducing novel cadres of worker for standalone ECD programmes may be also challenging at scale. Within this analysis, challenges related to adding ECD workstreams to the existing workload of established frontline workers were clearly reported and may have contributed to poorer retention of salaried health workers, alongside rotation of health workers. This finding has been mirrored across the implementation literature in other areas of global health; for example, an economic analysis of community based maternal and newborn care (CBMNC) across seven countries highlighted trade-offs between improved cost-effectiveness associated with use of existing multipurpose workers and difficulties related to overburdening those workers.(31-35)

Ongoing supportive supervision, not just initial training, was found to be crucial to intervention quality and fidelity, as has been found in global health more broadly. For example, quality supervision was emphasised as central to preservation of project quality as well as worker motivation in the CBMNC analyses, and was examined in more detail in several of these evaluations, including the cluster randomised controlled Goodstart (III) trial of maternal and newborn (MNH) care in South Africa.(32, 36) Similarly, supervision and training, and particularly the potential of e-supervision/training, were highlighted as key concerns for project feasibility in a review of interventions for children with intellectual disabilities (37) and additionally were found to be critical for sustainable scale and impact in both PRIME and a follow-up study of a cluster randomized trial of a psychosocial ECD project in Colombia.(33, 38, 39)

The challenge of retention of workers emerged as an important theme and is also not isolated to ECD. Within the Saving Brains portfolio, strategies used to mitigate against poor retention echoed findings in other global health implementation research including; over-recruitment, fast-track training, and provision of high-quality training and supervision.(33, 36, 39) *Andrew*

et al suggest designing interventions according to geographical practicalities and other contextual factors to mitigate staff turnover, and thus optimise project quality and impact.(38) There is appetite for shared learning to help tackle the human resource challenges highlighted in this paper, and resources such as the Early Childhood Workforce Initiative provide a useful platform for ECD policymakers and programmers globally to work together.(40, 41)

Regarding essential ECD intervention curricula and components for scale-up, commonalities were seen amongst the larger TTS projects which add to previous literature on this topic.(6, 14) However, there is no agreed standard package for ECD set out by the UN, contributing to project heterogeneity and precluding clear guidance for policymakers and programmers on ECD intervention content. This lack of standardised content is in contrast to more biomedical programmes, such as antenatal and postnatal care packages, as well as broader mental health and nutrition programmes which, though similar to ECD in their intersectoral nature, do have some standardised content, such as the WHO and UNICEF's Infant and Young Child Feeding approach.(31, 42, 43) While lack of description of intervention content in this portfolio hinders specific recommendations for a standardised ECD curricula, our findings suggest that the focus of a standardised ECD curricula should be on engaging parents in activities which promote development, rather than providing information on developmental milestones, as is seen in many countries.

Even with a standard package, contextualisation would be important, and our findings underline the need for formative research. Across the Saving Brains portfolio, there was a noticeable lack of in-depth description of curricula content, despite key informants highlighting this as important for sustainability.(14, 15) A framework for describing contextualised content of RCEL projects using, for example, parameters described by *Aboud et al* (information, performance, problem-solving, social support, materials and media) would provide clarity in the literature and strengthen programme comparison and evaluation.(14, 44) Further, as the NCF proposes, delineating ECD programmes more clearly into universal, targeted, and indicated packages to respond to the specific needs of children at particular developmental risk or with developmental disabilities would support better inclusion of children who otherwise risk not being reached by universal or conventional service models.(9, 45-47) As *Boggs et al* highlight, improved developmental monitoring is critical, and ECD workers have a vital role to play in identifying the young children most at risk of developmental

difficulty and referring for ECD intervention, as well as in intervention delivery.(21) While there is little published literature on early intervention to improve health and developmental outcomes for children with disabilities in LMIC, trials are underway and emerging models that have been adapted and that are being trialled in the context of the Zika epidemic may be informative.(48, 49)

Regarding delivery strategy, group sessions were frequently favoured across the Portfolio, notably based on increased practicality, efficiency, and acceptability, rather than increased effectiveness.(23) Previous evidence for both ECD and health programmes supports the use of a combination of home visits and group sessions as more effective in terms of information consolidation and parental behavioural change.(10, 14, 50) Intervention dosage was variable across the Portfolio and the need for flexibility in this when adapting to different contexts, for example during implementation of the 'Reach Up' package in Brazil, frequently emerged during analysis.(51) Dosage variability was similarly reported during the Goodstart (III) trial and was attributed to contextual and workforce factors including occupation, remuneration, and community recognition of workers.(36)

Strengths and Limitations

Many of the limitations of this evaluation are common to ECD programming more broadly. Several process-related metrics were not commonly reported including coverage, equity, and cost-effectiveness, likely influenced by the small-scale and 'proof of concept' nature of most projects.(39) The donor-facing system of data collection and reporting within the portfolio may have introduced bias, with investigators feeling obliged to report positively, however the open learning culture within the Saving Brains Platform acted to substantially reduce this. Grant awardees were selected by GCC and so projects and their aims may reflect funder priorities. Enhancing linkages between implementation processes and impacts within this portfolio and more broadly has the potential to strengthen evidence to inform policy and programming. Additionally, while this paper describes design decisions, there was not scope to explore the reasons behind these decisions. Exploration of these reasons may contribute to stronger and clearer evidence, policy and programming.

CONCLUSION

We have reported on the largest study to date of workforce and curricula content for ECD from a large and varied portfolio of 32 projects, providing a new synthesis about implementation challenges and enablers for ECD programming. Clear themes have emerged with parallels to LMIC programmatic learning in other areas, such as global mental health and nutrition. Development of a more standardised package or planning guide for ECD programmes would mitigate some of the challenges reported here, but programmes still need to be adapted to context. Carrying out and learning from such adaptation could be supported by a common framework for describing content and delivery strategies. More systematic evaluations of implementation costs, including worker costs will be essential inputs for planning of routine ECD programmes, within and beyond the health sector. There is currently a policy window for investment in ECD, enabled by the NCF, and practical evidence and data are essential to ensure that those investments are as effective as possible to reach all children, everywhere.(9)

AUTHOR CONTRIBUTIONSHIP STATEMENT

The first draft of the paper was undertaken by CJT, MKL and VPH. Other specific contributions were made by RB, SB, AB, VC, EG, JH, RH, KM, KM, RD, KS, and JEL. The Expert Advisory Group (Pia Britto, Tarun Dua, EG, SGM, Melissa Gladstone, JH, RH, KM, James Radner, Muneera Rasheed, KS, Arjun Upadhyay) contributed to the conceptual process throughout. All authors reviewed and agreed on the final manuscript.

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COMPETING INTERESTS

No competing interests.

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DISCLAIMER

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institution with which they are affiliated.

Data sharing

Supplementary data have been published online and may also be accessed by emailing cally.tann@lshtm.ac.uk.

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Figure 1: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

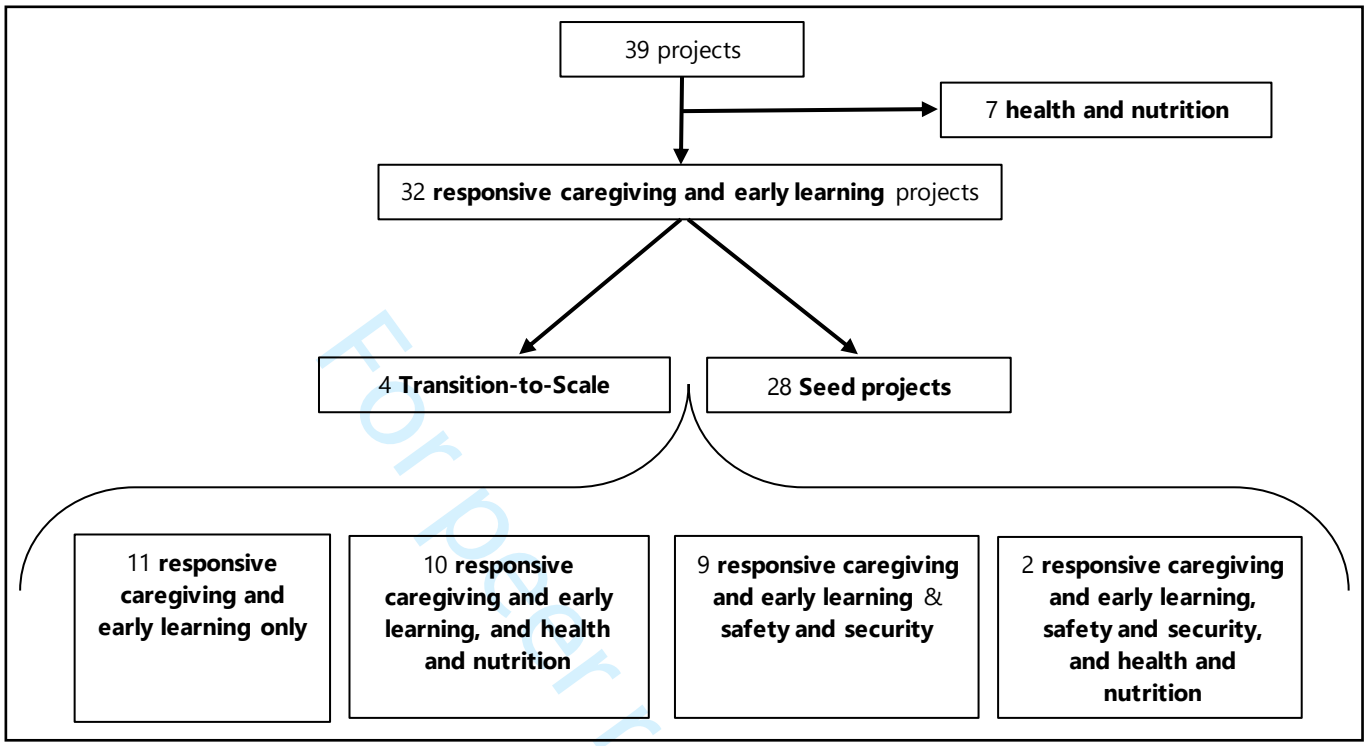
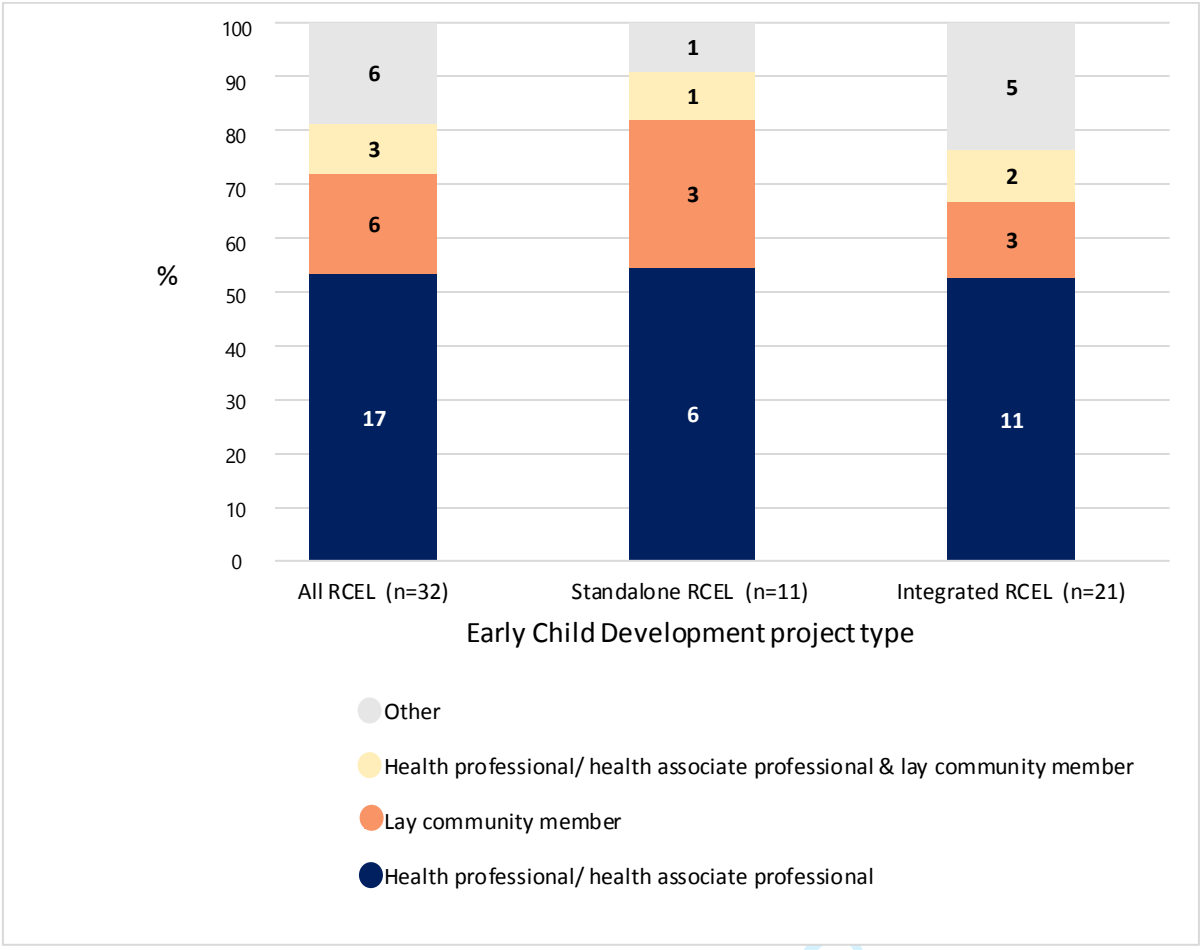


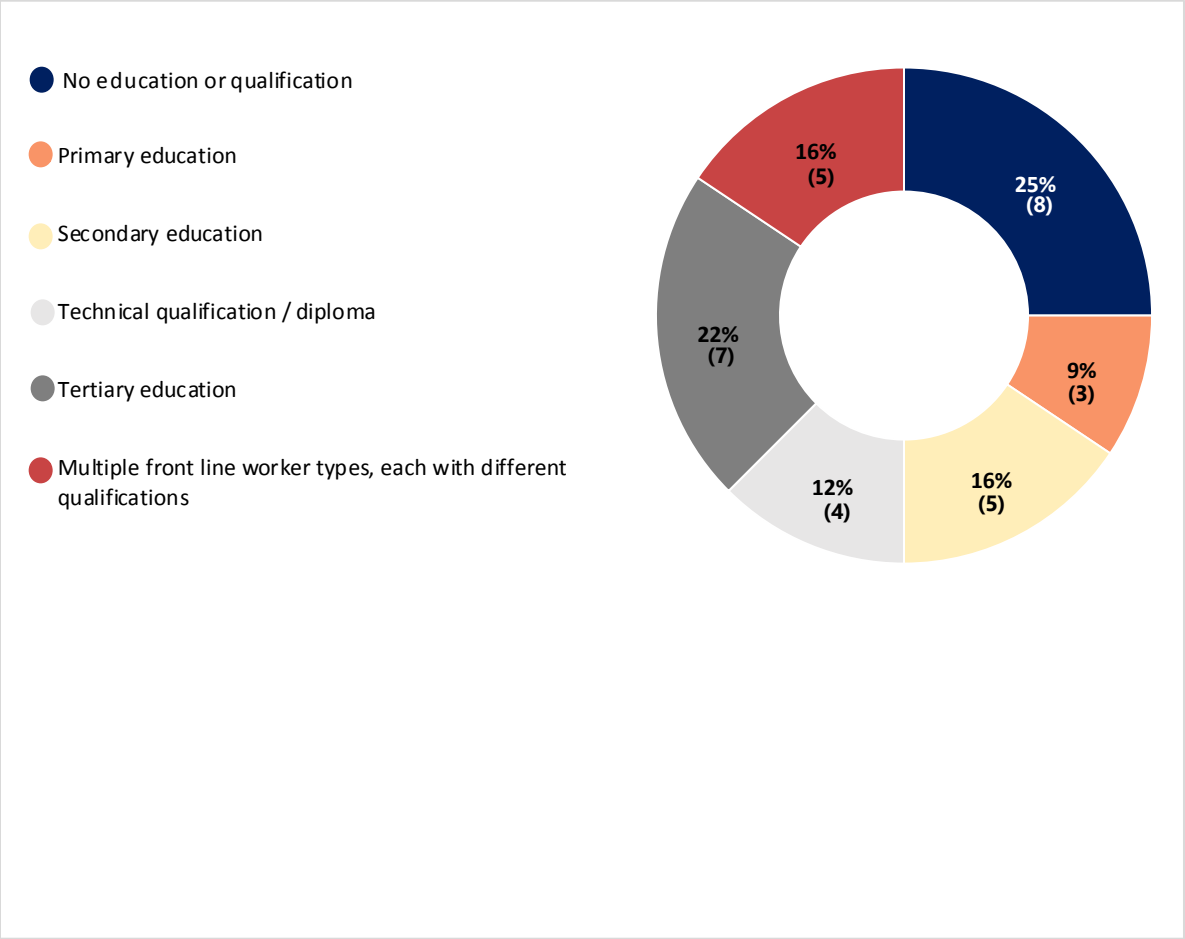
Figure 2: Occupation, incentivisation, qualification and retention of frontline workers amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Occupation of frontline worker delivering responsive care and early learning (RCEL) projects by type of RCEL intervention project.



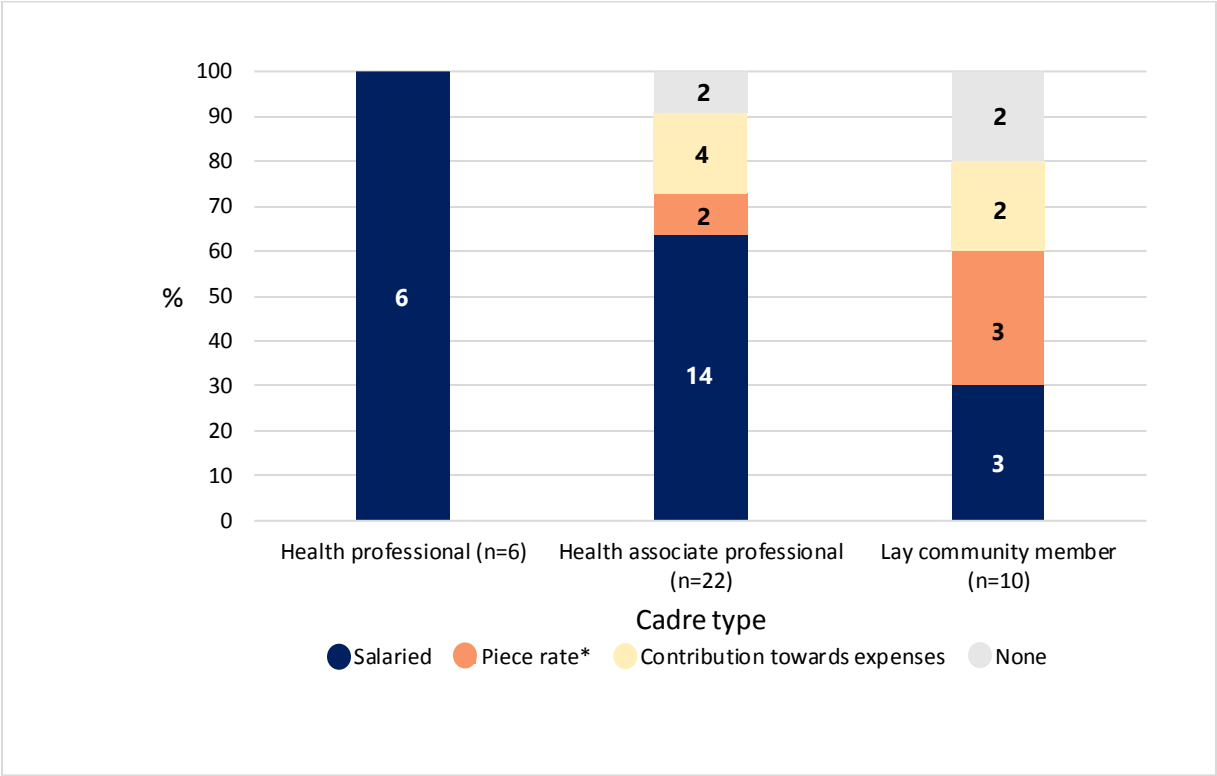
No missing data (N=32 projects). Figures on bars represent number of projects. 'Other'=teaching professionals, social work professionals, personal care workers and combinations of occupation types.

b) Reported level of education / qualification of frontline workers across all responsive care and early learning (RCEL) projects (N=32 projects)



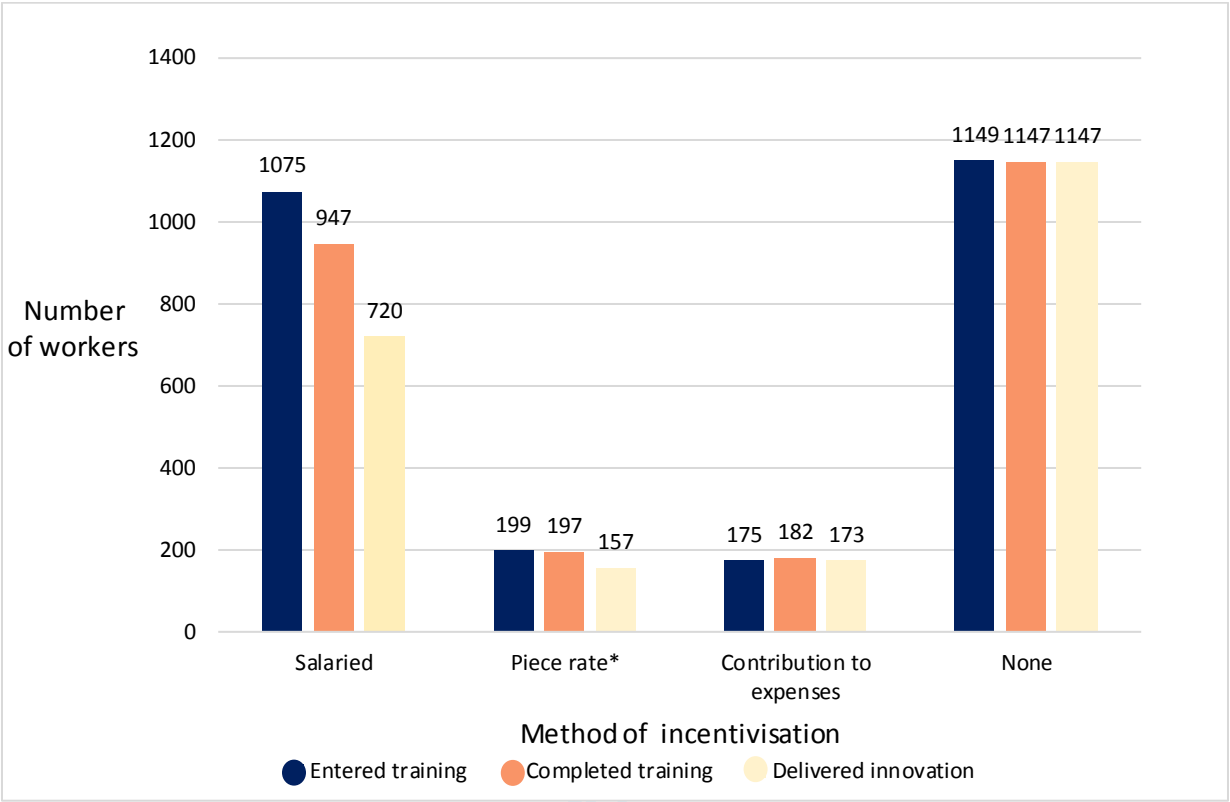
Data reported from Service Delivery Forms which reports on the level of education or qualifications that front-line workers had (rather than what implementers felt that they needed). No missing data.

c) Incentivisation of front-line workers delivering responsive care and early learning (RCEL) projects according to cadre of worker (N=25 projects)



Total 'n' is greater than number of projects included (N=25) as several projects used more than one occupation as workers. Piece rate=any irregular payment where pay is per task rather than fixed salary payment. Figures on bars represent number of projects. Missing data from 7 projects.

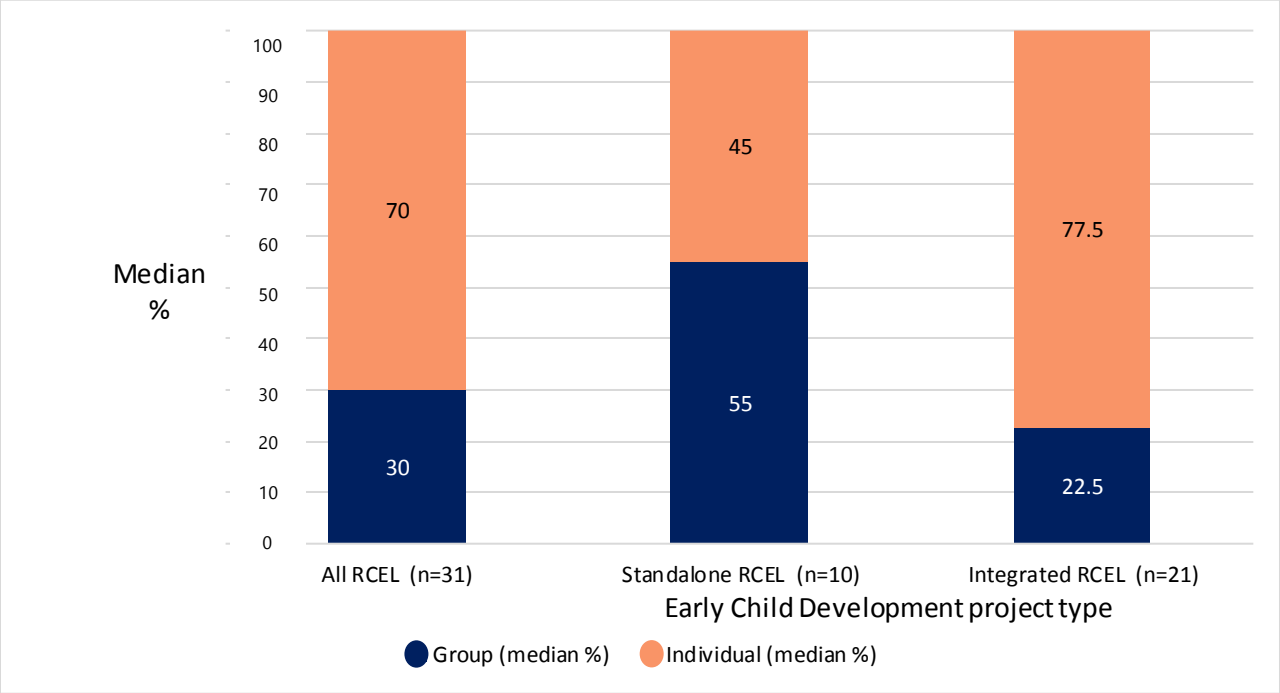
d) Retention of worker amongst responsive care and early learning (RCEL) projects according to method of incentivisation (N=30 projects)



Data reported from the Results-based Management and Analysis Framework (Web Annex Table A) reported from each project. Missing data from 2 projects. Piece rate=any irregular payment where pay is per task rather than fixed salary payment

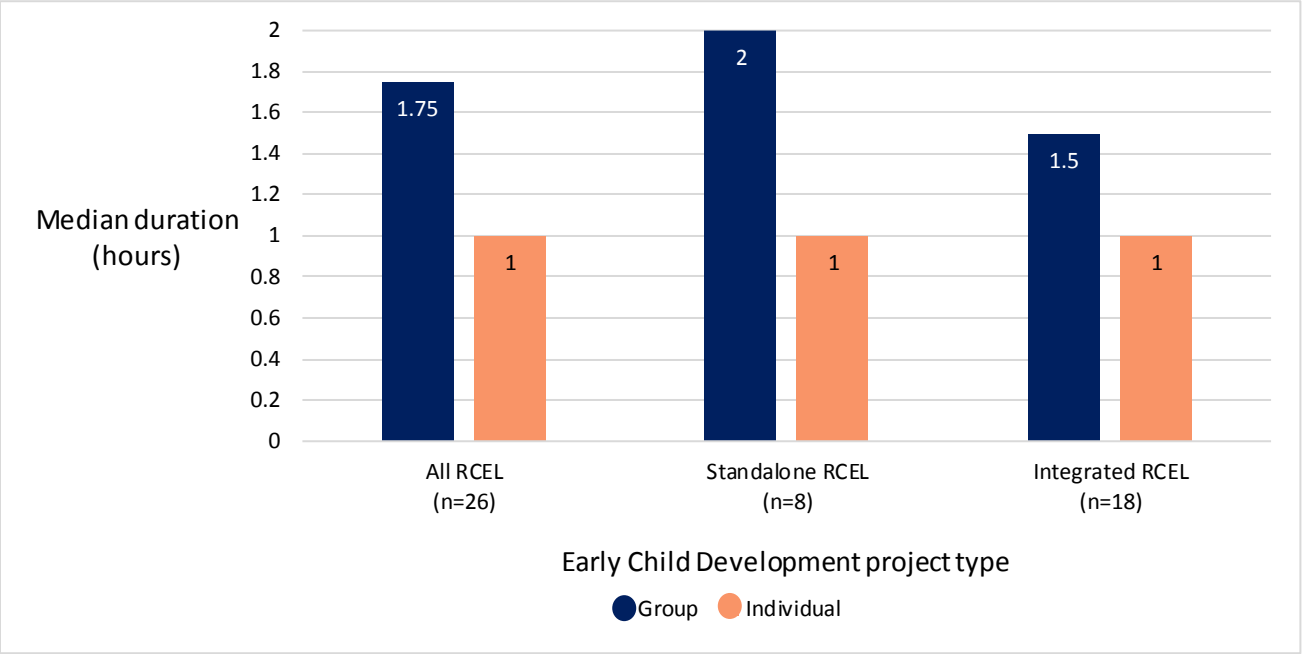
Figure 3: Method and duration of delivery of intervention curricula amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Method of project delivery: group vs individual by type of RCEL intervention project (N=31 projects)



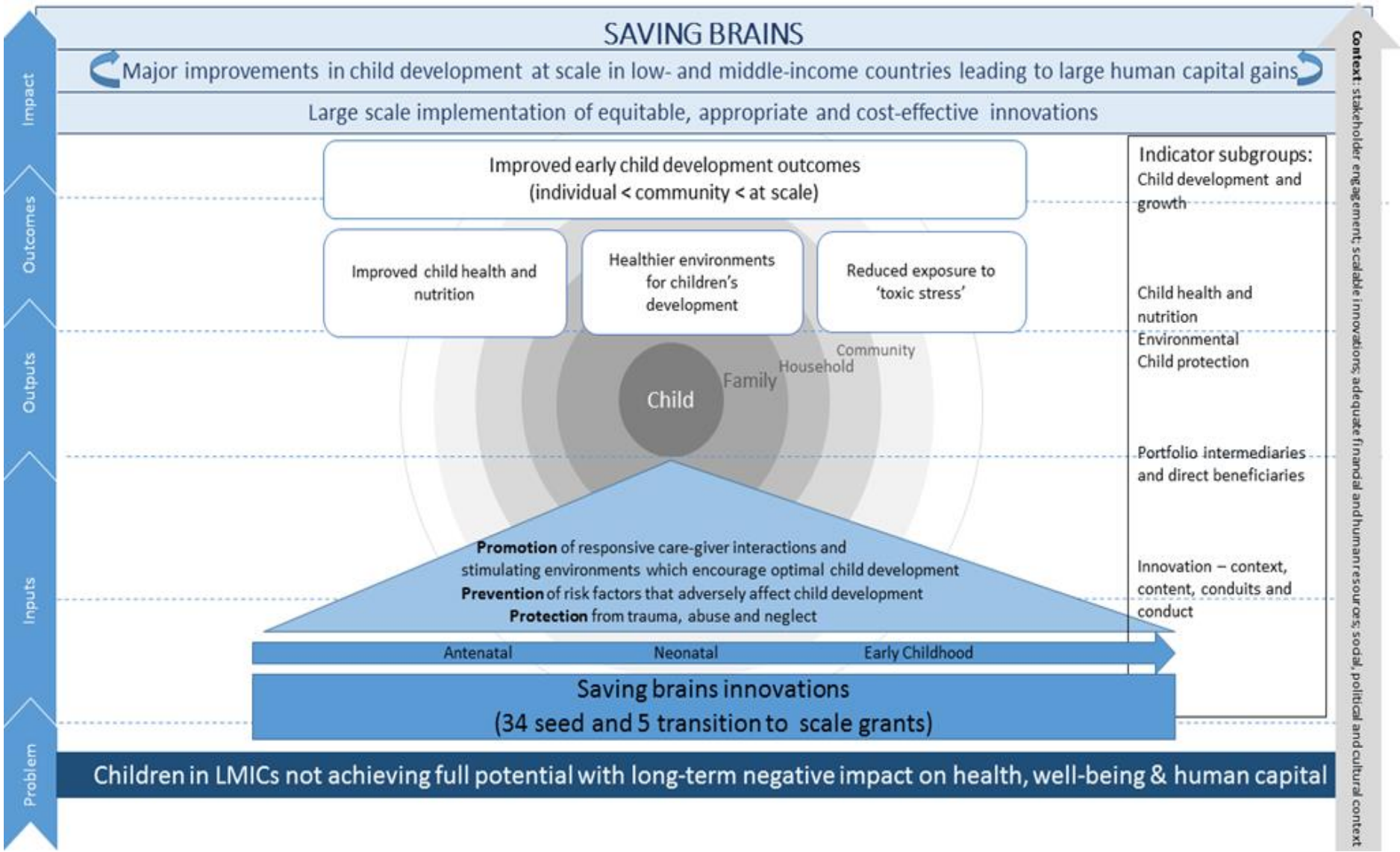
Missing data from 1 project.

b) Median duration of project sessions comparing projects delivering curricula in group vs individual sessions by type of RECL intervention project (N=26 projects)

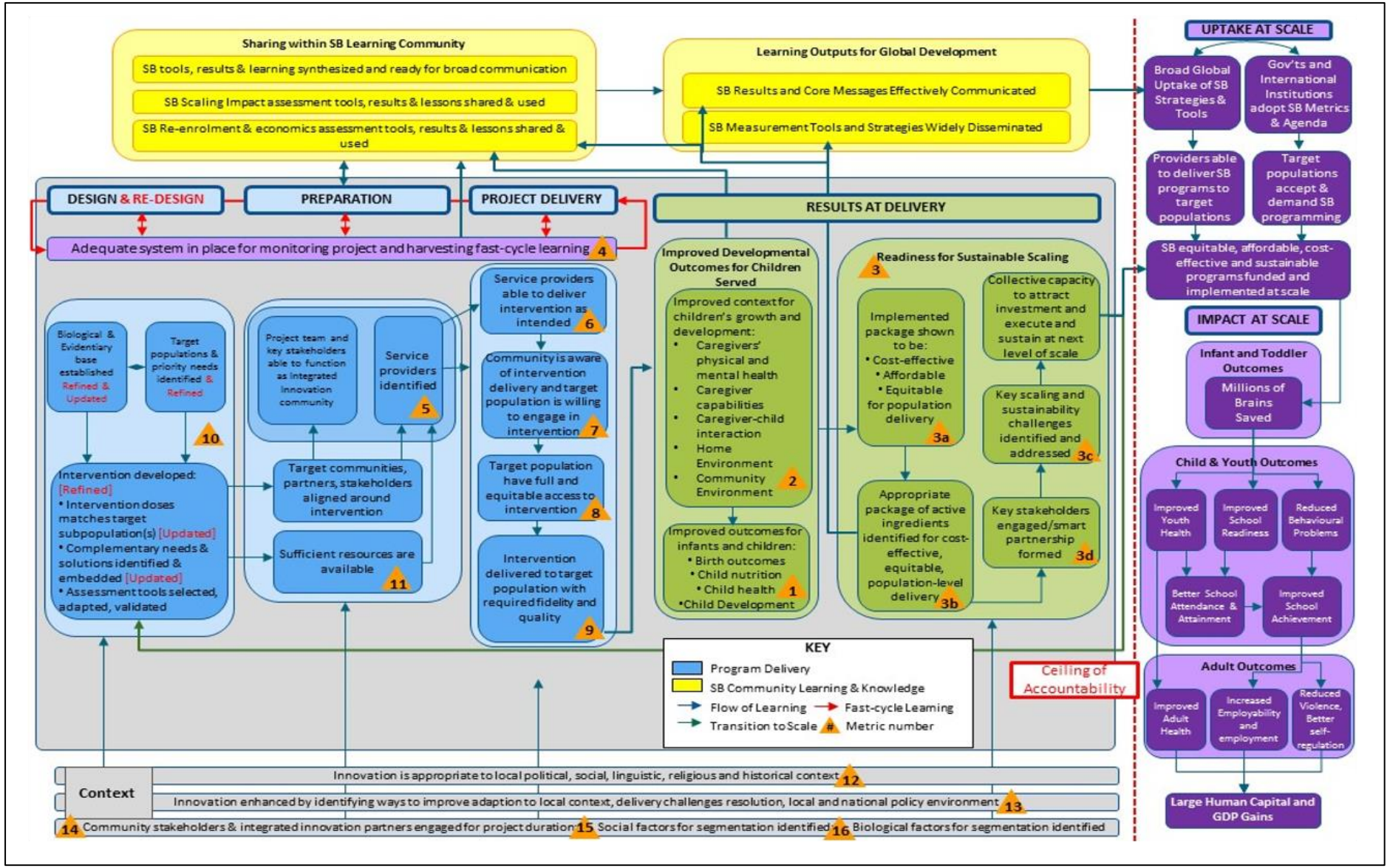


Missing data from 6

Web Appendix Figure A: Portfolio Conceptual Evaluation Framework



Web Appendix Figure B: Saving Brains portfolio level Theory of Change



Web Appendix Table A: Data sources utilised for the Saving Brains portfolio evaluation

Data Source	Description	Timing of data collection	Organisation receiving data	Data type
Service delivery forms	Document completed by grantees used to collect projected, interim and/or final and quantitative information on workforce and intervention delivery	Yearly	Grand Challenges Canada	Quantitative & Qualitative
Results- based Management and Accountability Framework (RMAF)	Framework completed by grantee which facilitates the collection of data and comparison of results around core metrics	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative
RMAF+	Framework completed by grantee developed from the original RMAF and Theory of Change containing more detailed metrics on impact, process and context of innovations	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative
Progress reports	Narrative reports completed by grantees detailing project progression, challenges, lessons learned, results, dissemination and next steps	Six-monthly	Grand Challenges Canada	Qualitative
Research proposals	Proposal of innovation design completed by potential grantees	Point of application for grant	Grand Challenges Canada	Qualitative
Saving Brains community meeting transcripts	Transcripts from discussions between grantees and platform members at two Saving Brains community meetings	21st-22nd Jun 2016 25th-26th Oct 2016	London School of Hygiene & Tropical Medicine	Qualitative
Key informant interviews	Key informants identified through professional networks and approached for interview on relevant themes	Jun-Oct 2016	World Health Organization & London School of Hygiene & Tropical Medicine	Qualitative
Grantee interviews	Grantees identified by LSHTM and platform members for thematic discussion	Jul-Sept 2016	London School of Hygiene & Tropical Medicine	Qualitative
Focus group discussions	Grantees selected and invited to online focus group discussion on workforce choices, supervision and training, and monitoring quality and coverage	Jun-Oct 2016	London School of Hygiene & Tropical Medicine	Qualitative

Web Appendix Table B: Interview and focus group topic guides from Saving Brains evaluation

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
Impact and outcome metrics question guide
Background Limitations of child development metrics pose a major challenge in policy and programming efforts to improve early child development outcomes in LMIC settings. Various initiatives are underway to improve measurement of outcomes at population and individual level (e.g. newly published data from McCoy DC et al, funded by the Saving Brains Programme, Grand Challenges Canada, providing the first global and regional estimates of the number of children failing to reach developmental milestones based on parent report measures.1 However major challenges remain and collaboration is required to improve measurement of impact of interventions on child development outcomes at scale in low-resources settings.
Objectives To discuss as a group; 1. Different approaches to impact measurement that have been taken across the Saving Brains portfolio 2. Challenges and benefits of different approaches taken 3. Lessons learned for policy makers and programmers attempting to measure impact of ECD interventions at scale
Questions 1. How has impact been measured across the Saving Brains portfolio? 2. How were decisions reached about impact measures used? What factors influenced these decisions? 3. How has use of these impact measures worked in practice? 4. How about intermediary outcome measurement in terms of environment, caregiver relationships etc.? 5. What have been the programming requirements to support this in terms of human resources, cost, timeline etc.? 6. Have measures used required translation and adaptation in your local context and if so, how has this been managed? 7. Do measures used include children less than 3 years and children with disabilities? 8. Could measures used within the Saving Brains portfolio be used if innovations were scaled up at National level? If so, how and what would be required to support this? If not, what alternatives would you recommend for programmers and policy makers? 9. Given the range of players involved, how can coordination within ECD networks be improved to support development of improved metrics? 10. Any other aspects of impact measurement that you think are important considerations which we have not covered?
Cadre question guide
Background Choices around human resources for implementation of ECD interventions have significant implications for effectiveness, sustainability and scale-up. Across the Savings Brains portfolio, a broad range of workers have been used to implement innovations with potential lessons for policy makers and programmers aiming to implement ECD interventions at scale in a range of contexts.
Objectives 1. To discuss the range of workers used to implement innovations across settings. 2. To discuss rationale for choice of workers used across settings. 3. To discuss programming implications with use of different cadres of workers.
Questions 1. What was the rationale for selection of worker type across different SB innovations?

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
2. What challenges and benefits were noted with use of various cadres of workers across settings? 3. Where pre-existing categories of workers were used, what were the pros and cons experienced? How was the overall workload for individual workers managed when implementing 'additional' ECD intervention? 4. Where new worker groups were used, what were the pros and cons of this approach? How were issues of financing, governance and sustainability managed? 5. How were decisions around incentivisation reached? 6. Where community health workers were used, how were decisions reached around type of community health worker, level of training, supervision, equipment and incentivisation? 7. Where community health workers were used with the goal of improving equity and coverage of interventions, were these tracked? And if so, provisional recommendations or findings? 8. When thinking about decisions at a national scale, are there additional factors that need to be considered about human resources for implementation of ECD interventions?
Content (positive stimulation interventions) question guide
Background Available evidence provides general guidance to policy makers and programmers about elements of positive stimulation interventions associated with increased effectiveness.2 In particular, use of a structured evidence based curriculum, provision of opportunity to practice skills with the child, provision of feedback to the parent, adequate training and supervision for staff, integrated health, nutrition and ECD elements and both community and government support are thought to be important in intervention effectiveness.2 There are also an increasing range of resources available to programmers implementing ECD interventions.3, 4 However, from a practical perspective programmers still face detailed choices about intervention design and pros and cons of alternate choices in different settings may not be clear.
Objectives 1. To consider key intervention design questions raised when implementing positive stimulation interventions across the SB portfolio. 2. To consider how choices were made around these intervention design elements. 3. To consider relevance of lessons learned to programmers developing models for ECD interventions at national scale.
Questions 1. Across the SB portfolio what factors have informed choices about the following elements of positive stimulation interventions; 2. Target of intervention (e.g. parent, parent and child, child only) 3. Age of children 4. Number of contacts 5. Frequency of contacts 6. Duration of contacts 7. Chosen curriculum (with as much detail re actual curriculum as possible) 8. With regards to choices made, what has worked well and why? 9. Are there areas which have not worked well and if so, please describe? 10. Are there design elements that need to change to enable scale up and if so, please provide examples? 11. Any other elements that you consider important for programmers at national level to consider when developing models for implementation at scale? NB *That questions re universal vs targeted and integration of interventions are asked elsewhere but could also be covered here.*
Delivery setting question guide
Background

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
ECD interventions are delivered in diverse settings in terms of geography, rural/urban, different sectors, facility/communities or home or often a mix of settings. Decisions about setting have implications for policy and on many aspects of programming.
Objectives To discuss as a group; 1. How decisions about implementation setting were made across the portfolio 2. Implications of those decisions, both positive and negative on program implementation and scale-up 3. Lessons learned for policy makers and programmers designing ECD programmes at national
Questions 1. How were decisions about the setting for implementation of your ECD programme reached (e.g. convenience, targeting of vulnerable subgroup, prior involvement with that sector etc.)? 2. What information did you use in deciding about the setting of implementation for your program? 3. Was there any information that if you'd had it earlier, would have altered your decision about setting? 4. Benefits specific to your setting? 5. Challenges specific to your setting? 6. What implications has setting choice had on the ease of program implementation? 7. What recommendations about delivery setting would you make to policy makers and programmers designing ECD programmes at national scale? 8. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Universal and targeted approaches
Background Universal approaches to improving ECD aim to increase protective factors and reduced risks for adverse child development at a whole population level. Targeted approaches are aimed specifically at children identified as having a higher-than-population-baseline risk of adverse developmental outcomes. While systems which provide both universal and targeted ECD interventions are ideal, in resource limited settings, some have suggested that services should initially be targeted to the most vulnerable.5 Further, from a rights perspective, it can be argued that ensuring equity through inclusion of children with specific additional risk factors (e.g. disability, membership to ethnic minority subgroups etc.) is a priority, regardless of setting. There are however many challenges. While effectiveness of interventions may be greatest for certain vulnerable population sub-groups, with potentially favourable 'benefit to cost ratio' for investment, scaling up services to include those 'hardest to reach' may involve higher initial costs.2 These complexities pose challenges for policy makers trying to develop ECD programmes which are equitable but also provide sustainable coverage at scale.
Objectives To discuss as a group; 1. The rationale for selection of targeted versus universal approaches to ECD implementation in different settings within the SB portfolio. 2. Programming implications for both approaches 3. Requirements to inform policy makers in decisions about either universal or targeted approach to implementation
Questions 1. What was the rationale for selection of targeted versus universal approaches to ECD implementation in your context? 2. In interventions where a targeted approach was taken, how was the target population

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
identified (e.g. data driven, empirically, opportunistically)? 3. What are the benefits and disadvantages of a targeted approach in different settings? 4. What are the benefits and disadvantages of a universal approach in different settings? 5. What have been the programming implications of different approaches taken (e.g. human resources, training and supervision, financial)? 6. Have there been implications for financial sustainability and if so, moving forward, what strategies might be used to address these? 7. For interventions taking a universal approach, what strategies have been implemented to ensure inclusion of disadvantaged population subgroups including children with disabilities? 8. What recommendations about intervention targeting would you make to policy makers and programmers designing ECD programmes at national scale? 9. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Processes for monitoring coverage and quality at scale
Background Processes to ensure quality and coverage are important for effective and equitable implementation of ECD interventions.2 However, review by Yousafzai et al has highlighted the need for further consideration of implementation processes to facilitate more comprehensive guidance as to how to effectively implement interventions.6, 7 The SB portfolio provides a unique opportunity to consider implementation processes in order to provide more detailed guidance for programming at scale.
Objectives To discuss: 1. Priorities in measuring quality and coverage of intervention. 2. Approaches used to monitor quality and coverage across the portfolio. 3. Considerations for monitoring coverage and quality of ECD interventions at scale.
Questions 1. What do you think are the 3 most important elements of 'quality' of implementation to measure? 2. What indicators have been most helpful in measuring these? 3. What processes of supervision and training have been developed to support this? (As much detail as possible re number of supervisors per worker, frequency, duration and mode of supervision) 4. What has been required to support monitoring of quality and coverage in terms of; 5. Data sources - are these procedures integrated into existing national data collection systems or stand-alone systems? 6. Technical and funding support? 7. Incentivisation of workers? 8. How have findings from monitoring been incorporated into ongoing implementation? 9. Would these approaches to monitoring of quality be feasible and appropriate for interventions delivered at national scale? 10. What strategies have been used to ensure equitable coverage of interventions? 11. What strategies have been used to reach the most difficult to reach populations including children with disabilities? 12. What challenges have been faced with regard to retention of participants? How have these challenges been overcome? 13. How would these approaches need modified for implementation at national scale?
Integration
Background Integrated delivery of ECD with interventions in other sectors is often recommended to promote holistic care of children and their families, to maximise synergies of interventions and for efficiency.

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
However, an integrated approach to service delivery also has many implications for programming.
Objectives To consider as a group; 1. Experience with integrated innovations across the SB portfolio in terms.
Questions 1. What has been the rationale for choosing ECD specific or integrated ECD approaches in different settings across the portfolio? 2. Where integrated approaches have been taken, how has this worked? 3. What have been the programmatic implications of an integrated approach in terms of; 4. Work-load for workers? 5. Training and supervision? 6. Equipment? 7. Cost? 8. Monitoring and evaluation? 9. How has governance across sectors been managed? 10. What are the implications of an integrated approach for implementation at national scale? 11. Are there other elements of an integrated approach which are important to consider in implementation of ECD programmes at national scale?
Questions for experts in the field
1. What do you consider to be priority needs for policy makers and programmers in implementing ECD programming at national scale, once a decision has been made to invest in early child development? 2. With regards to ECD programmes at scale, what do you consider to be the key design decisions for policy makers and programmers? 3. Given the challenges of measuring impact in ECD programmes and the constraints that this poses to progress in policy and planning, what do you see as next steps in improving developmental outcome metrics within programmes and at national scale? 4. If it were possible to monitor 3 indicators on the pathway to improving ECD at a national level, what would you measure and why? 5. What key lessons can be learned about cadres of worker for delivery of ECD interventions from other global child health interventions? In particular, what lessons around use of CHWs are relevant for CHW delivery of positive stimulation interventions in home settings?

Web Appendix Table C: Key informants contributing to qualitative components of portfolio evaluation

	Organisation Type/Name	Position	Question theme
ECD POLICY AND PROGRAMMING			
1	Saving Brains	Executive	ECD research, policy and programming; contemporary challenges and future directions.
2.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
3.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
4.	Private international ECD foundation	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
5.	International Financial Institution.	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
6.	Multilateral non-government organisation.	Policy &programming.	ECD programming, iNGO perspective on what is needed to progress the field
7.	International Child Health Research Institution	Policy, programming & research.	ECD in global child health – challenges and future directions.
8.	Non-government disability-ECD organisation - national level.	Policy and programming.	Inclusion in ECD programming – iNGO perspective
9.	Ministry of Health, sub-Saharan African country.	Policy and Programming	ECD in global child health, health perspectives.
OTHER EXPERTS IN FIELD			
	General		
10.	Public health academic institution, UK	Senior Researcher	Research priorities in ECD
11.	Public health academic institution, USA.	Senior Researcher.	Challenges, priorities and approaches in future ECD research.
	Specific technical		
12.	Public health academic institution, USA.	Senior Researcher.	Impact metrics
13.	Public health academic institution, USA.	Researcher.	Impact metrics
14.	Public health academic institution, UK	Senior Researcher.	Impact metrics
15.	Multilateral UN organisation.	Senior Researcher.	Impact metrics
16.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, human resourcing.
17.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, cost-effectiveness
18.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Integration.
19.	Academic Centre, USA.	Senior Researcher.	Implementation process knowledge gaps, priority questions and research methodology.
	Saving Brains Platform		
Members of the Saving Brains Platform team who were consulted about various aspects of the evaluation, their experiences working within the Saving Brains portfolio and in regard to specific technical, programming and research related themes.			
	Grantees		
Twenty-one of thirty-nine (54%) of research teams were specifically interviewed regarding their innovation and various aspects of their experiences within the Saving Brains portfolio.			

Web Appendix Table D: Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of challenges and course correction

Project Name	**Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improve malnourished children's development**	**An integrated intervention targeted at deprived pre-school children in rural areas**	**Home visiting programs to improve early child development and maternal mental health**	**Saving Brains, Changing Mindsets**
HUMAN RESOURCES: CHALLENGES AND COURSE CORRECTION				
Interaction with existing services	Integration and coordination with health services in rural Bangladesh.	Competition from a new government-run parenting program, ICBF.	Integration into existing family health strategy home-visits increased visit frequency but reduced number of families visited. Local workers demanded financial incentives to deliver new project and prioritized pre-existing activities.	Issues encountered were gaining confidence and trust of construction companies, quality assurance of individual NGOs, securing adequate infrastructure, particularly as a decline in the construction industry slowed project progress
Adaptation for implementation	-	Shift required from didactic learning to 'demonstration and practice' method of learning. Supervision forms were adapted to type of data collected.	Busy schedule of CHWs meant missed appointments were not rescheduled. CDAs more frequently rescheduled visits. Supervision was jeopardised by existing heavy workloads and required intervention by project coordinator.	During scale-up, the focus remained on strengthening supervision quality of partner NGOs.
Training time commitment	Training schedule difficulty for government clinic workers was mitigated by split of training schedules to maintain clinic duty cover.	Long training time commitment was mitigated by incentivisation.	-	-
Staff recruitment / remuneration / retention	Salaried government workers expected incentivisation for additional work and some refused to conduct sessions; this was mitigated by motivational meetings and supervision.	Attrition of workers was mitigated through fast-track training programme. Workers in one affluent town did not value RCEL project, and tasks were unfamiliar to these workers (<3% of sample).	Difficulty in identifying CHWs to deliver intervention in addition to existing routine. High turnover of CHWs considering intervention too time consuming.	Difficulties in identifying sufficiently qualified workers, but not overqualified and viewed RCEL as 'beneath their station'. Initial high attrition rates as workers apprehensive about working with children <3 yrs. Changes made to training modules and selection criteria.
Supervision	-	Reticence from providers unfamiliar with close coaching was mitigated by promoting positive tutoring relationships. Implications and impacts from rurality of workers on supervision.	Supervision not considered a priority by supervisor priority requiring project coordinator to intervene, holding meetings with CDAs and performing supervised visits.	-
CONTENT: CHALLENGES AND COURSE CORRECTION				
Adaptation for implementation	Minor adaptations to Reach-up for the pair study and major adaptation for the group study. Adapted for use in community clinics instead of homes and to be used for fortnightly visits instead of weekly in both studies.	Simplification of curricula language to facilitate provider use. Reluctance to lend toys/materials led to introduction of toy library. Wide developmental age range in groups led to adaptation with more baby-friendly routines and sub-groups by age.	Reach-Up was adapted for twice monthly visits instead of the original weekly visit. Mothers did not like the toy's original appearance which they considered poor. Toy was redesigned to be more appealing.	During scale-up in other regions of India e.g. Bangalore, training module was contextualized, and nutrition menu adapted to the local context.
Materials	Complaints regarding quality of toys (parents) led to extended provider training to facilitate more 'fun' interactive	Initial reluctance for recyclable toy materials but toy-making workshops changed perceptions. Toy library	Materials required cultural adaptation. Adaptation guide needed to be clear regarding exactly what could be adapted	Materials were translated for regions requiring the desired learning materials.

	sessions and directions for making new toys.	developed to promote unrestricted use which was appreciated by caregivers.	and what concepts had to be maintained to guarantee fidelity.	
Recipient attendance, retention & incentivisation	Attendance challenges included distance to clinic, late start to sessions, and expectation of nutritional supplement. More timely attendance and stricter time-keeping encouraged. Incentivisation included oil supplementation distribution & caregiver motivational meetings.	High value of project nutritional package incentivised attendance. Tutors and providers supported problem-solving to overcome barriers to attendance (i.e. long distances, travel costs, job responsibilities etc.). Encouraging positive social interactions meant beneficiaries more motivated.	Beneficiaries had no other incentives but the program itself. The major cause of attrition was mobile populations due to rental accommodation. Mothers enjoyed and wanted to complete the programme.	-
References	(21-23)	(23, 24)	(23, 25)	(23, 26)

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ABSTRACT

Objective: The World Health Organization recommends responsive caregiving and early learning (RCEL) interventions to improve early child development (ECD), and to achieve the Sustainable Development Goals' vision of a world where all children thrive. Implementation of RCEL programmes in low- and middle-income countries (LMIC) requires evidence to inform decisions about human resources and curricula content. We aimed to describe human resources and curricula content for implementation of RCEL projects across diverse LMIC, using data from the Grand Challenges Canada® Saving Brains® ECD portfolio.

Setting: We evaluated 32 RCEL projects across 17 LMIC on four continents.

Participants: Overall, 2,165 workers delivered ECD interventions to 25,909 families.

Intervention: Projects were either standalone RCEL or RCEL combined with health and nutrition, and/or safety and security.

Primary and secondary outcomes: We undertook a mixed-methods evaluation of RCEL projects within the Saving Brains® portfolio. Quantitative data were collected through standardised reporting tools. Qualitative data were collected from ECD experts and stakeholders and analysed using thematic content analysis, informed by literature review.

Results: Major themes regarding human resources included: worker characteristics, incentivisation, retention, training and supervision, and regarding curricula content: flexible adaptation of content and delivery, fidelity, and intervention duration and dosage. Lack of a universally agreed standard ECD package contributed to project heterogeneity. Incorporation of ECD into existing services may facilitate scale-up but overburdened workers plus potential reductions in service quality remain challenging. Supportive training and supervision, inducement, worker retention, dosage and delivery modality emerged as key implementation decisions.

Conclusions: This mixed-method evaluation of a multi-country ECD portfolio identified themes for consideration by policymakers and programme leaders relevant to RCEL implementation in diverse LMIC. Larger studies, that also examine impact, including high-

quality process and costing evaluations with comparable data, are required to further inform decisions for implementation of RCEL projects at national and regional scale.

ARTICLE SUMMARY

Strengths and limitations of this study

- Scale-up of responsive caregiving and early learning (RCEL) interventions, a key domain in the World Health Organization/UNICEF/World Bank Nurturing Care Framework, requires evidence to inform decisions about human resources and curricula content for implementation.
- This is the first paper to report on workforce data from the large multi-country Saving Brains® early child development (ECD) portfolio. We analysed data from 32 RCEL projects based in 17 low- and middle-income countries, including a total of 2,165 frontline workers who delivered ECD interventions to over 25,000 children and parents.
- A lack of universally agreed standard package for ECD interventions contributed to project heterogeneity within the portfolio. The importance of contextual adaptation of curricula content, human resources management, and service delivery strategies was highlighted. Development of more standardised RCEL curricula and training content for scaling would address project heterogeneity and adaptation to context.
- Incorporation of ECD into existing services may allow for wider scale-up, but challenges related to already high workloads plus potential reductions in service quality remain.
- Rigorous evaluations are required to inform decisions for implementation of RCEL projects at scale. There are almost no cost data to plan services, and we found no data on materials for workers' use.

BACKGROUND

Optimal early child development (ECD) is central to the Sustainable Development Goals' vision of a world in which children can *thrive*.(1, 2) ECD programmes have the potential to transform human capital across the life course, and scale-up of responsive caregiving and early learning (RCEL) is advocated by the World Health Organization, UNICEF and World Bank, as a key part of the Nurturing Care Framework launched in 2018 (see Box 1).(3-7) Programmes promoting RCEL have been found to be effective for ECD and related to longer term outcomes, including educational attainment and adult earnings.(5, 8)

Box 1: ***Terms for responsive care & early learning for early child development***

Multiple terms are used to describe interventions that promote early child development. The World Health Organization, UNICEF & World Bank's Nurturing Care Framework refers to a spectrum of requirements necessary for reaching full developmental potential, including: good health, security and safety, nutrition, responsive caregiving, and early learning.

In this paper, we use the concept of nurturing care, and specifically the term 'responsive care and early learning' (RCEL). RCEL describes the promotion of ECD through learning, play, and caregiving that is responsive to children's needs.(5, 9, 10) Similar terms include 'responsive care/caregiving', 'responsive stimulation', 'nurturing care', 'psychosocial stimulation', 'early learning' and 'play'.

However, there are limited data to guide practical implementation of RCEL programmes at scale in low- and middle-income countries (LMIC), and a particular lack of data regarding human resources and curricula content.(11-13) Additionally, guidance for contextual adaptation of projects is crucial but complex for RCEL which involves sectors beyond health. These gaps present challenges to decision-makers and may result in small-scale projects making design choices that limit the potential for sustainable scaling.(5, 14, 15) Thus, analysis of implementation factors for scaling of RCEL projects, particularly human resources and curricula content, is needed.(11)

The *Lancet* series 'Advancing Early Child Development: from Science to Scale' (16) and the *Annals of the New York Academy of Sciences* series 'Implementation Research and Practice for Early Childhood Development' (17) described gaps in the literature relating to ECD programming. The *Archives of Diseases in Childhood* series 'Informing design and implementation for early child development programmes' (18-22) provided evidence from

the Grand Challenges Canada® (GCC) Saving Brains® portfolio for decision points related to ECD programming but did not specifically address human resources and curricula content. This paper responds to this gap, building on *Radner et al*'s exploration of lessons learned on scaling from the Saving Brains portfolio, to explore human resources and curricula content in a diverse range of RCEL programmes from the same portfolio.(23) We predominantly use a health sector perspective, and contextualise our findings within learning from multi-country evaluations of community-based maternal and newborn care and evaluations of mental health and nutrition programming.

Aims & objectives

This paper aims to describe human resources and curricula content for implementation of RCEL projects across diverse LMIC, using data from the Saving Brains portfolio. We will address *who* delivers the project, including training, supervision and inducement; and *what* the specific curricula content is, including materials, intensity, quality, fidelity and adaptation. Objectives are to:

1. Quantitatively analyse human resources and curricula content for RCEL projects in the Saving Brains portfolio.
2. Qualitatively analyse programme design and implementation decisions, focusing on themes related to human resources and curricula content.
3. Synthesise lessons learned and implications for future design and implementation of RCEL programmes at scale.

METHODS

We took a mixed-methods approach, incorporating quantitative data from an evaluation of projects in the Saving Brains portfolio alongside qualitative data from in-depth interviews (IDI) and focus group discussions (FGD) with ECD experts and Saving Brains project leads. Impact and outcome data were not available for the majority of projects at the time of the evaluation and were therefore not included in the evaluation.

Overview of the Saving Brains Portfolio evaluation

Saving Brains is a diverse portfolio of projects, each aimed at improving ECD in LMIC through interventions in the first thousand days, as outlined by *Radner et al*.(23) Projects sought to improve brain development through preventing brain injury, promoting stimulating and responsive environments and/or protecting children from developmental risk factors.(18) An evaluation of Saving Brains was undertaken in 2016-2017 by a team from the London School of Hygiene & Tropical Medicine in collaboration with the Saving Brains Platform team of experts, led by TruePoint Center/Harvard University and the World Health Organization.(24) The team evaluated 39 Saving Brains Seed and Transition-To-Scale (TTS) grants awarded between 2012 and 2016 to project leads from LMIC with variable design and implementation approaches (see *Milner et al* for summary of projects).(18) Seed grants focused on demonstration of 'proof of concept' over 18-24 months while TTS grants focused on progression towards scale in partnership with other organisations over 3 years. The portfolio evaluation used a conceptual evaluation framework (Web Appendix Figure A), based around the Medical Research Council Guidance on Evaluation of Complex Interventions and was developed around a portfolio-level 'theory of change' (developed by Saving Brains Platform members) to systematically describe and assess human resource and curricula content implementation factors (Web Appendix Figure B).(25) The 'theory of change' metric indicators directly relate to Results-based Management and Accountability Framework data points (see below) collected by each project.

Objective 1. Quantitative data sources and analyses

Quantitative data sources

Quantitative data on project design and implementation were collected from GCC pre-specified data collection tools (Web Appendix Table A). Service Delivery Forms (SDFs) comprised data regarding human resources and RCEL curricula and the Results-based Management and Accountability Framework (RMAF) comprised data on numbers of recipients and beneficiaries, child growth and development outcomes, parental and home environment outcomes, and funding, coverage and context of projects. Data were extracted from SDFs and RMAFs and imported into Microsoft Excel for cleaning, management and analysis (May-Nov 2016).

Quantitative analysis

Descriptive statistics relating to frequency and mode of outcome measurement across the portfolio were generated using Stata 14 and Microsoft Excel. Data on occupation of workers delivering the RCEL projects were classified according to the International Standardised Classification of Occupations.(26) For quantitative analysis, projects were grouped to highlight differences in implementation design factors. Groupings were as follows i) all RCEL projects ii) standalone RCEL projects and iii) integrated RCEL projects, where 'integrated projects' were integrated with another domain of the Nurturing Care Framework (other than RCEL) and 'standalone projects' were not.

Objective 2: Qualitative data sources and analyses

Literature review and topic guides

IDI and FGD were facilitated using topic guides, which were developed based on a literature review guided by the Consolidated Criteria for Reporting Qualitative Research. The review explored implementation experiences relating to human resources and curricula content amongst ECD experts and Saving Brains project leads. Thematic areas of enquiry (Web Appendix Table B) were established based on the literature, stakeholder consultation, and analysis of written project proposals and progress reports submitted by project leads to GCC (Web Appendix Table A). Our analysis was also informed by examples from the literature of similar efforts to support decision-making for implementation in other maternal and newborn health projects in LMIC.

Medline and Embase were searched, with the following MeSH terms; 'Child development' OR 'Developmental Disabilities' AND 'Developing Countries'. Additional articles were retrieved through reference lists of identified articles and publications from the Saving Brains community. Grey literature was searched via websites of major multilateral organisations engaged in ECD programming including the World Health Organization, UNICEF, Save the Children Fund, the World Bank, World Vision International, other related organisations, and Google.

Qualitative data inputs from key informant interviews and focus group discussions

Key informants (n=19) were ECD experts implementing ECD programmes in LMIC (Web Appendix Table C). ECD experts were purposively selected from professional networks including national and international programmers and policy makers, ECD researchers, Saving Brains project leads, and members of the Saving Brains Platform and GCC. All key informants were invited to participate by email. IDI were conducted with key informants and FGD with Saving Brains project leads, with between 4 and 10 participants per FGD. All participants provided verbal informed consent and data collection was concluded once saturation was reached.

IDI and FGD were conducted in English (Jun-Oct 2016) and were audio recorded or transcribed by a member of the evaluation team. Each IDI lasted approximately 60 minutes while each FGD lasted between 60 and 90 minutes. All IDI and FGD were conducted face-to-face or via an online video link. Interviewers and FGD facilitators summarised and verified throughout data collection to improve validity of results. Meetings of Saving Brains innovators and partners on prioritising research in ECD and strategies for implementation of interventions were audio recorded and/or transcribed. Audio recordings of IDI, FGD and meetings were submitted to a third party for transcription. Members of the Saving Brains evaluation team conducted IDI (MKL, KMM and VC) and facilitated FGD (CJT, KMM, VC) alongside members of the Saving Brains platform.

Qualitative data also included Saving Brains project progress reports; written narratives on implementation challenges and mitigation strategies.

Qualitative analysis

Written project documents and transcribed IDI and FGD were de-identified, imported and coded in NVivo 11. Data were independently coded line-by-line by two members of the evaluation team (MKL, KMM). An inductive approach was used to create a coding framework, and thematic content analysis was undertaken to explore themes related to human resources and curricula content until saturation was reached. Inter-rater coding reliability was high on review of NVivo 11 coding reports.

Patient and Public Involvement

This evaluation was conducted without direct patient involvement and they did not contribute to the interpretation of results or writing and editing of this document. However, families were frequently involved in different aspects of the design and interpretation of individual projects within Saving Brains including, but not limited to, the materials used in intervention delivery and methods for incentivising participation.

Ethics approval

The study was approved by the London School of Hygiene & Tropical Medicine Ethics Committee (16001/RR/11202).

RESULTS

Overview: quantitative and qualitative results

32 of the 39 Seed and TTS projects included some aspect of RCEL (Figure 1); the 7 non-RCEL projects were not included in this analysis. Of these 32 projects, 34% (n=11) projects were standalone RCEL interventions and 66% (n=21) were integrated with interventions in 'health and nutrition' (10 projects), 'security and safety' (9 projects) or both (2 projects) (Figure 1). Projects were implemented in 17 LMIC across four continents (see Figure 2).

IDI were conducted with 66% (n=21) of Saving Brains project teams including all TTS projects. Emergent themes from the qualitative analysis are presented in Table 1. Saving Brains TTS project leads provided quantitative data on these emergent themes (Table 2).

Table 1: Themes and sub-themes from quantitative and qualitative data analysis for 32 Saving Brains projects, and 19 key informant in-depth interviews regarding human resources and curricula content for ECD programming

	Themes	Sub-themes
Human Resources	1. Characteristics / selection of worker	1.1 Health vs other sector
		1.2 Integration with existing programmes
		1.3 Pre-existing government worker vs novel worker
		1.4 Professional vs lay worker
		1.5 Qualities and qualifications
	2. Inducement and retention	2.1 Modalities of incentivisation
		2.2 Impact on pre-existing workers
	3. Training and supervision	3.1 Content of training
		3.2 Flexibility vs fidelity

		3.3 Education theory
		3.4 Supportive relationships
Curricula content	4. Content and components	4.1 Defining critical components
		4.2 Formative work and adaptation
		4.3 Flexibility vs fidelity
		4.4 Behaviour change
	5. Delivery, duration and dosage	5.1 Adapting delivery to local context
		5.2 Intervention duration and dosage
		5.3 Retention of participants

Table 2: Description of the Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of human resources and curricula content (N=4 projects)

Project Name	**Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improved malnourished children's development**	**An integrated intervention targeted at deprived pre-school children in rural areas**	**Home visiting programs to improve early child development and maternal mental health**	**Saving Brains, Changing Mindsets**
Lead Institution	**International Centre for Diarrhoeal Disease Research (ICDDR,B)**	**Universidad de los Andes (UDLA)**	**Faculdade de Medicina da Universidade de Sao Paulo (USP)**	**Mobile Crèches for Working Mothers' Children (MC)**
Country	**Bangladesh**	**Colombia**	**Brazil**	**India**
Site	Dhaka area: Narsingdi and Kishoreganj. Rural	Central rural regions: Boyacá, Cundinamarca, Santander	Sao Paulo, urban slums in western area	Delhi area, Bangalore, Ahmedabad, Chandigarh
Vision/ Goal/ Objectives	Integrate RCEL intervention for poor, underweight children into routine government health services	Improve quality of a pre-existing public parenting programme in a scalable fashion	Evaluate the efficacy and cost-effectiveness of two alternative platforms for home visiting programme	Demonstrate scalability of workplace-based childcare for children of migrant construction workers
No. participating children	1,597	2,134	800	4,845
HUMAN RESOURCES				
Type	Assoc Health Professional	Lay community member as paraprofessional	CHW and CDA	Personal care worker
Pre-existing / novel cadre	Pre-existing	Pre-existing	CHWs pre-existing, CDAs novel cadre	Pre-existing
Incentivisation, including remuneration	Occasional small gifts.	Remunerated by government	30% elevated salary pre-existing CHWs, salary-matched CDAs	Salaried
Qualification/ skill / competence	Technical qualification	Secondary education	No qualification needed	Primary & Secondary education
Gender of workers	Majority female	Majority female	Exclusively female	Majority female
Length of training	15 days	85 hrs over 3.5 weeks	40 hrs initial (Reach Up) & 32 hrs refresher	36 days
No. of workers recruited (completing training, delivering project)	354 (320, 168)	171 (171, 171)	15 (15,13)	139 (83, 67)
Frequency of supervision	Minimum once per month.	Every six weeks.	Once per week.	Six months rigorous, then monthly.
CURRICULA CONTENT				
Group vs individual	2 or 4-5 dyads	80% grp, 20% individual	All individual	70% grp, 30% individual
Duration of intervention	12 months	11 months	12 months	3 months
Average length of sessions	50 mins	1 hr	1 hr	8 hrs (full creche day)
Number of sessions	25	55	24	75
Freq. of contacts per month	2	3	2	25
Materials	Play materials	Books, puzzles, images, and toys (recyclable materials)	Books, puzzles, images and toys (recyclable materials)	Play materials, blocks, puzzles, big picture books, toys (low cost)

Project Name		Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improved malnourished children's development	An integrated intervention targeted at deprived pre-school children in rural areas	Home visiting programs to improve early child development and maternal mental health	Saving Brains, Changing Mindsets
Curriculum		Adaptation of Reach Up	Adaptation of Reach Up	Adaptation of Reach Up	Thematic curriculum on school readiness skills
Use of digital media		None	None	None	None
Mechan-ism of behaviour change	*Mentoring*	Yes	Yes	Yes	Yes
	Problem-solving	Yes	Yes	-	-
	Didactic	-	-	-	-
	Demonstrations	Yes	Yes	Yes	Yes
	Service mapping	-	-	-	-
	Empowerment	Yes	Yes	Yes	Yes
	Peer support	Yes	Yes	-	-
	Media	-	-	-	-
	Materials	Yes	-	Yes	-
Published references		(23, 27, 28)	(23, 29)	(23,25)	(23, 30)

CDA=Child Development Agents, CHW=Community Health Worker

Human resources in ECD projects: themes and sub-themes

Three major human resources themes and eleven sub-themes were identified (Table 1).

1. Characteristics / selection of workers

Variation in workforce across the Saving Brains portfolio is summarised in Figure 3. The use of health or associate health professionals, such as community health workers, was common. Health professionals commonly delivered projects that included health and nutrition domains (Figure 3a). Lay community members were also common as frontline workers across all project types.

Integrating ECD projects into existing programmes was identified by informants as a key challenge.

> *"Early child development is harder than anything because of its integrated nature…. ...we all decided that services had to be fully integrated….and this has imposed an operational burden that is very complicated."* – Saving Brains TTS project lead

Approximately one third of workers (34% n=11/32) had either only primary school-level or no education (Figure 3b). Tertiary-level education of workers was more common for RCEL projects which included health and nutrition domains (42%, n=5) (Figure 3b), likely reflecting

the greater representation of healthcare professionals delivering these integrated interventions.

Soft skills including interpersonal and communication skills were identified as important by project leads.

> *"We have learned a lot about the type of person that can fill the health promoter role. It is important that he/she is committed to the project, responsible, and loves working with kids, especially this age group."* – Saving Brains Seed project lead

> *"Having a champion in the field is crucial for success…combination of strength and kindness; excellent interpersonal skills; problem solver; works with all stakeholders."* – Saving Brains TTS project lead

A key choice in ECD implementation was whether to use established or novel cadres of worker. In some projects, novel cadres of worker were recruited to support quality of implementation. However, limitations of this approach were acknowledged with regards to sustainability.

> *"…even after identifying and training them there is no assurance that the government will take up the process."* – Saving Brains TTS project lead

Conversely, while a number of projects used pre-existing frontline workers, key informants also expressed concerns regarding direct control over recruitment, incentivisation, supervision, and training when shared with a partner organisation (Web Appendix Table D, ICDDR,B & USP). The increased burden, change in focus, and challenge in coordination for pre-existing salaried workers was also highlighted by experts and project teams.

> "*It's a big challenge…you take a health worker and add a 24th task to her 23rd task, which are requested by six different funders with no coordination between any of them."* - ECD Lead for an International NGO

> *"They think [to themselves], 'I'm dealing with dengue and Zika and you expect me to play with a child for an hour.'"* – Saving Brains TTS project lead

2. Provision of incentives based on performance (inducement)

Overall, most (61%) project workers were salaried (Figure 3c). However, considering lay community member workers only, 20% of projects offered no incentives, and a further 20% offered only a contribution to expenses (Figure 3c). Key informants expressed a range of opinions about remuneration of community health workers. Some cited elevated status within the community and personal satisfaction as a non-financial incentivisation. In contrast, concerns were expressed regarding sustainability and human rights implications of implementation models that relied on voluntary workers, who were often socially disadvantaged women. However, all health and most allied health professionals were salaried and financial remuneration for these groups was considered a key part of inducement.

> *"Asking clinic staff to conduct the sessions meant additional tasks for them and they had to spend longer hours in the clinic. They therefore had expectations to be paid some wages for this extra task, but our goal was to integrate the activity into their daily routine hours to make it sustainable."* – Saving Brains TTS project lead

Staff recruitment and retention was a major recurring theme. Of the 2,572 workers recruited to deliver ECD interventions across the Saving Brains RCEL projects, 2,433 (95%) completed initial training and, of those trained, 2,165 (84%) ultimately delivered the intervention (Figure 3d). Across the portfolio, retention was most challenging amongst salaried staff who were mostly health staff with 67% of salaried workers trained delivering the intervention (Figure 3d). Specific reasons for drop-off were not available from existing data.

During programme planning, several teams described strategies including 'over-recruitment' to allow for anticipated staff attrition.

> *"In this next phase, we trained many more promoters than we needed, approximately twice as many as we originally needed in order to have a healthy resource base."* – Saving Brains Seed project lead

> *"It was hard to get [the staff], but we were very successful in keeping them. … We paid them well which is something that I don't know that the government will be able to do. They also had a lot of support and a lot of training. They really appreciated all that they received from our team…"* – Saving Brains TTS project lead

3. Training and supervision

A wide variation in supervision frequency, duration and ratios, and training structure and duration was seen across projects (Table 3).

Table 3: Supervision and training of workers delivering responsive care and early learning Saving Brain projects

	Median	**Range**	**Inter-quartile range**
Number of days in training (N=31)	10	0-90	5-13.6
Number of trainees per workshop (N=31)	10	0-50	5-20
Frequency of supervision (N=28)	2 per month	0-10	1.5-4
Duration of supervision (N=27)	2 hours	0-8	1-4
Ratio of supervisor to trainee during training session (N=20)	3:20	0.04-2	0.1-0.2

*Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data for 1 project on number of days in training and number of trainees per workshop, 4 projects did not report on frequency of supervision and 5 projects on duration. 12 projects did not report on the ratio of supervisor to trainee.

Training and supervision emerged as major themes during qualitative analysis (Table 1). Within training, the need to not only address details of ECD curricula but also a diverse range of related issues including pedagogy, strategies for managing the emotional load of work and administrative requirements, communication skills, and problem-solving abilities were identified. Several key informants also highlighted the value of observational supervision.

> *"…not only to see that content is delivered but that it is delivered in a way that parents will be responsive to."* – Saving Brains TTS project lead

The importance of flexible training and supervision protocols that were feasible for staff who had multiple roles and were likely to be sustainable with scale-up was also emphasised.

> "*Ongoing training including proficiency evaluations and feedback build confidence in participating community health workers to apply the tools and methodologies to deal with mothers and children. We have learned this over the years of work with community health workers and plan to systematize the work into teaching protocols as part of the transition to scale phase."* – Saving Brains TTS project lead

Key informants highlighted the need to develop formal structures for high-quality supportive training and supervision at all staff levels; this was particularly important in maintaining fidelity during intervention scale-up (Web Appendix Table D). In addition, discussions emphasised the importance of peer support amongst workers (Web Appendix Table D).

Curricula content: themes and sub-themes

Two major themes and seven sub-themes were identified with respect to curricula content (Table 1).

4. Content and components

Improved understanding of the critical components of RCEL interventions was a major theme identified by key informants as crucial to sustainability and scale-up.

Many projects provided general descriptions of content (e.g. parenting programme, responsive parenting, nutrition) or the original curriculum from which their project was developed (commonly the established Jamaican 'Reach Up' curricula) (Table 2). (21) However, for many, the critical components were less well defined and described. Specifically, details of activities for different ages or developmental stages, child health or nutrition components, behavioural change approaches used, pedagogy, and materials were typically limited. Lack of an established and standardised framework for describing curricula content was identified by key informants as a barrier to improved reporting and understanding design factors responsible for impact.

The importance of formative research and piloting for development and adaptation of interventions to setting was highlighted.

> "*Project development is also really important…these projects are not 'off-the-shelf' 'ready-to-go'.*" – ECD expert

Additionally, the importance of balancing project flexibility, fidelity and content heterogeneity with clear, specific and structured curricula was emphasised.

> "*The other determinant of success I would say is… we were able to develop a contextualized project, delivery product and processes.*" – Saving Brains Seed project lead

Specific materials and activities often required guided cultural adaptation to maintain fidelity (Web Appendix Table D). However, it is important to note that key informants placed equal emphasis on behaviour change mechanisms as well as on specific curricula activities and materials.

> "*Key components [were] inspiration, confidence… empathy, attachment of mothers and children to the deliverer…assessment for change*." – Saving Brains Seed project lead

5. Delivery, duration and dosage

The importance of project delivery, duration and dosage emerged as a major theme in the analysis. Figure 4 summarises the method and duration of delivery of ECD interventions. The proportion using groups to deliver the intervention was highest amongst standalone RCEL projects and lowest amongst integrated approaches (Figure 4a). Duration of sessions generally lasted longer for groups than individual visits (Figure 4b).

ECD investigators reported that the decision regarding group or individual delivery approach was influenced more by context, efficiency, and feasibility than effectiveness.

> "*Our problem…was trying to do something that we thought was evidence based, but that was not a good fit with the socio-political structures and the way people are comfortable in trying new things.*" – Saving Brains Seed project lead

Key informants highlighted 'dosage' of the intervention as an important design decision. The median number of project sessions delivered, length of sessions, and length of intervention, ranged broadly (Table 4).

Table 4: Summary of project sessions including duration and intensity amongst responsive care and early learning Saving Brain projects (n=32)

	Median	**Range**	**Inter-quartile range**

Number of project sessions (N=29)	24 sessions	2-192 sessions	11-37 sessions
Total length of intervention (N=26)	12 months	1-24 months	8-12 months
Length of sessions (N=26)	1 hour	10 mins-8 hours	45-90 minutes

Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data on number of project sessions for three projects, and on total length of intervention and length of sessions for six projects.

The majority (60%, n=19) of projects were primarily targeted at the child or caregiver level as opposed to targeting families or the community more broadly. Geographical, political and economic factors were important in engaging target populations.

> *"…some mothers find it difficult to come to the clinics for the fortnightly sessions. The reasons were lack of time, distance from the clinic, not allowed by the father or grandparents of the child and occasionally travelling outside the area."* – Saving Brains TTS project lead

Project teams used a range of methods to incentivise caregivers to attend sessions. One TTS team trialled both provision of oil supplementation and 'motivational meetings' (Table 2, ICDDR,B); both methods were found to be effective but motivational meetings were adopted due to sustainability.

DISCUSSION

This is the first paper to report on workforce data from a large multi-country child development portfolio, including 32 RCEL projects with 2,165 workers delivering interventions across 17 LMIC. This analysis addresses human resources and curricula content for implementation at scale; it is noted that these factors do not stand in isolation but interact with each other and other programme design factors as well as with local contexts. *Radner et al.*'s exploration of the Saving Brains portfolio highlighted that workforce decisions around delivery of RCEL programmes can have substantial bearings on programme sustainability and impact. In this paper, we built on this to further probe specifics of workforce choices in ECD programme implementation, particularly from a health sector perspective.(13, 23) Resultant themes and sub-themes resonate with and extend existing literature regarding workforce choices, particularly the community health workforce, for programme implementation in LMIC settings.

Workforce factors are one of the most critical impediments to implementation at scale. This is well recognised for ECD programmes, especially given intersectoral complexities. Our results suggest that whilst challenges exist for integrating ECD into existing services, introducing novel cadres of worker for standalone ECD programmes may be also challenging at scale. Within this analysis, challenges related to adding ECD workstreams to the existing workload of established frontline workers were clearly reported and may have contributed to poorer retention of salaried health workers, alongside rotation of health workers. This finding has been mirrored across the implementation literature in other areas of global health; for example, an economic analysis of community based maternal and newborn care across seven countries highlighted trade-offs between improved cost-effectiveness associated with use of existing multipurpose workers and difficulties related to overburdening those workers.(31-35)

Ongoing supportive supervision, not just initial training, was found to be crucial to intervention quality and fidelity, as has been found in global health more broadly. For example, quality supervision was emphasised as central to preservation of project quality as well as worker motivation in the economic analysis of maternal and newborn care mentioned above, and was examined in more detail in several of these evaluations, including the cluster randomised controlled Goodstart (III) trial of maternal and newborn care in South Africa.(32, 36) Similarly, supervision and training, and particularly the potential of e-supervision/training, were highlighted as key concerns for project feasibility in a review of interventions for children with intellectual disabilities (37) and additionally were found to be critical for sustainable scale and impact in both PRIME (Programme for Improving Mental Health Care) and a follow-up study of a cluster randomized trial of a psychosocial ECD project in Colombia.(33, 38, 39)

The challenge of retention of workers emerged as an important theme and is also not isolated to ECD. Within the Saving Brains portfolio, strategies used to mitigate against poor retention echoed findings in other global health implementation research including; over-recruitment, fast-track training, and provision of high-quality training and supervision.(33, 36, 39) *Andrew et al* suggest designing interventions according to geographical practicalities and other contextual factors to mitigate staff turnover, and thus optimise project quality and impact.(38) There is appetite for shared learning to help tackle the human resource

challenges highlighted in this paper, and resources such as the Early Childhood Workforce Initiative provide a useful platform for ECD policymakers and programmers globally to work together.(40, 41)

Regarding essential ECD intervention curricula and components for scale-up, commonalities were seen amongst the larger TTS projects which add to previous literature on this topic.(3, 14) However, there is no agreed standard package for ECD set out by the UN, contributing to project heterogeneity and precluding clear guidance for policymakers and programmers on ECD intervention content. This lack of standardised content is in contrast to more biomedical programmes, such as antenatal and postnatal care packages, as well as broader mental health and nutrition programmes which, though similar to ECD in their intersectoral nature, do have some standardised content, such as the World Health Organization and UNICEF's Infant and Young Child Feeding approach.(31, 42, 43) While lack of description of intervention content in this portfolio hinders specific recommendations for a standardised ECD curricula, our findings suggest that the focus of a standardised ECD curricula should be on engaging parents in activities which promote development, rather than providing information on developmental milestones, as is seen in many countries.

Even with a standard package, contextualisation would be important, and our findings underline the need for formative research. Across the Saving Brains portfolio, there was a noticeable lack of in-depth description of curricula content, despite key informants highlighting this as important for sustainability.(14, 15) A framework for describing contextualised content of RCEL projects using, for example, parameters described by *Aboud et al* (information, performance, problem-solving, social support, materials and media) would provide clarity in the literature and strengthen programme comparison and evaluation.(14, 44) Further, as the Nurturing Care Framework proposes, delineating ECD programmes more clearly into universal, targeted, and indicated packages to respond to the specific needs of children at particular developmental risk or with developmental disabilities would support better inclusion of children who otherwise risk not being reached by universal or conventional service models.(7, 45-47) As *Boggs et al* highlight, improved developmental monitoring is critical, and ECD workers have a vital role to play in identifying the young children most at risk of developmental difficulty and referring for ECD intervention, as well as in intervention delivery.(21) While there is little published literature on early intervention to

improve health and developmental outcomes for children with disabilities in LMIC, trials are underway and emerging models that have been adapted and that are being trialled in the context of the Zika epidemic may be informative.(48, 49)

Regarding delivery strategy, group sessions were frequently favoured across the Portfolio, notably based on increased practicality, efficiency, and acceptability, rather than increased effectiveness.(23) Previous evidence for both ECD and health programmes supports the use of a combination of home visits and group sessions as more effective in terms of information consolidation and parental behavioural change.(8, 14, 50) Future ECD research would benefit from an alignment of outcomes, where feasible, to ensure comparability in assessment of effectiveness. Intervention dosage was variable across the Portfolio and the need for flexibility in this when adapting to different contexts, for example during implementation of the 'Reach Up' package in Brazil, frequently emerged during analysis.(51) Dosage variability was similarly reported during the Goodstart (III) trial and was attributed to contextual and workforce factors including occupation, remuneration, and community recognition of workers.(36)

Strengths and Limitations

Many of the limitations of this evaluation are common to ECD programming more broadly. Several process-related metrics were not commonly reported including coverage, equity, and cost-effectiveness, likely influenced by the small-scale and 'proof of concept' nature of most projects.(39) The donor-facing system of data collection and reporting within the portfolio may have introduced bias, with investigators feeling obliged to report positively, however the open learning culture within the Saving Brains Platform acted to substantially reduce this. Grant awardees were selected by GCC and so projects and their aims may reflect funder priorities. The diversity in human resources and curricula content between projects made it difficult to draw conclusions for individual RCEL programme implementation from the portfolio-level evaluation outcomes. Impact data was not available for most projects at the time of the evaluation and so assessment of impact was not included. Enhancing linkages between implementation processes and impacts within this portfolio and more broadly has the potential to strengthen evidence to inform policy and programming. Additionally, while this paper describes design decisions, there was not scope to explore the reasons behind

these decisions. Exploration of these reasons may contribute to stronger and clearer evidence, policy and programming.

CONCLUSION

We have reported on the largest study to date of workforce and curricula content for ECD from a large and varied portfolio of 32 projects, providing a detailed description and new synthesis about implementation challenges and enablers for ECD programming. Despite heterogeneity of projects, clear themes have emerged with parallels to LMIC programmatic learning in other areas, such as global mental health and nutrition. Development of a more standardised package or planning guide for ECD programmes would mitigate some of the challenges reported here, but programmes still need to be adapted to context. Carrying out and learning from such adaptation could be supported by a common framework for describing content and delivery strategies. More systematic evaluations of implementation costs, including worker costs will be essential inputs for planning of routine ECD programmes, within and beyond the health sector. Further research investigating associations between human resource and curricula content choices and, importantly, impact is needed.

FIGURE CAPTIONS/LEGENDS

Figure 1: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

Figure 2: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

6 projects (Brazil), 4 projects (India, Kenya), 3 projects (Pakistan), 2 projects (Bangladesh, Guatemala, Peru, Vietnam), 1 project (Colombia, Democratic Republic of Congo, Ethiopia, Grenada, Jamaica, Nigeria, Rwanda, Zambia, Zimbabwe), 0 projects

Note: Total number of countries of implementation >32 as one project implemented in 3 countries

Figure 3: Occupation, incentivisation, qualification and retention of frontline workers amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Occupation of frontline worker delivering responsive care and early learning (RCEL) projects by type of RCEL intervention project. (N=32 projects)

No missing data (N=32 projects). Figures on bars represent number of projects. Other'=teaching professionals, social work professionals, personal care workers and combinations of occupation types.

b) Reported level of education / qualification of frontline workers across all responsive care and early learning (RCEL) projects (N=32 projects)

Data reported from Service Delivery Forms which reports on the level of education or qualifications that front-line workers had (rather than what implementers felt that they needed). No missing data.

c) Incentivisation of front-line workers delivering responsive care and early learning (RCEL) projects according to cadre of worker (N=25 projects)

Total 'n' is greater than number of projects included (N=25) as several projects used more than one occupation as workers. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

d) Retention of worker amongst responsive care and early learning (RCEL) projects according to method of incentivisation (N=29 projects)

Data reported from the Results-based Management and Analysis Framework (Web Annex Table A) reported from each project. Missing data from 3 projects. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

Figure 4: Method and duration of delivery of intervention curricula amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Method of project delivery: group vs individual by type of RCEL intervention project (N=31 projects)

Missing data from 1 project.

b) Median duration of project sessions comparing projects delivering curricula in group vs individual sessions by type of RECL intervention project (N=26 projects)

Missing data from 6 projects.

AUTHOR CONTRIBUTIONSHIP STATEMENT

The first draft of the paper was undertaken by CJT, MKL and VPH. Other specific contributions were made by RB, SB, AB, VC, EG, JH, RH, KM, KMM, JR, SS, KS, and JEL. All authors reviewed and agreed on the final manuscript.

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COMPETING INTERESTS

No competing interests.

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DISCLAIMER

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institution with which they are affiliated.

Data sharing

Supplementary data have been published online and may also be accessed by emailing cally.tann@lshtm.ac.uk.

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Figure 1: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

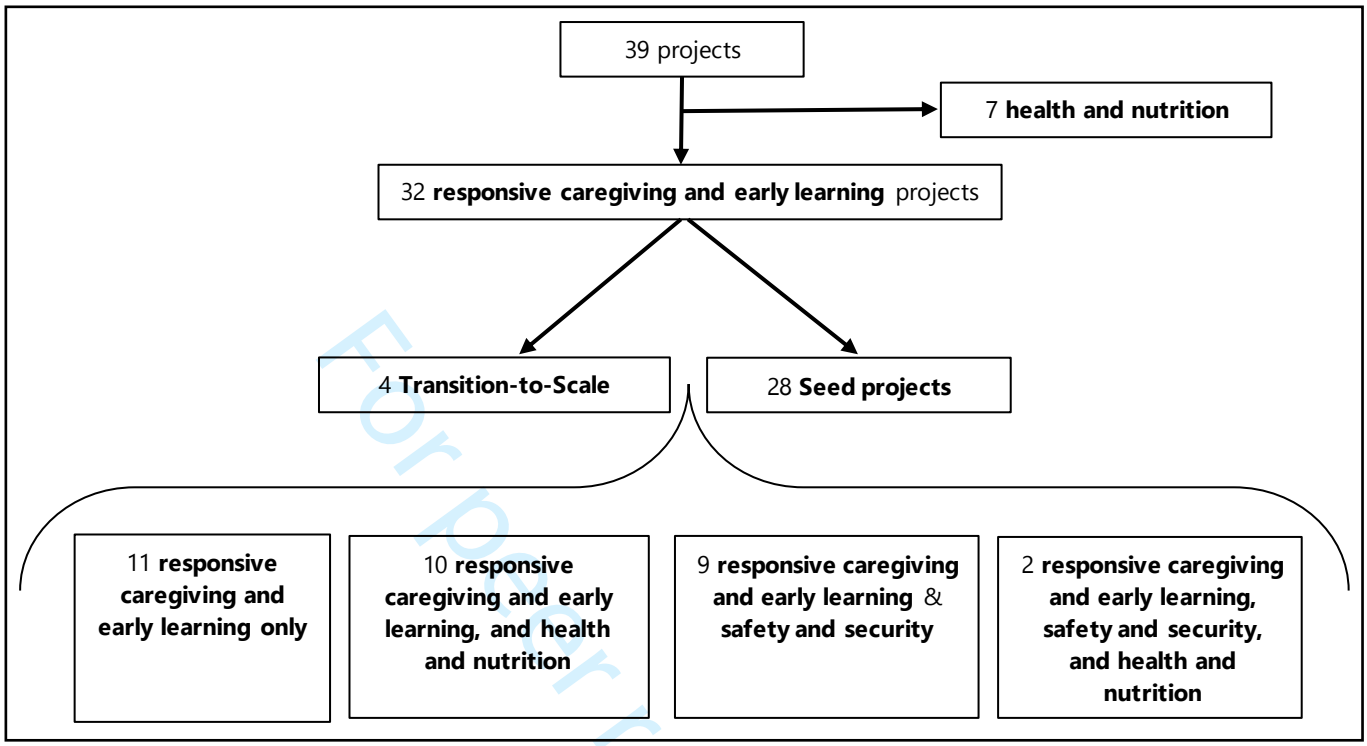
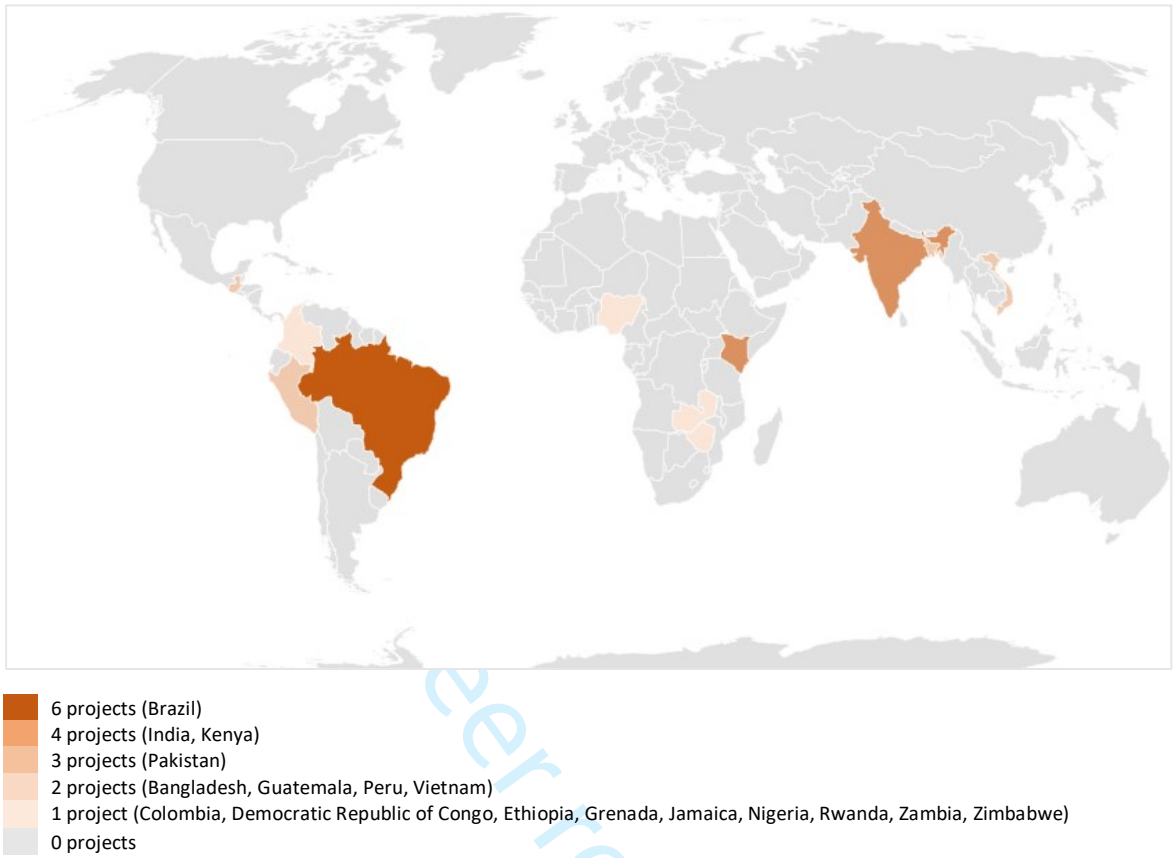


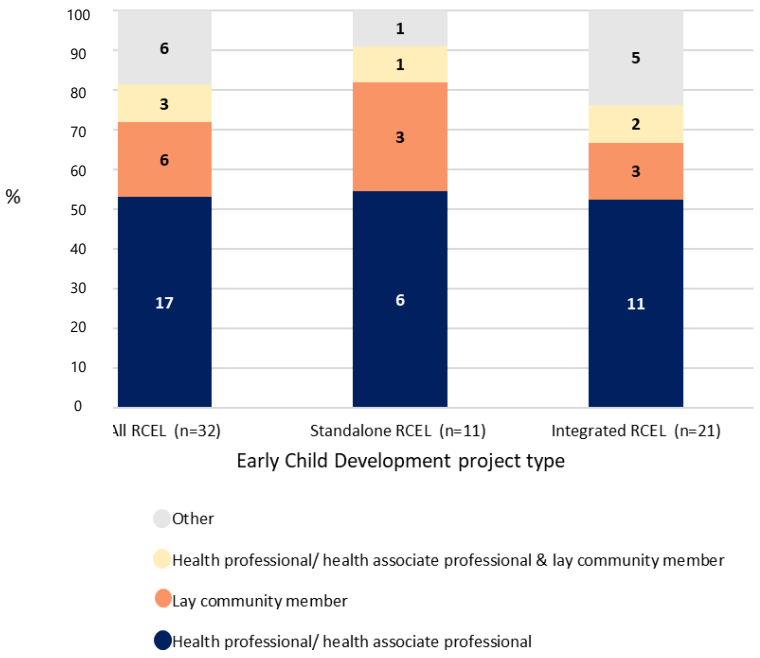
Figure 2: Project implementation countries



Note: Total number of countries of implementation >32 as one project implemented in 3 countries

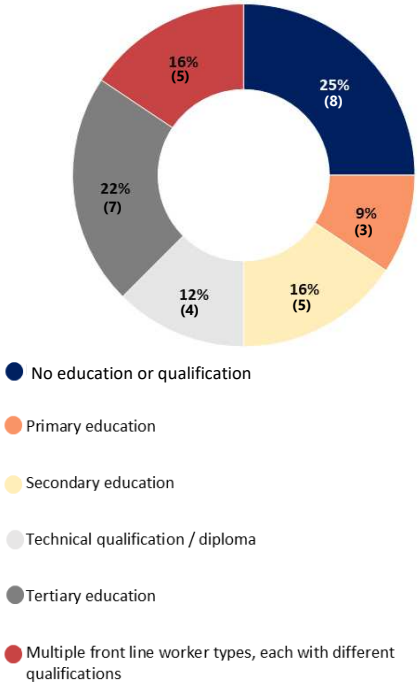
Figure 3: Occupation, incentivisation, qualification and retention of frontline workers amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Occupation of frontline worker delivering responsive care and early learning (RCEL) projects by type of RCEL intervention project. (N=32 projects)



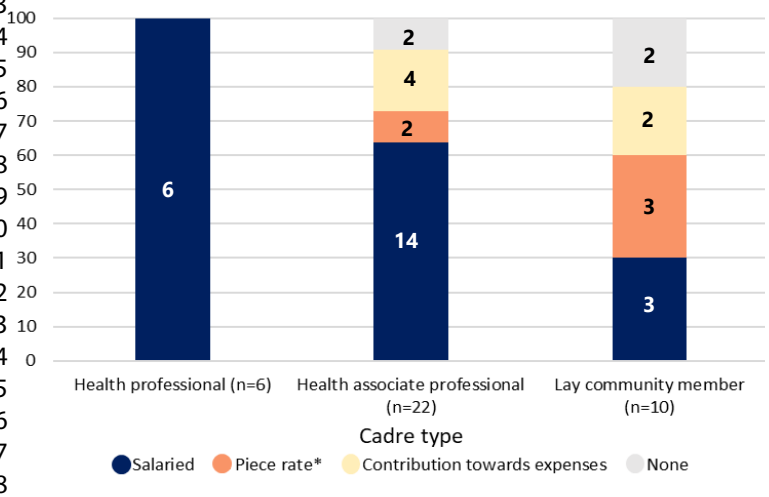
No missing data (N=32 projects). Figures on bars represent number of projects. 'Other'=teaching professionals, social work professionals, personal care workers and combinations of occupation types.

b) Reported level of education / qualification of frontline workers across all responsive care and early learning (RCEL) projects (N=32 projects)



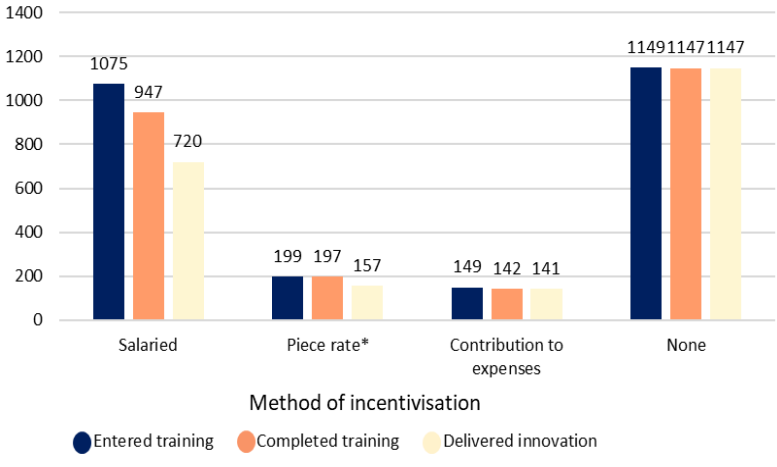
Data reported from Service Delivery Forms which reports on the level of education or qualifications that front-line workers had (rather than what implementers felt that they needed). No missing data.

c) Incentivisation of front-line workers delivering responsive care and early learning (RCEL) projects according to cadre of worker (N=25 projects)



Total 'n' is greater than number of projects included (N=25) as several projects used more than one occupation as workers. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

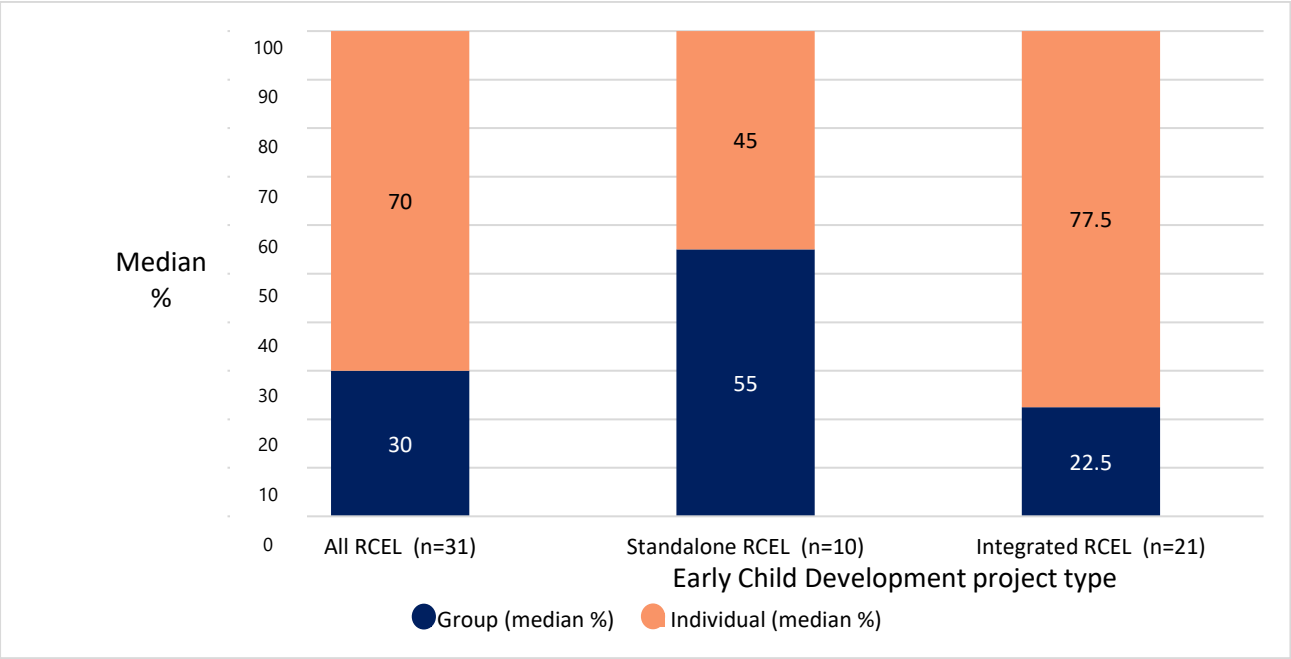
d) Retention of worker amongst responsive care and early learning (RCEL) projects according to method of incentivisation (N=29 projects)



Data reported from the Results-based Management and Analysis Framework (Web Annex Table A) reported from each project. Missing data from 3 projects. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

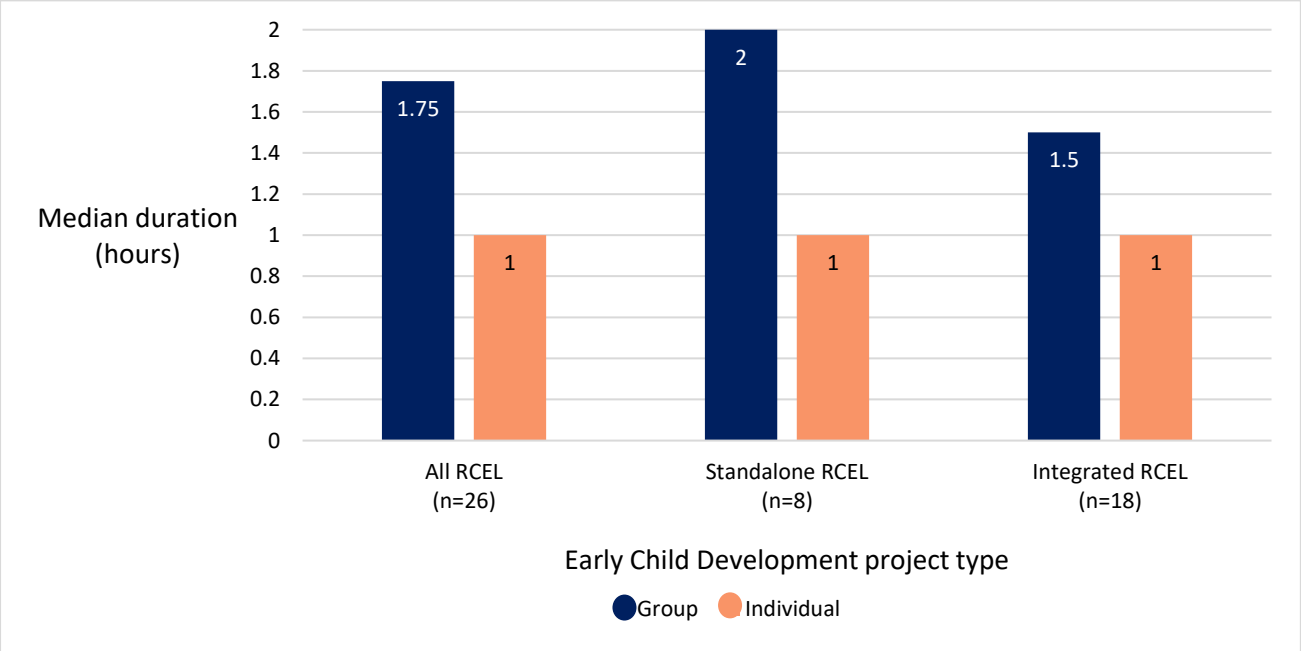
Figure 4: Method and duration of delivery of intervention curricula amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Method of project delivery: group vs individual by type of RCEL intervention project (N=31 projects)



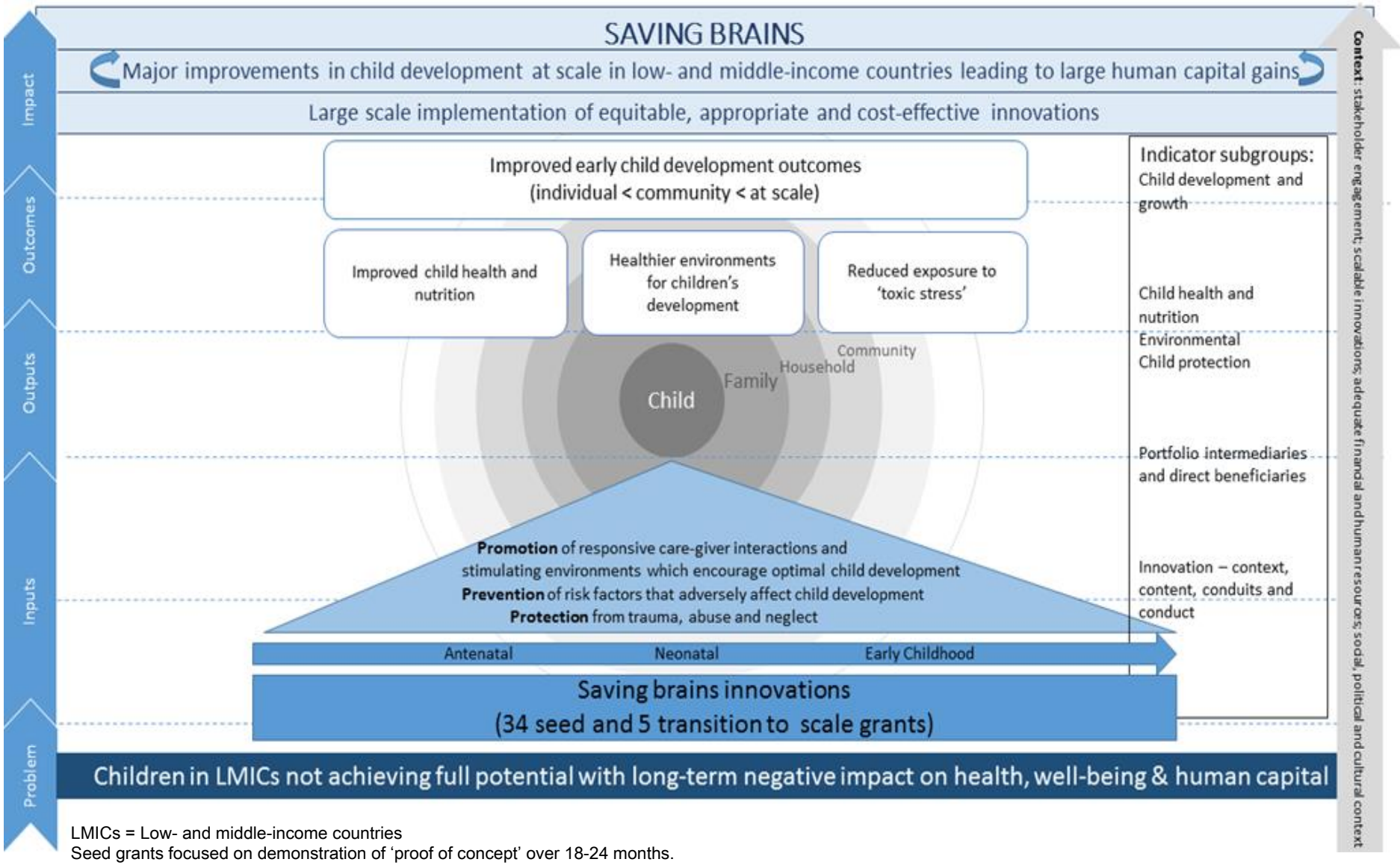
Missing data from 1 project.

b) Median duration of project sessions comparing projects delivering curricula in group vs individual sessions by type of RECL intervention project (N=26 projects)



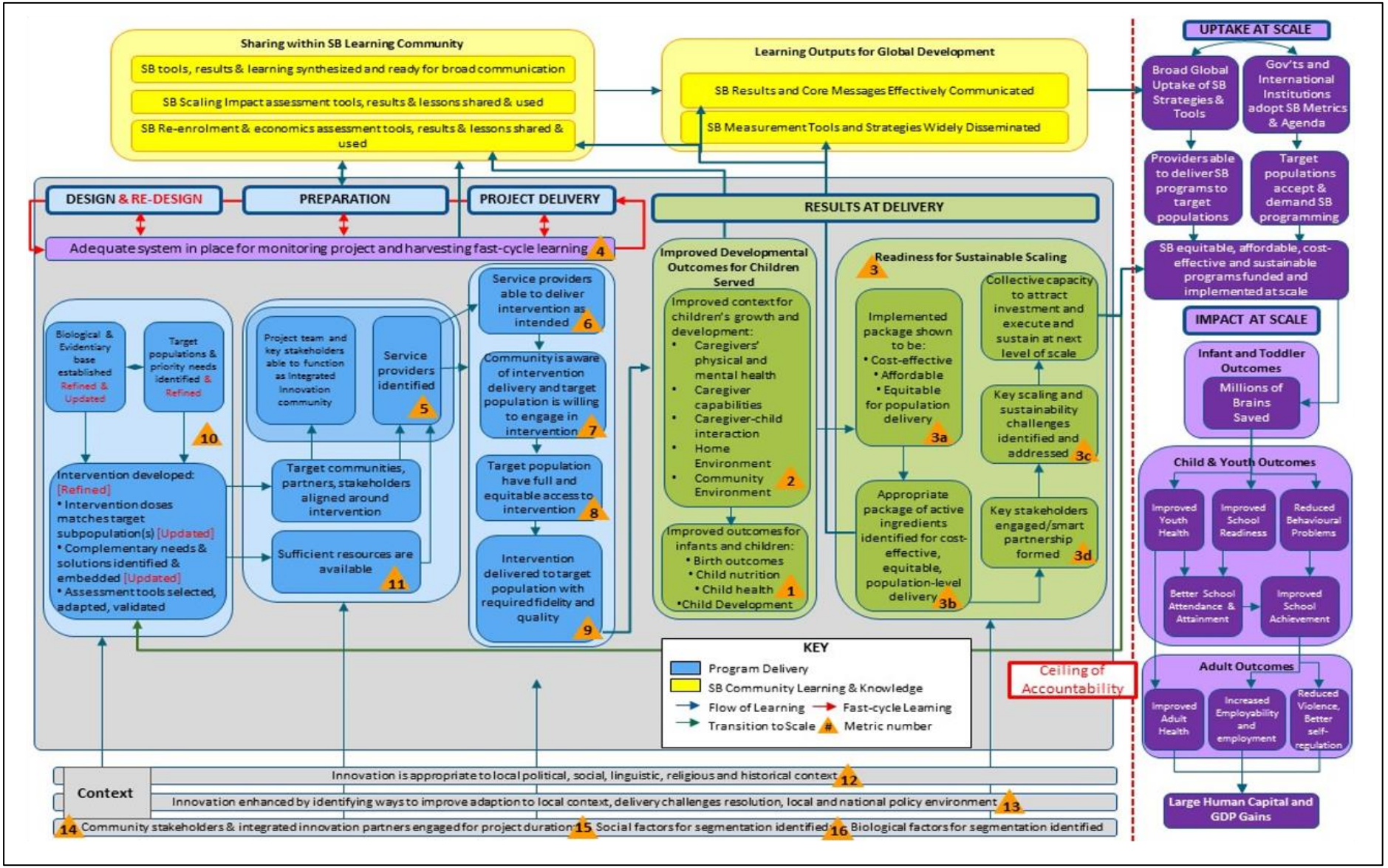
Missing data from 6 projects.

Web Appendix Figure A: Portfolio Conceptual Evaluation Framework



LMICs = Low- and middle-income countries
Seed grants focused on demonstration of 'proof of concept' over 18-24 months.
Transition to scale grants focused on progression towards scale in partnership with other organisations over 3 years.

Web Appendix Figure B: Saving Brains portfolio level Theory of Change



SB=Saving Brains

Note: Theory of Change was developed by Grand Challenges Canada Saving Brains platform members.

Web Appendix Table A: Data sources utilised for the Saving Brains portfolio evaluation

Data Source	Description	Timing of data collection	Organisation receiving data	Data type	Number of data source items
Service delivery forms	Document completed by grantees used to collect projected, interim and/or final and quantitative information on workforce and intervention delivery	Yearly	Grand Challenges Canada	Quantitative & Qualitative	32 (Endpoint service delivery forms)
Results-based Management and Accountability Framework (RMAF)	Framework completed by grantee which facilitates the collection of data and comparison of results around core metrics	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative	7
RMAF+	Framework completed by grantee developed from the original RMAF and Theory of Change containing more detailed metrics on impact, process and context of innovations (Round 3 onwards)	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative	25
Progress reports	Narrative reports completed by grantees detailing project progression, challenges, lessons learned, results, dissemination and next steps	Six-monthly	Grand Challenges Canada	Qualitative	32
Research proposals	Proposal of innovation design completed by potential grantees	Point of application for grant	Grand Challenges Canada	Qualitative	32
Saving Brains community meeting transcripts	Transcripts from discussions between grantees and platform members at two Saving Brains community meetings	21st-22nd Jun 2016 25th-26th Oct 2016	London School of Hygiene & Tropical Medicine	Qualitative	2
Key informant interviews	Key informants, including Saving Brains project leads, identified through professional networks and approached for interview on relevant themes	Jun-Oct 2016	World Health Organization & London School of Hygiene & Tropical Medicine	Qualitative	19
Grantee interviews	Grantees identified by LSHTM and platform members for thematic discussion	Jul-Sept 2016	London School of Hygiene & Tropical Medicine Qualitative	Qualitative	21
Focus group discussions	Grantees selected and invited to focus group discussions, either online or during Saving Brains community meetings, on workforce choices, supervision and training, and monitoring quality and coverage	Jun-Oct 2016	London School of Hygiene & Tropical Medicine	Qualitative	13 (4-10 participants per FGD)

Web Appendix Table B: Interview and focus group topic guides from Saving Brains evaluation

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
Impact and outcome metrics question guide
Background Limitations of child development metrics pose a major challenge in policy and programming efforts to improve early child development outcomes in LMIC settings. Various initiatives are underway to improve measurement of outcomes at population and individual level (e.g. newly published data from McCoy DC et al, funded by the Saving Brains Programme, Grand Challenges Canada, providing the first global and regional estimates of the number of children failing to reach developmental milestones based on parent report measures.1 However major challenges remain and collaboration is required to improve measurement of impact of interventions on child development outcomes at scale in low-resources settings.
Objectives To discuss as a group; 1. Different approaches to impact measurement that have been taken across the Saving Brains portfolio 2. Challenges and benefits of different approaches taken 3. Lessons learned for policy makers and programmers attempting to measure impact of ECD interventions at scale
Questions 1. How has impact been measured across the Saving Brains portfolio? 2. How were decisions reached about impact measures used? What factors influenced these decisions? 3. How has use of these impact measures worked in practice? 4. How about intermediary outcome measurement in terms of environment, caregiver relationships etc.? 5. What have been the programming requirements to support this in terms of human resources, cost, timeline etc.? 6. Have measures used required translation and adaptation in your local context and if so, how has this been managed? 7. Do measures used include children less than 3 years and children with disabilities? 8. Could measures used within the Saving Brains portfolio be used if innovations were scaled up at National level? If so, how and what would be required to support this? If not, what alternatives would you recommend for programmers and policy makers? 9. Given the range of players involved, how can coordination within ECD networks be improved to support development of improved metrics? 10. Any other aspects of impact measurement that you think are important considerations which we have not covered?
Cadre question guide
Background Choices around human resources for implementation of ECD interventions have significant implications for effectiveness, sustainability and scale-up. Across the Savings Brains portfolio, a broad range of workers have been used to implement innovations with potential lessons for policy makers and programmers aiming to implement ECD interventions at scale in a range of contexts.
Objectives 1. To discuss the range of workers used to implement innovations across settings. 2. To discuss rationale for choice of workers used across settings. 3. To discuss programming implications with use of different cadres of workers.
Questions 1. What was the rationale for selection of worker type across different SB innovations?

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).

2. What challenges and benefits were noted with use of various cadres of workers across settings?
3. Where pre-existing categories of workers were used, what were the pros and cons experienced? How was the overall workload for individual workers managed when implementing 'additional' ECD intervention?
4. Where new worker groups were used, what were the pros and cons of this approach? How were issues of financing, governance and sustainability managed?
5. How were decisions around incentivisation reached?
6. Where community health workers were used, how were decisions reached around type of community health worker, level of training, supervision, equipment and incentivisation?
7. Where community health workers were used with the goal of improving equity and coverage of interventions, were these tracked? And if so, provisional recommendations or findings?
8. When thinking about decisions at a national scale, are there additional factors that need to be considered about human resources for implementation of ECD interventions?

Content (positive stimulation interventions) question guide

Background

Available evidence provides general guidance to policy makers and programmers about elements of positive stimulation interventions associated with increased effectiveness.2 In particular, use of a structured evidence based curriculum, provision of opportunity to practice skills with the child, provision of feedback to the parent, adequate training and supervision for staff, integrated health, nutrition and ECD elements and both community and government support are thought to be important in intervention effectiveness.2 There are also an increasing range of resources available to programmers implementing ECD interventions.3, 4 However, from a practical perspective programmers still face detailed choices about intervention design and pros and cons of alternate choices in different settings may not be clear.

Objectives

1. To consider key intervention design questions raised when implementing positive stimulation interventions across the SB portfolio.
2. To consider how choices were made around these intervention design elements.
3. To consider relevance of lessons learned to programmers developing models for ECD interventions at national scale.

Questions

1. Across the SB portfolio what factors have informed choices about the following elements of positive stimulation interventions;
2. Target of intervention (e.g. parent, parent and child, child only)
3. Age of children
4. Number of contacts
5. Frequency of contacts
6. Duration of contacts
7. Chosen curriculum (with as much detail re actual curriculum as possible)
8. With regards to choices made, what has worked well and why?
9. Are there areas which have not worked well and if so, please describe?
10. Are there design elements that need to change to enable scale up and if so, please provide examples?
11. Any other elements that you consider important for programmers at national level to consider when developing models for implementation at scale?

NB *That questions re universal vs targeted and integration of interventions are asked elsewhere but could also be covered here.*

Delivery setting question guide

Background

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
ECD interventions are delivered in diverse settings in terms of geography, rural/urban, different sectors, facility/communities or home or often a mix of settings. Decisions about setting have implications for policy and on many aspects of programming.
Objectives To discuss as a group; 1. How decisions about implementation setting were made across the portfolio 2. Implications of those decisions, both positive and negative on program implementation and scale-up 3. Lessons learned for policy makers and programmers designing ECD programmes at national
Questions 1. How were decisions about the setting for implementation of your ECD programme reached (e.g. convenience, targeting of vulnerable subgroup, prior involvement with that sector etc.)? 2. What information did you use in deciding about the setting of implementation for your program? 3. Was there any information that if you'd had it earlier, would have altered your decision about setting? 4. Benefits specific to your setting? 5. Challenges specific to your setting? 6. What implications has setting choice had on the ease of program implementation? 7. What recommendations about delivery setting would you make to policy makers and programmers designing ECD programmes at national scale? 8. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Universal and targeted approaches
Background Universal approaches to improving ECD aim to increase protective factors and reduced risks for adverse child development at a whole population level. Targeted approaches are aimed specifically at children identified as having a higher-than-population-baseline risk of adverse developmental outcomes. While systems which provide both universal and targeted ECD interventions are ideal, in resource limited settings, some have suggested that services should initially be targeted to the most vulnerable.5 Further, from a rights perspective, it can be argued that ensuring equity through inclusion of children with specific additional risk factors (e.g. disability, membership to ethnic minority subgroups etc.) is a priority, regardless of setting. There are however many challenges. While effectiveness of interventions may be greatest for certain vulnerable population sub-groups, with potentially favourable 'benefit to cost ratio' for investment, scaling up services to include those 'hardest to reach' may involve higher initial costs.2 These complexities pose challenges for policy makers trying to develop ECD programmes which are equitable but also provide sustainable coverage at scale.
Objectives To discuss as a group; 1. The rationale for selection of targeted versus universal approaches to ECD implementation in different settings within the SB portfolio. 2. Programming implications for both approaches 3. Requirements to inform policy makers in decisions about either universal or targeted approach to implementation
Questions 1. What was the rationale for selection of targeted versus universal approaches to ECD implementation in your context? 2. In interventions where a targeted approach was taken, how was the target population

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
identified (e.g. data driven, empirically, opportunistically)? 3. What are the benefits and disadvantages of a targeted approach in different settings? 4. What are the benefits and disadvantages of a universal approach in different settings? 5. What have been the programming implications of different approaches taken (e.g. human resources, training and supervision, financial)? 6. Have there been implications for financial sustainability and if so, moving forward, what strategies might be used to address these? 7. For interventions taking a universal approach, what strategies have been implemented to ensure inclusion of disadvantaged population subgroups including children with disabilities? 8. What recommendations about intervention targeting would you make to policy makers and programmers designing ECD programmes at national scale? 9. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Processes for monitoring coverage and quality at scale
Background Processes to ensure quality and coverage are important for effective and equitable implementation of ECD interventions.2 However, review by Yousafzai et al has highlighted the need for further consideration of implementation processes to facilitate more comprehensive guidance as to how to effectively implement interventions.6, 7 The SB portfolio provides a unique opportunity to consider implementation processes in order to provide more detailed guidance for programming at scale.
Objectives To discuss: 1. Priorities in measuring quality and coverage of intervention. 2. Approaches used to monitor quality and coverage across the portfolio. 3. Considerations for monitoring coverage and quality of ECD interventions at scale.
Questions 1. What do you think are the 3 most important elements of 'quality' of implementation to measure? 2. What indicators have been most helpful in measuring these? 3. What processes of supervision and training have been developed to support this? (As much detail as possible re number of supervisors per worker, frequency, duration and mode of supervision) 4. What has been required to support monitoring of quality and coverage in terms of; 5. Data sources - are these procedures integrated into existing national data collection systems or stand-alone systems? 6. Technical and funding support? 7. Incentivisation of workers? 8. How have findings from monitoring been incorporated into ongoing implementation? 9. Would these approaches to monitoring of quality be feasible and appropriate for interventions delivered at national scale? 10. What strategies have been used to ensure equitable coverage of interventions? 11. What strategies have been used to reach the most difficult to reach populations including children with disabilities? 12. What challenges have been faced with regard to retention of participants? How have these challenges been overcome? 13. How would these approaches need modified for implementation at national scale?
Integration
Background Integrated delivery of ECD with interventions in other sectors is often recommended to promote holistic care of children and their families, to maximise synergies of interventions and for efficiency.

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
However, an integrated approach to service delivery also has many implications for programming.
Objectives To consider as a group; 1. Experience with integrated innovations across the SB portfolio in terms.
Questions 1. What has been the rationale for choosing ECD specific or integrated ECD approaches in different settings across the portfolio? 2. Where integrated approaches have been taken, how has this worked? 3. What have been the programmatic implications of an integrated approach in terms of; 4. Work-load for workers? 5. Training and supervision? 6. Equipment? 7. Cost? 8. Monitoring and evaluation? 9. How has governance across sectors been managed? 10. What are the implications of an integrated approach for implementation at national scale? 11. Are there other elements of an integrated approach which are important to consider in implementation of ECD programmes at national scale?
Questions for experts in the field
1. What do you consider to be priority needs for policy makers and programmers in implementing ECD programming at national scale, once a decision has been made to invest in early child development? 2. With regards to ECD programmes at scale, what do you consider to be the key design decisions for policy makers and programmers? 3. Given the challenges of measuring impact in ECD programmes and the constraints that this poses to progress in policy and planning, what do you see as next steps in improving developmental outcome metrics within programmes and at national scale? 4. If it were possible to monitor 3 indicators on the pathway to improving ECD at a national level, what would you measure and why? 5. What key lessons can be learned about cadres of worker for delivery of ECD interventions from other global child health interventions? In particular, what lessons around use of CHWs are relevant for CHW delivery of positive stimulation interventions in home settings?

Web Appendix Table C: Key informants contributing to qualitative components of portfolio evaluation

	Organisation Type/Name	Position	Question theme
ECD POLICY AND PROGRAMMING			
1	Saving Brains	Executive	ECD research, policy and programming; contemporary challenges and future directions.
2.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
3.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
4.	Private international ECD foundation	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
5.	International Financial Institution.	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
6.	Multilateral non-government organisation.	Policy &programming.	ECD programming, iNGO perspective on what is needed to progress the field
7.	International Child Health Research Institution	Policy, programming & research.	ECD in global child health – challenges and future directions.
8.	Non-government disability-ECD organisation - national level.	Policy and programming.	Inclusion in ECD programming – iNGO perspective
9.	Ministry of Health, sub-Saharan African country.	Policy and Programming	ECD in global child health, health perspectives.
OTHER EXPERTS IN FIELD			
	General		
10.	Public health academic institution, UK	Senior Researcher	Research priorities in ECD
11.	Public health academic institution, USA.	Senior Researcher.	Challenges, priorities and approaches in future ECD research.
	Specific technical		
12.	Public health academic institution, USA.	Senior Researcher.	Impact metrics
13.	Public health academic institution, USA.	Researcher.	Impact metrics
14.	Public health academic institution, UK	Senior Researcher.	Impact metrics
15.	Multilateral UN organisation.	Senior Researcher.	Impact metrics
16.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, human resourcing.
17.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, cost-effectiveness
18.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Integration.
19.	Academic Centre, USA.	Senior Researcher.	Implementation process knowledge gaps, priority questions and research methodology.
	Saving Brains Platform		
Members of the Saving Brains Platform team who were consulted about various aspects of the evaluation, their experiences working within the Saving Brains portfolio and in regard to specific technical, programming and research related themes.			
	Grantees		
Twenty-one of thirty-nine (54%) of research teams were specifically interviewed regarding their innovation and various aspects of their experiences within the Saving Brains portfolio.			

ECD=Early Child Development

Web Appendix Table D: Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of challenges and course correction

Project Name	**Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improve malnourished children's development**	**An integrated intervention targeted at deprived pre-school children in rural areas**	**Home visiting programs to improve early child development and maternal mental health**	**Saving Brains, Changing Mindsets**
HUMAN RESOURCES: CHALLENGES AND COURSE CORRECTION				
Interaction with existing services	Integration and coordination with health services in rural Bangladesh.	Competition from a new government-run parenting program,	Integration into existing family health strategy home-visits increased visit frequency but reduced number of families visited. Local workers demanded financial incentives to deliver new project and prioritized pre-existing activities.	Issues encountered were gaining confidence and trust of construction companies, quality assurance of individual NGOs, securing adequate infrastructure, particularly as a decline in the construction industry slowed project progress
Adaptation for implementation	-	Shift required from didactic learning to 'demonstration and practice' method of learning. Supervision forms were adapted to type of data collected.	Busy schedule of CHWs meant missed appointments were not rescheduled. CDAs more frequently rescheduled visits. Supervision was jeopardised by existing heavy workloads and required intervention by project coordinator.	During scale-up, the focus remained on strengthening supervision quality of partner NGOs.
Training time commitment	Training schedule difficulty for government clinic workers was mitigated by split of training schedules to maintain clinic duty cover.	Long training time commitment was mitigated by incentivisation.	-	-
Staff recruitment / remuneration / retention	Salaried government workers expected incentivisation for additional work and some refused to conduct sessions; this was mitigated by motivational meetings and supervision.	Attrition of workers was mitigated through fast-track training programme. Workers in one affluent town did not value RCEL project, and tasks were unfamiliar to these workers (<3% of sample).	Difficulty in identifying CHWs to deliver intervention in addition to existing routine. High turnover of CHWs considering intervention too time consuming.	Difficulties in identifying sufficiently qualified workers, but not overqualified and viewed RCEL as 'beneath their station'. Initial high attrition rates as workers apprehensive about working with children <3 yrs. Changes made to training modules and selection criteria.
Supervision	-	Reticence from providers unfamiliar with close coaching was mitigated by promoting positive tutoring relationships. Implications and impacts from rurality of workers on supervision.	Supervision not considered a priority by supervisor priority requiring project coordinator to intervene, holding meetings with CDAs and performing supervised visits.	-
CONTENT: CHALLENGES AND COURSE CORRECTION				
Adaptation for implementation	Minor adaptations to Reach-up for the pair study and major adaptation for the group study. Adapted for use in community clinics instead of homes and to be used for fortnightly visits instead of weekly in both studies.	Simplification of curricula language to facilitate provider use. Reluctance to lend toys/materials led to introduction of toy library. Wide developmental age range in groups led to adaptation with more baby-friendly routines and sub-groups by age.	Reach-Up was adapted for twice monthly visits instead of the original weekly visit. Mothers did not like the toy's original appearance which they considered poor. Toy was redesigned to be more appealing.	During scale-up in other regions of India e.g. Bangalore, training module was contextualized, and nutrition menu adapted to the local context.
Materials	Complaints regarding quality of toys (parents) led to extended provider training to facilitate more 'fun' interactive	Initial reluctance for recyclable toy materials but toy-making workshops changed perceptions. Toy library	Materials required cultural adaptation. Adaptation guide needed to be clear regarding exactly what could be adapted	Materials were translated for regions requiring the desired learning materials.

	sessions and directions for making new toys.	developed to promote unrestricted use which was appreciated by caregivers.	and what concepts had to be maintained to guarantee fidelity.	
Recipient attendance, retention & incentivisation	Attendance challenges included distance to clinic, late start to sessions, and expectation of nutritional supplement. More timely attendance and stricter time-keeping encouraged. Incentivisation included oil supplementation distribution & caregiver motivational meetings.	High value of project nutritional package incentivised attendance. Tutors and providers supported problem-solving to overcome barriers to attendance (i.e. long distances, travel costs, job responsibilities etc.). Encouraging positive social interactions meant beneficiaries more motivated.	Beneficiaries had no other incentives but the program itself. The major cause of attrition was mobile populations due to rental accommodation. Mothers enjoyed and wanted to complete the programme.	-
References	(21-23)	(23, 24)	(23, 25)	(23, 26)

CDA=Child development agent, CHW=Community health worker, RCEL=Responsive caregiving and early learning

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ABSTRACT

Objective: The World Health Organization recommends responsive caregiving and early learning (RCEL) interventions to improve early child development (ECD), and to achieve the Sustainable Development Goals' vision of a world where all children thrive. Implementation of RCEL programmes in low- and middle-income countries (LMIC) requires evidence to inform decisions about human resources and curricula content. We aimed to describe human resources and curricula content for implementation of RCEL projects across diverse LMIC, using data from the Grand Challenges Canada® Saving Brains® ECD portfolio.

Setting: We evaluated 32 RCEL projects across 17 LMIC on four continents.

Participants: Overall, 2,165 workers delivered ECD interventions to 25,909 families.

Intervention: Projects were either standalone RCEL or RCEL combined with health and nutrition, and/or safety and security.

Primary and secondary outcomes: We undertook a mixed-methods evaluation of RCEL projects within the Saving Brains® portfolio. Quantitative data were collected through standardised reporting tools. Qualitative data were collected from ECD experts and stakeholders and analysed using thematic content analysis, informed by literature review.

Results: Major themes regarding human resources included: worker characteristics, incentivisation, retention, training and supervision, and regarding curricula content: flexible adaptation of content and delivery, fidelity, and intervention duration and dosage. Lack of an agreed standard ECD package contributed to project heterogeneity. Incorporation of ECD into existing services may facilitate scale-up but overburdened workers plus potential reductions in service quality remain challenging. Supportive training and supervision, inducement, worker retention, dosage and delivery modality emerged as key implementation decisions.

Conclusions: This mixed-method evaluation of a multi-country ECD portfolio identified themes for consideration by policymakers and programme leaders relevant to RCEL implementation in diverse LMIC. Larger studies, that also examine impact, including high-

quality process and costing evaluations with comparable data, are required to further inform decisions for implementation of RCEL projects at national and regional scale.

ARTICLE SUMMARY

Strengths and limitations of this study

- We analysed data from 32 RCEL projects based in 17 low- and middle-income countries, from the multi-country Saving Brains® early child development portfolio, including data from a total of 2,165 frontline workers who delivered interventions to over 25,000 children and parents.
- Our mixed-methods approach to this analysis enabled us to draw rich and varied conclusions from both quantitative project data and qualitative stakeholder interviews.
- Several process-related metrics, such as coverage, equity and cost-effectiveness, were not commonly reported by the projects and so were difficult to explore fully in this analysis.
- Impact data were not available for most projects at the time of the evaluation and so no assessment of impact was included.
- High heterogeneity within the Saving Brains portfolio presented challenges in drawing conclusions for individual project implementation.

BACKGROUND

Optimal early child development (ECD) is central to the Sustainable Development Goals' vision of a world in which children can *thrive*.(1, 2) ECD programmes have the potential to transform human capital across the life course, and scale-up of responsive caregiving and early learning (RCEL) is advocated by the World Health Organization, UNICEF and World Bank, as a key part of the Nurturing Care Framework launched in 2018 (see Box 1).(3-7) Programmes promoting RCEL have been found to be effective for ECD and related to longer term outcomes, including educational attainment and adult earnings.(5, 8)

Box 1: ***Terms for responsive care & early learning for early child development***

Multiple terms are used to describe interventions that promote early child development. The World Health Organization, UNICEF & World Bank's Nurturing Care Framework refers to a spectrum of requirements necessary for reaching full developmental potential, including: good health, security and safety, nutrition, responsive caregiving, and early learning.

In this paper, we use the concept of nurturing care, and specifically the term 'responsive care and early learning' (RCEL). RCEL describes the promotion of ECD through learning, play, and caregiving that is responsive to children's needs.(5, 9, 10) Similar terms include 'responsive care/caregiving', 'responsive stimulation', 'nurturing care', 'psychosocial stimulation', 'early learning' and 'play'.

However, there are limited data to guide practical implementation of RCEL programmes at scale in low- and middle-income countries (LMIC), and a particular lack of data regarding human resources and curricula content.(11-13) Additionally, guidance for contextual adaptation of projects is crucial but complex for RCEL which involves sectors beyond health. These gaps present challenges to decision-makers and may result in small-scale projects making design choices that limit the potential for sustainable scaling.(5, 14, 15) Thus, analysis of implementation factors for scaling of RCEL projects, particularly human resources and curricula content, is needed.(11)

The *Lancet* series 'Advancing Early Child Development: from Science to Scale' (16) and the *Annals of the New York Academy of Sciences* series 'Implementation Research and Practice for Early Childhood Development' (17) described gaps in the literature relating to ECD programming. The *Archives of Diseases in Childhood* series 'Informing design and implementation for early child development programmes' (18-22) provided evidence from

the Grand Challenges Canada® (GCC) Saving Brains® portfolio for decision points related to ECD programming but did not specifically address human resources and curricula content. This paper responds to this gap, building on *Radner et al*'s exploration of lessons learned on scaling from the Saving Brains portfolio, to explore human resources and curricula content in a diverse range of RCEL programmes from the same portfolio.(23) We predominantly use a health sector perspective, and contextualise our findings within learning from multi-country evaluations of community-based maternal and newborn care and evaluations of mental health and nutrition programming.

Aims & objectives

This paper aims to describe human resources and curricula content for implementation of RCEL projects across diverse LMIC, using data from the Saving Brains portfolio. We will address *who* delivers the project, including training, supervision and inducement; and *what* the specific curricula content is, including materials, intensity, quality, fidelity and adaptation. Objectives are to:

1. Quantitatively analyse human resources and curricula content for RCEL projects in the Saving Brains portfolio.
2. Qualitatively analyse programme design and implementation decisions, focusing on themes related to human resources and curricula content.
3. Synthesise lessons learned and implications for future design and implementation of RCEL programmes at scale.

METHODS

We took a mixed-methods approach, incorporating quantitative data from an evaluation of projects in the Saving Brains portfolio alongside qualitative data from in-depth interviews (IDI) and focus group discussions (FGD) with ECD experts and Saving Brains project leads. Impact and outcome data were not available for the majority of projects at the time of the evaluation and were therefore not included in the evaluation.

Overview of the Saving Brains Portfolio evaluation

Saving Brains is a diverse portfolio of projects, each aimed at improving ECD in LMIC through interventions in the first thousand days, as outlined by *Radner et al*.(23) Projects sought to improve brain development through preventing brain injury, promoting stimulating and responsive environments and/or protecting children from developmental risk factors.(18) An evaluation of Saving Brains was undertaken in 2016-2017 by a team from the London School of Hygiene & Tropical Medicine in collaboration with the Saving Brains Platform team of experts, led by TruePoint Center/Harvard University and the World Health Organization.(24) The team evaluated 39 Saving Brains Seed and Transition-To-Scale (TTS) grants awarded between 2012 and 2016 to project leads from LMIC with variable design and implementation approaches (see *Milner et al* for summary of projects).(18) Seed grants focused on demonstration of 'proof of concept' over 18-24 months while TTS grants focused on progression towards scale in partnership with other organisations over 3 years. The portfolio evaluation team developed a conceptual evaluation framework (Web Appendix Figure A) based on the Medical Research Council Guidance on Evaluation of Complex Interventions and developed around a portfolio-level 'theory of change' (developed by Saving Brains Platform members) (Web Appendix Figure B).(25) The conceptual evaluation framework provided a structure for the evaluation to systematically consider, describe and assess human resource and curricula content implementation factors. The evaluation team referred to the conceptual evaluation framework throughout the evaluation process to ensure comprehensive assessment of human resource and curricula content issues. The 'theory of change' metric indicators directly relate to Results-based Management and Accountability Framework data points (see below) collected by each project.

Objective 1. Quantitative data sources and analyses

Quantitative data sources

Quantitative data on project design and implementation were collected from GCC pre-specified data collection tools (Web Appendix Table A). Service Delivery Forms (SDFs) comprised data regarding human resources and RCEL curricula and the Results-based Management and Accountability Framework (RMAF) comprised data on numbers of recipients and beneficiaries, child growth and development outcomes, parental and home

environment outcomes, and funding, coverage and context of projects. Data were extracted from SDFs and RMAFs and imported into Microsoft Excel for cleaning, management and analysis (May-Nov 2016).

Quantitative analysis

Descriptive statistics relating to frequency and mode of outcome measurement across the portfolio were generated using Stata 14 and Microsoft Excel. Data on occupation of workers delivering the RCEL projects were classified according to the International Standardised Classification of Occupations.(26) For quantitative analysis, projects were grouped to highlight differences in implementation design factors. Groupings were as follows i) all RCEL projects ii) standalone RCEL projects and iii) integrated RCEL projects, where 'integrated projects' were integrated with another domain of the Nurturing Care Framework (other than RCEL) and 'standalone projects' were not.

Objective 2: Qualitative data sources and analyses

Literature review and topic guides

IDI and FGD were facilitated using topic guides, which were developed based on a literature review guided by the Consolidated Criteria for Reporting Qualitative Research. The review explored implementation experiences relating to human resources and curricula content amongst ECD experts and Saving Brains project leads. Thematic areas of enquiry (Web Appendix Table B) were established based on the literature, stakeholder consultation, and analysis of written project proposals and progress reports submitted by project leads to GCC (Web Appendix Table A). Our analysis was also informed by examples from the literature of similar efforts to support decision-making for implementation in other maternal and newborn health projects in LMIC.

Medline and Embase were searched, with the following MeSH terms; 'Child development' OR 'Developmental Disabilities' AND 'Developing Countries'. Additional articles were retrieved through reference lists of identified articles and publications from the Saving Brains community. Grey literature was searched via websites of major multilateral organisations engaged in ECD programming including the World Health Organization, UNICEF, Save the

Children Fund, the World Bank, World Vision International, other related organisations, and Google.

Qualitative data inputs from key informant interviews and focus group discussions

Key informants (n=19) were ECD experts implementing ECD programmes in LMIC (Web Appendix Table C). ECD experts were purposively selected from professional networks including national and international programmers and policy makers, ECD researchers, Saving Brains project leads, and members of the Saving Brains Platform and GCC. All key informants were invited to participate by email. IDI were conducted with key informants and FGD with Saving Brains project leads, with between 4 and 10 participants per FGD. All participants provided verbal informed consent and data collection was concluded once saturation was reached.

IDI and FGD were conducted in English (Jun-Oct 2016) and were audio recorded or transcribed by a member of the evaluation team. Each IDI lasted approximately 60 minutes while each FGD lasted between 60 and 90 minutes. All IDI and FGD were conducted face-to-face or via an online video link. Interviewers and FGD facilitators summarised and verified throughout data collection to improve validity of results. Meetings of Saving Brains innovators and partners on prioritising research in ECD and strategies for implementation of interventions were audio recorded and/or transcribed. Audio recordings of IDI, FGD and meetings were submitted to a third party for transcription. Members of the Saving Brains evaluation team conducted IDI (MKL, KMM and VC) and facilitated FGD (CJT, KMM, VC) alongside members of the Saving Brains platform.

Qualitative data also included Saving Brains project progress reports; written narratives on implementation challenges and mitigation strategies.

Qualitative analysis

Written project documents and transcribed IDI and FGD were de-identified, imported and coded in NVivo 11. Data were independently coded line-by-line by two members of the evaluation team (MKL, KMM). An inductive approach was used to create a coding framework, and thematic content analysis was undertaken to explore themes related to human resources

and curricula content until saturation was reached. Inter-rater coding reliability was high on review of NVivo 11 coding reports.

Patient and Public Involvement

This evaluation was conducted without direct patient involvement and they did not contribute to the interpretation of results or writing and editing of this document. However, families were frequently involved in different aspects of the design and interpretation of individual projects within Saving Brains including, but not limited to, the materials used in intervention delivery and methods for incentivising participation.

Ethics approval

The study was approved by the London School of Hygiene & Tropical Medicine Ethics Committee (16001/RR/11202). Deidentified data were used in this analysis.

RESULTS

Overview: quantitative and qualitative results

32 of the 39 Seed and TTS projects included some aspect of RCEL (Figure 1); the 7 non-RCEL projects were not included in this analysis. Of these 32 projects, 34% (n=11) projects were standalone RCEL interventions and 66% (n=21) were integrated with interventions in 'health and nutrition' (10 projects), 'security and safety' (9 projects) or both (2 projects) (Figure 1). Projects were implemented in 17 LMIC across four continents (see Figure 2).

IDI were conducted with 66% (n=21) of Saving Brains project teams including all TTS projects. Emergent themes from the qualitative analysis are presented in Table 1. Saving Brains TTS project leads provided quantitative data on these emergent themes (Table 2).

Table 1: Themes and sub-themes from quantitative and qualitative data analysis for 32 Saving Brains projects, and 19 key informant in-depth interviews regarding human resources and curricula content for early child development (ECD) programming

	Themes	Sub-themes
Human Resources	1. Characteristics / selection of worker	1.1 Health vs other sector
		1.2 Integration with existing programmes
		1.3 Pre-existing government worker vs novel worker
		1.4 Professional vs lay worker

		1.5 Qualities and qualifications
	2. Inducement and retention	2.1 Modalities of incentivisation
		2.2 Impact on pre-existing workers
	3. Training and supervision	3.1 Content of training
		3.2 Flexibility vs fidelity
		3.3 Education theory
		3.4 Supportive relationships
Curricula content	4. Content and components	4.1 Defining critical components
		4.2 Formative work and adaptation
		4.3 Flexibility vs fidelity
		4.4 Behaviour change
	5. Delivery, duration and dosage	5.1 Adapting delivery to local context
		5.2 Intervention duration and dosage
		5.3 Retention of participants

Table 2: Description of the Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of human resources and curricula content (N=4 projects)

Project Name	**Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improved malnourished children's development**	**An integrated intervention targeted at deprived pre-school children in rural areas**	**Home visiting programs to improve early child development and maternal mental health**	**Saving Brains, Changing Mindsets**
Lead Institution	**International Centre for Diarrhoeal Disease Research (ICDDR,B)**	**Universidad de los Andes (UDLA)**	**Faculdade de Medicina da Universidade de Sao Paulo (USP)**	**Mobile Crèches for Working Mothers' Children (MC)**
Country	**Bangladesh**	**Colombia**	**Brazil**	**India**
Site	Dhaka area: Narsingdi and Kishoreganj. Rural	Central rural regions: Boyacá, Cundinamarca, Santander	Sao Paulo, urban slums in western area	Delhi area, Bangalore, Ahmedabad, Chandigarh
Vision/ Goal/ Objectives	Integrate RCEL intervention for poor, underweight children into routine government health services	Improve quality of a pre-existing public parenting programme in a scalable fashion	Evaluate the efficacy and cost-effectiveness of two alternative platforms for home visiting programme	Demonstrate scalability of workplace-based childcare for children of migrant construction workers
No. participating children	1,597	2,134	800	4,845
HUMAN RESOURCES				
Type	Assoc Health Professional	Lay community member as paraprofessional	Community Health Workers (CHWs) and Child Development Agents (CDAs)	Personal care worker
Pre-existing / novel cadre	Pre-existing	Pre-existing	CHWs pre-existing, CDAs novel cadre	Pre-existing
Incentivisation, including remuneration	Occasional small gifts.	Remunerated by government	30% elevated salary pre-existing CHWs, salary-matched CDAs	Salaried
Qualification/ skill / competence	Technical qualification	Secondary education	No qualification needed	Primary & Secondary education
Gender of workers	Majority female	Majority female	Exclusively female	Majority female
Length of training	15 days	85 hrs over 3.5 weeks	40 hrs initial (Reach Up) & 32 hrs refresher	36 days
No. of workers recruited (completing training, delivering project)	354 (320, 168)	171 (171, 171)	15 (15,13)	139 (83, 67)
Frequency of supervision	Minimum once per month.	Every six weeks.	Once per week.	Six months rigorous, then monthly.

Project Name		Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improved malnourished children's development	An integrated intervention targeted at deprived pre-school children in rural areas	Home visiting programs to improve early child development and maternal mental health	Saving Brains, Changing Mindsets
CURRICULA CONTENT					
Group vs individual		2 or 4-5 dyads	80% grp, 20% individual	All individual	70% grp, 30% individual
Duration of intervention		12 months	11 months	12 months	3 months
Average length of sessions		50 mins	1 hr	1 hr	8 hrs (full creche day)
Number of sessions		25	55	24	75
Freq. of contacts per month		2	3	2	25
Materials		Play materials	Books, puzzles, images, and toys (recyclable materials)	Books, puzzles, images and toys (recyclable materials)	Play materials, blocks, puzzles, big picture books, toys (low cost)
Curriculum		Adaptation of Reach Up	Adaptation of Reach Up	Adaptation of Reach Up	Thematic curriculum on school readiness skills
Use of digital media		None	None	None	None
Mechan-ism of behaviour change	*Mentoring*	Yes	Yes	Yes	Yes
	Problem-solving	Yes	Yes	-	-
	Didactic	-	-	-	-
	Demonstrations	Yes	Yes	Yes	Yes
	Service mapping	-	-	-	-
	Empowerment	Yes	Yes	Yes	Yes
	Peer support	Yes	Yes	-	-
	Media	-	-	-	-
	Materials	Yes	-	Yes	-
Published references		(23, 27, 28)	(23, 29)	(23, 29)	(23, 30)

CDA=Child Development Agents, CHW=Community Health Worker

Human resources in ECD projects: themes and sub-themes

Three major human resources themes and eleven sub-themes were identified (Table 1).

1. Characteristics / selection of workers

Variation in workforce across the Saving Brains portfolio is summarised in Figure 3. The use of health or associate health professionals, such as community health workers, was common. Health professionals commonly delivered projects that included health and nutrition domains (Figure 3a). Lay community members were also common as frontline workers across all project types.

Integrating ECD projects into existing programmes was identified by informants as a key challenge.

> *"Early child development is harder than anything because of its integrated nature…. ...we all decided that services had to be fully integrated….and this has imposed an operational burden that is very complicated."* – Saving Brains TTS project lead

Approximately one third of workers (34% n=11/32) had either only primary school-level or no education (Figure 3b). Tertiary-level education of workers was more common for RCEL projects which included health and nutrition domains (42%, n=5) (Figure 3b), likely reflecting the greater representation of healthcare professionals delivering these integrated interventions.

Soft skills including interpersonal and communication skills were identified as important by project leads.

> *"We have learned a lot about the type of person that can fill the health promoter role. It is important that he/she is committed to the project, responsible, and loves working with kids, especially this age group."* – Saving Brains Seed project lead

> *"Having a champion in the field is crucial for success…combination of strength and kindness; excellent interpersonal skills; problem solver; works with all stakeholders."* – Saving Brains TTS project lead

A key choice in ECD implementation was whether to use established or novel cadres of worker. In some projects, novel cadres of worker were recruited to support quality of implementation. However, limitations of this approach were acknowledged with regards to sustainability.

> *"…even after identifying and training them there is no assurance that the government will take up the process."* – Saving Brains TTS project lead

Conversely, while a number of projects used pre-existing frontline workers, key informants also expressed concerns regarding direct control over recruitment, incentivisation, supervision, and training when shared with a partner organisation (Web Appendix Table D, ICDDR,B & USP). The increased burden, change in focus, and challenge in coordination for pre-existing salaried workers was also highlighted by experts and project teams.

> "*It's a big challenge…you take a health worker and add a 24th task to her 23rd task, which are requested by six different funders with no coordination between any of them."* - ECD Lead for an International NGO

> *"They think [to themselves], 'I'm dealing with dengue and Zika and you expect me to play with a child for an hour.'"* – Saving Brains TTS project lead

2. Provision of incentives based on performance (inducement)

Overall, most (61%) project workers were salaried (Figure 3c). However, considering lay community member workers only, 20% of projects offered no incentives, and a further 20% offered only a contribution to expenses (Figure 3c). Key informants expressed a range of opinions about remuneration of community health workers. Some cited elevated status within the community and personal satisfaction as a non-financial incentivisation. In contrast, concerns were expressed regarding sustainability and human rights implications of implementation models that relied on voluntary workers, who were often socially disadvantaged women. However, all health and most allied health professionals were salaried and financial remuneration for these groups was considered a key part of inducement.

> *"Asking clinic staff to conduct the sessions meant additional tasks for them and they had to spend longer hours in the clinic. They therefore had expectations to be paid some wages for this extra task, but our goal was to integrate the activity into their daily routine hours to make it sustainable."* – Saving Brains TTS project lead

Staff recruitment and retention was a major recurring theme. Of the 2,572 workers recruited to deliver ECD interventions across the Saving Brains RCEL projects, 2,433 (95%) completed initial training and, of those trained, 2,165 (84%) ultimately delivered the intervention (Figure 3d). Across the portfolio, retention was most challenging amongst salaried staff who were mostly health staff with 67% of salaried workers trained delivering the intervention (Figure 3d). Specific reasons for drop-off were not available from existing data.

During programme planning, several teams described strategies including 'over-recruitment' to allow for anticipated staff attrition.

> *"In this next phase, we trained many more promoters than we needed, approximately twice as many as we originally needed in order to have a healthy resource base."* – Saving Brains Seed project lead

"It was hard to get [the staff], but we were very successful in keeping them. … We paid them well which is something that I don't know that the government will be able to do. They also had a lot of support and a lot of training. They really appreciated all that they received from our team…" – Saving Brains TTS project lead

3. Training and supervision

A wide variation in supervision frequency, duration and ratios, and training structure and duration was seen across projects (Table 3).

Table 3: Supervision and training of workers delivering responsive care and early learning Saving Brain projects

	Median	**Range**	**Inter-quartile range**
Number of days in training (N=31)	10	0-90	5-13.6
Number of trainees per workshop (N=31)	10	0-50	5-20
Frequency of supervision (N=28)	2 per month	0-10	1.5-4
Duration of supervision (N=27)	2 hours	0-8	1-4
Ratio of supervisor to trainee during training session (N=20)	3:20	0.04-2	0.1-0.2

*Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data for 1 project on number of days in training and number of trainees per workshop, 4 projects did not report on frequency of supervision and 5 projects on duration. 12 projects did not report on the ratio of supervisor to trainee.

Training and supervision emerged as major themes during qualitative analysis (Table 1). Within training, the need to not only address details of ECD curricula but also a diverse range of related issues including pedagogy, strategies for managing the emotional load of work and administrative requirements, communication skills, and problem-solving abilities were identified. Several key informants also highlighted the value of observational supervision.

"…not only to see that content is delivered but that it is delivered in a way that parents will be responsive to." – Saving Brains TTS project lead

The importance of flexible training and supervision protocols that were feasible for staff who had multiple roles and were likely to be sustainable with scale-up was also emphasised.

"*Ongoing training including proficiency evaluations and feedback build confidence in participating community health workers to apply the tools and methodologies to deal with mothers and children. We have learned this over the years of work with community*

health workers and plan to systematize the work into teaching protocols as part of the transition to scale phase." – Saving Brains TTS project lead

Key informants highlighted the need to develop formal structures for high-quality supportive training and supervision at all staff levels; this was particularly important in maintaining fidelity during intervention scale-up (Web Appendix Table D). In addition, discussions emphasised the importance of peer support amongst workers (Web Appendix Table D).

Curricula content: themes and sub-themes

Two major themes and seven sub-themes were identified with respect to curricula content (Table 1).

4. Content and components

Improved understanding of the critical components of RCEL interventions was a major theme identified by key informants as crucial to sustainability and scale-up.

Many projects provided general descriptions of content (e.g. parenting programme, responsive parenting, nutrition) or the original curriculum from which their project was developed (commonly the established Jamaican 'Reach Up' curricula) (Table 2). (21) However, for many, the critical components were less well defined and described. Specifically, details of activities for different ages or developmental stages, child health or nutrition components, behavioural change approaches used, pedagogy, and materials were typically limited. Lack of an established and standardised framework for describing curricula content was identified by key informants as a barrier to improved reporting and understanding design factors responsible for impact.

The importance of formative research and piloting for development and adaptation of interventions to setting was highlighted.

"*Project development is also really important…these projects are not 'off-the-shelf' 'ready-to-go'.*" – ECD expert

Additionally, the importance of balancing project flexibility, fidelity and content heterogeneity with clear, specific and structured curricula was emphasised.

> "*The other determinant of success I would say is… we were able to develop a contextualized project, delivery product and processes.*" – Saving Brains Seed project lead

Specific materials and activities often required guided cultural adaptation to maintain fidelity (Web Appendix Table D). However, it is important to note that key informants placed equal emphasis on behaviour change mechanisms as well as on specific curricula activities and materials.

> "*Key components [were] inspiration, confidence… empathy, attachment of mothers and children to the deliverer…assessment for change*." – Saving Brains Seed project lead

5. Delivery, duration and dosage

The importance of project delivery, duration and dosage emerged as a major theme in the analysis. Figure 4 summarises the method and duration of delivery of ECD interventions. The proportion using groups to deliver the intervention was highest amongst standalone RCEL projects and lowest amongst integrated approaches (Figure 4a). Duration of sessions generally lasted longer for groups than individual visits (Figure 4b).

ECD investigators reported that the decision regarding group or individual delivery approach was influenced more by context, efficiency, and feasibility than effectiveness.

> "*Our problem…was trying to do something that we thought was evidence based, but that was not a good fit with the socio-political structures and the way people are comfortable in trying new things.*" – Saving Brains Seed project lead

Key informants highlighted 'dosage' of the intervention as an important design decision. The median number of project sessions delivered, length of sessions, and length of intervention, ranged broadly (Table 4).

Table 4: Summary of project sessions including duration and intensity amongst responsive care and early learning Saving Brain projects (n=32)

	Median	**Range**	**Inter-quartile range**

Number of project sessions (N=29)	24 sessions	2-192 sessions	11-37 sessions
Total length of intervention (N=26)	12 months	1-24 months	8-12 months
Length of sessions (N=26)	1 hour	10 mins-8 hours	45-90 minutes

Data from Saving Brains standardised programme reporting 'Service Delivery Form'. Missing data on number of project sessions for three projects, and on total length of intervention and length of sessions for six projects.

The majority (60%, n=19) of projects were primarily targeted at the child or caregiver level as opposed to targeting families or the community more broadly. Geographical, political and economic factors were important in engaging target populations.

> *"…some mothers find it difficult to come to the clinics for the fortnightly sessions. The reasons were lack of time, distance from the clinic, not allowed by the father or grandparents of the child and occasionally travelling outside the area."* – Saving Brains TTS project lead

Project teams used a range of methods to incentivise caregivers to attend sessions. One TTS team trialled both provision of oil supplementation and 'motivational meetings' (Table 2, ICDDR,B); both methods were found to be effective but motivational meetings were adopted due to sustainability.

DISCUSSION

This is the first paper to report on workforce data from a large multi-country child development portfolio, including 32 RCEL projects with 2,165 workers delivering interventions across 17 LMIC. This analysis addresses human resources and curricula content for implementation at scale; it is noted that these factors do not stand in isolation but interact with each other and other programme design factors as well as with local contexts. *Radner et al.*'s exploration of the Saving Brains portfolio highlighted that workforce decisions around delivery of RCEL programmes can have substantial bearings on programme sustainability and impact. In this paper, we built on this to further probe specifics of workforce choices in ECD programme implementation, particularly from a health sector perspective.(13, 23) Resultant themes and sub-themes resonate with and extend existing literature regarding workforce choices, particularly the community health workforce, for programme implementation in LMIC settings.

Workforce factors are one of the most critical impediments to implementation at scale. This is well recognised for ECD programmes, especially given intersectoral complexities. Our results suggest that whilst challenges exist for integrating ECD into existing services, introducing novel cadres of worker for standalone ECD programmes may be also challenging at scale. Within this analysis, challenges related to adding ECD workstreams to the existing workload of established frontline workers were clearly reported and may have contributed to poorer retention of salaried health workers, alongside rotation of health workers. This finding has been mirrored across the implementation literature in other areas of global health; for example, an economic analysis of community based maternal and newborn care across seven countries highlighted trade-offs between improved cost-effectiveness associated with use of existing multipurpose workers and difficulties related to overburdening those workers.(31-35)

Ongoing supportive supervision, not just initial training, was found to be crucial to intervention quality and fidelity, as has been found in global health more broadly. For example, quality supervision was emphasised as central to preservation of project quality as well as worker motivation in the economic analysis of maternal and newborn care mentioned above, and was examined in more detail in several of these evaluations, including the cluster randomised controlled Goodstart (III) trial of maternal and newborn care in South Africa.(32, 36) Similarly, supervision and training, and particularly the potential of e-supervision/training, were highlighted as key concerns for project feasibility in a review of interventions for children with intellectual disabilities (37) and additionally were found to be critical for sustainable scale and impact in similar studies, such as PRIME (Programme for Improving Mental Health Care) and a follow-up study of a cluster randomized trial of a psychosocial ECD project in Colombia.(33, 38, 39)

The challenge of retention of workers emerged as an important theme and is also not isolated to ECD. Within the Saving Brains portfolio, strategies used to mitigate against poor retention echoed findings in other global health implementation research including; over-recruitment, fast-track training, and provision of high-quality training and supervision.(33, 36, 39) *Andrew et al* suggest designing interventions according to geographical practicalities and other contextual factors to mitigate staff turnover, and thus optimise project quality and impact.(38) There is appetite for shared learning to help tackle the human resource

challenges highlighted in this paper, and resources such as the Early Childhood Workforce Initiative provide a useful platform for ECD policymakers and programmers globally to work together.(40, 41)

Regarding essential ECD intervention curricula and components for scale-up, commonalities were seen amongst the larger TTS projects which add to previous literature on this topic.(3, 14) However, there is no agreed standard package for ECD set out by the UN, contributing to project heterogeneity and precluding clear guidance for policymakers and programmers on ECD intervention content. This lack of standardised content is in contrast to more biomedical programmes, such as antenatal and postnatal care packages, as well as broader mental health and nutrition programmes which, though similar to ECD in their intersectoral nature, do have some standardised content, such as the World Health Organization and UNICEF's Infant and Young Child Feeding approach.(31, 42, 43) While lack of description of intervention content in this portfolio hinders specific recommendations for a standardised ECD curricula, our findings suggest that the focus of a standardised ECD curricula should be on engaging parents in activities which promote development, rather than providing information on developmental milestones, as is seen in many countries.

Even with a standard package, contextualisation would be important, and our findings underline the need for formative research. Across the Saving Brains portfolio, there was a noticeable lack of in-depth description of curricula content, despite key informants highlighting this as important for sustainability.(14, 15) A framework for describing contextualised content of RCEL projects using, for example, parameters described by *Aboud et al* (information, performance, problem-solving, social support, materials and media) would provide clarity in the literature and strengthen programme comparison and evaluation.(14, 44) Further, as the Nurturing Care Framework proposes, delineating ECD programmes more clearly into universal, targeted, and indicated packages to respond to the specific needs of children at particular developmental risk or with developmental disabilities would support better inclusion of children who otherwise risk not being reached by universal or conventional service models.(7, 45-47) As *Boggs et al* highlight, improved developmental monitoring is critical, and ECD workers have a vital role to play in identifying the young children most at risk of developmental difficulty and referring for ECD intervention, as well as in intervention delivery.(21) While there is little published literature on early intervention to

improve health and developmental outcomes for children with disabilities in LMIC, trials are underway and emerging models that have been adapted and that are being trialled in the context of the Zika epidemic may be informative.(48, 49)

Regarding delivery strategy, group sessions were frequently favoured across the Portfolio, notably based on increased practicality, efficiency, and acceptability, rather than increased effectiveness.(23) Previous evidence for both ECD and health programmes supports the use of a combination of home visits and group sessions as more effective in terms of information consolidation and parental behavioural change.(8, 14, 50) Future ECD research would benefit from an alignment of outcomes, where feasible, to ensure comparability in assessment of effectiveness. Intervention dosage was variable across the Portfolio and the need for flexibility in this when adapting to different contexts, for example during implementation of the 'Reach Up' package in Brazil, frequently emerged during analysis.(51) Dosage variability was similarly reported during the Goodstart (III) trial and was attributed to contextual and workforce factors including occupation, remuneration, and community recognition of workers.(36)

Strengths and Limitations

Many of the limitations of this evaluation are common to ECD programming more broadly. Several process-related metrics were not commonly reported including coverage, equity, and cost-effectiveness, likely influenced by the small-scale and 'proof of concept' nature of most projects.(39) The donor-facing system of data collection and reporting within the portfolio may have introduced bias, with investigators feeling obliged to report positively, however the open learning culture within the Saving Brains Platform acted to substantially reduce this. Grant awardees were selected by GCC and so projects and their aims may reflect funder priorities. The diversity in human resources and curricula content between projects made it difficult to draw conclusions for individual RCEL programme implementation from the portfolio-level evaluation outcomes. Impact data were not available for most projects at the time of the evaluation and so assessment of impact was not included. Enhancing linkages between implementation processes and impacts within this portfolio and more broadly has the potential to strengthen evidence to inform policy and programming. Additionally, while this paper describes design decisions, there was not scope to explore the reasons behind

these decisions. Exploration of these reasons may contribute to stronger and clearer evidence, policy and programming.

CONCLUSION

We have reported on the largest study to date of workforce and curricula content for ECD from a large and varied portfolio of 32 projects, providing a detailed description and new synthesis about implementation challenges and enablers for ECD programming. Despite heterogeneity of projects, clear themes have emerged with parallels to LMIC programmatic learning in other areas, such as global mental health and nutrition. Development of a more standardised package or planning guide for ECD programmes would mitigate some of the challenges reported here, but programmes still need to be adapted to context. Carrying out and learning from such adaptation could be supported by a common framework for describing content and delivery strategies. More systematic evaluations of implementation costs, including worker costs will be essential inputs for planning of routine ECD programmes, within and beyond the health sector. Further research investigating associations between human resource and curricula content choices and, importantly, impact is needed.

FIGURE CAPTIONS/LEGENDS

Figure 1: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

Figure 2: Project implementation countries

6 projects (Brazil), 4 projects (India, Kenya), 3 projects (Pakistan), 2 projects (Bangladesh, Guatemala, Peru, Vietnam), 1 project (Colombia, Democratic Republic of Congo, Ethiopia, Grenada, Jamaica, Nigeria, Rwanda, Zambia, Zimbabwe), 0 projects

Note: Total number of countries of implementation >32 as one project implemented in 3 countries

Figure 3: Occupation, incentivisation, qualification and retention of frontline workers amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Occupation of frontline worker delivering responsive care and early learning (RCEL) projects by type of RCEL intervention project. (N=32 projects)

No missing data (N=32 projects). Figures on bars represent number of projects. Other'=teaching professionals, social work professionals, personal care workers and combinations of occupation types.

b) Reported level of education / qualification of frontline workers across all responsive care and early learning (RCEL) projects (N=32 projects)

Data reported from Service Delivery Forms which reports on the level of education or qualifications that front-line workers had (rather than what implementers felt that they needed). No missing data.

c) Incentivisation of front-line workers delivering responsive care and early learning (RCEL) projects according to cadre of worker (N=25 projects)

Total 'n' is greater than number of projects included (N=25) as several projects used more than one occupation as workers. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

d) Retention of worker amongst responsive care and early learning (RCEL) projects according to method of incentivisation (N=29 projects)

Data reported from the Results-based Management and Analysis Framework (Web Annex Table A) reported from each project. Missing data from 3 projects. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

Figure 4: Method and duration of delivery of intervention curricula amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Method of project delivery: group vs individual by type of RCEL intervention project (N=31 projects)

Missing data from 1 project.

b) Median duration of project sessions comparing projects delivering curricula in group vs individual sessions by type of RECL intervention project (N=26 projects)

Missing data from 6 projects.

AUTHOR CONTRIBUTIONSHIP STATEMENT

The first draft of the paper was undertaken by CJT, MKL and VPH. Other specific contributions were made by RB, SB, AB, VC, EG, JH, RH, KM, KMM, JR, SS, KS, and JEL. All authors reviewed and agreed on the final manuscript.

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COMPETING INTERESTS

No competing interests.

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DISCLAIMER

The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institution with which they are affiliated.

Data sharing

Supplementary data have been published online and may also be accessed by emailing cally.tann@lshtm.ac.uk.

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Figure 1: Project inclusion flow chart: inclusions and subsets of responsive care and early learning projects from the Saving Brains portfolio (n=39)

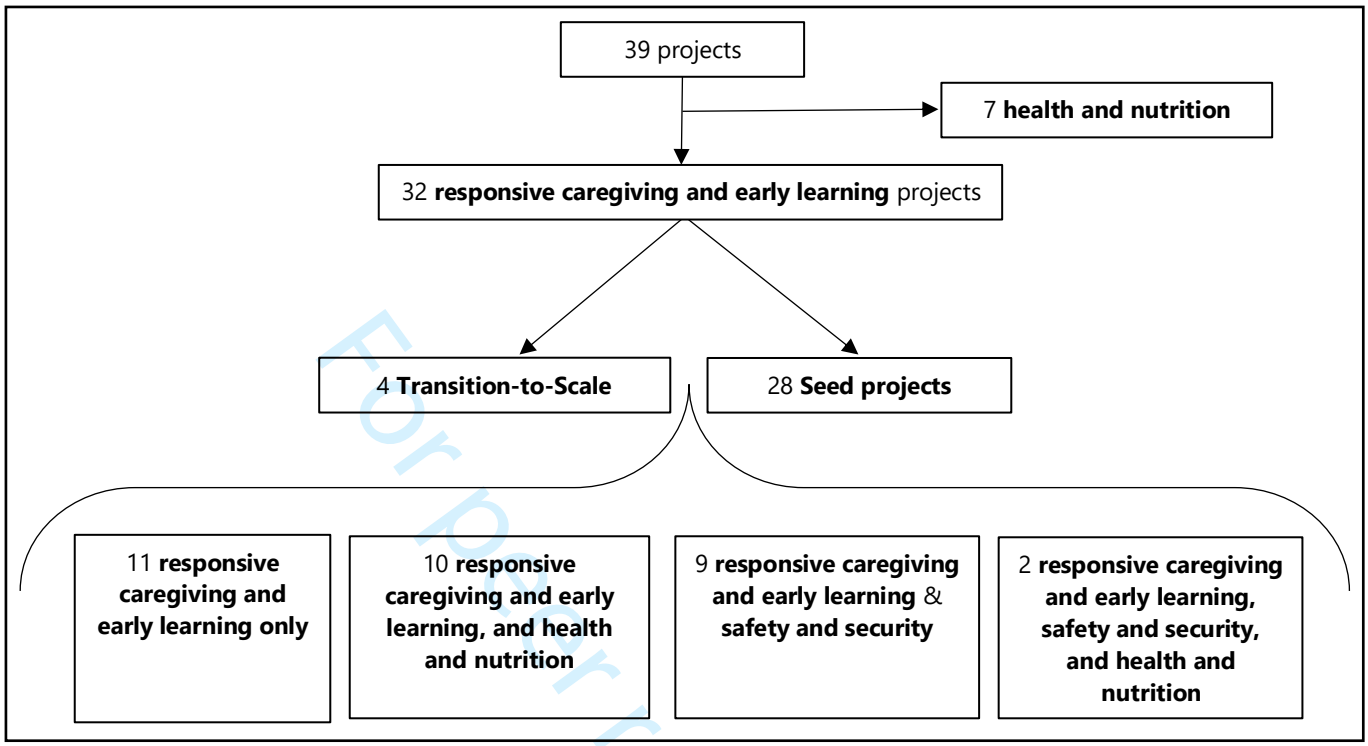
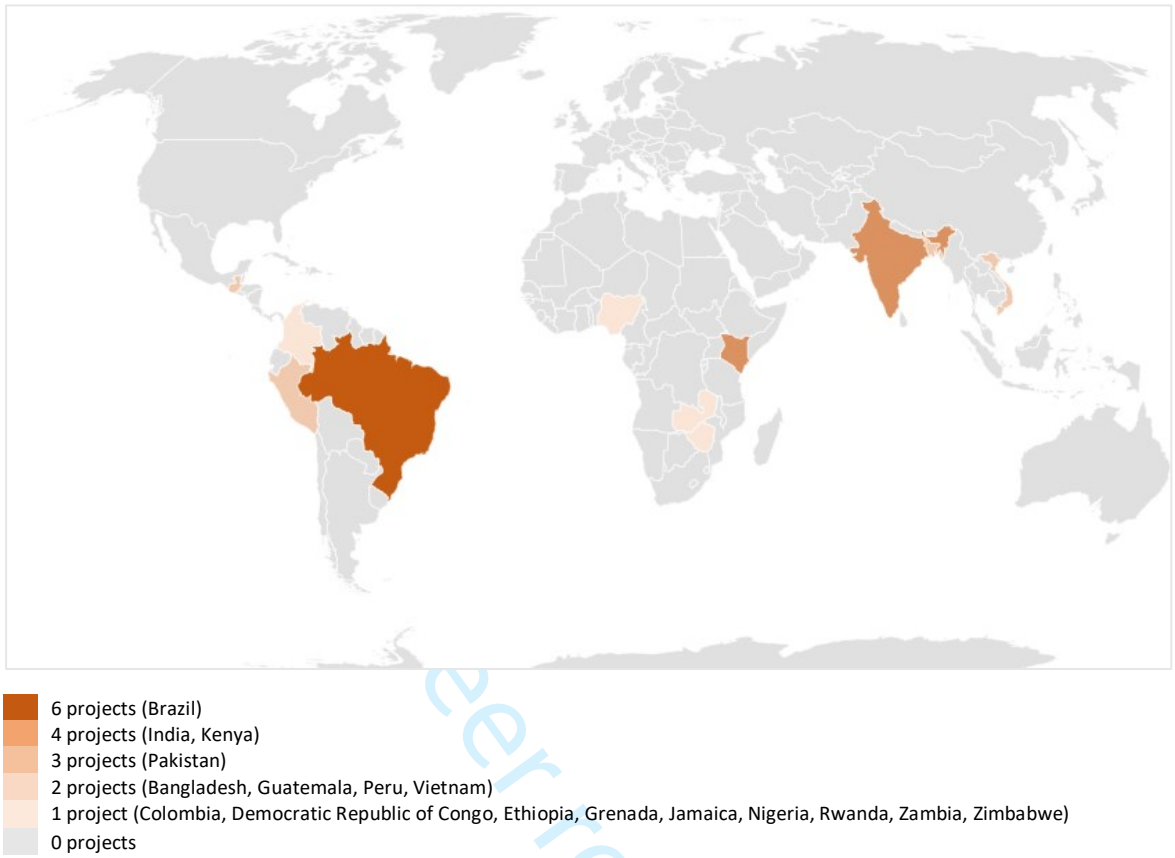


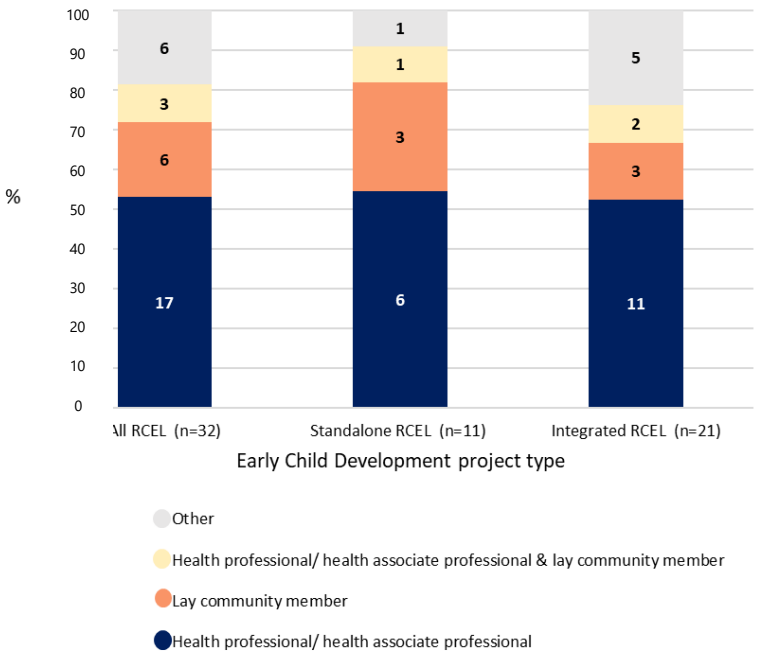
Figure 2: Project implementation countries



Note: Total number of countries of implementation >32 as one project implemented in 3 countries

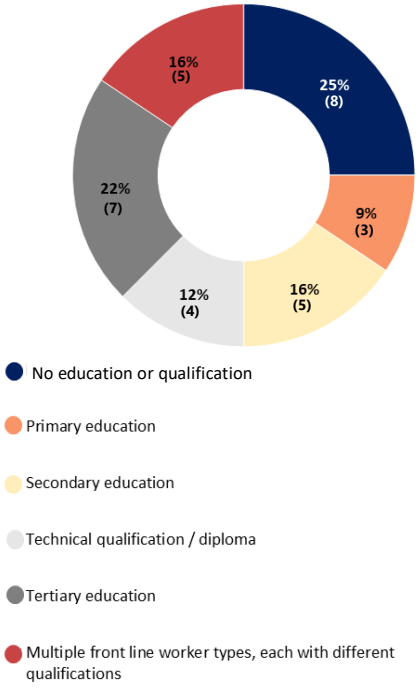
Figure 3: Occupation, incentivisation, qualification and retention of frontline workers amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Occupation of frontline worker delivering responsive care and early learning (RCEL) projects by type of RCEL intervention project. (N=32 projects)



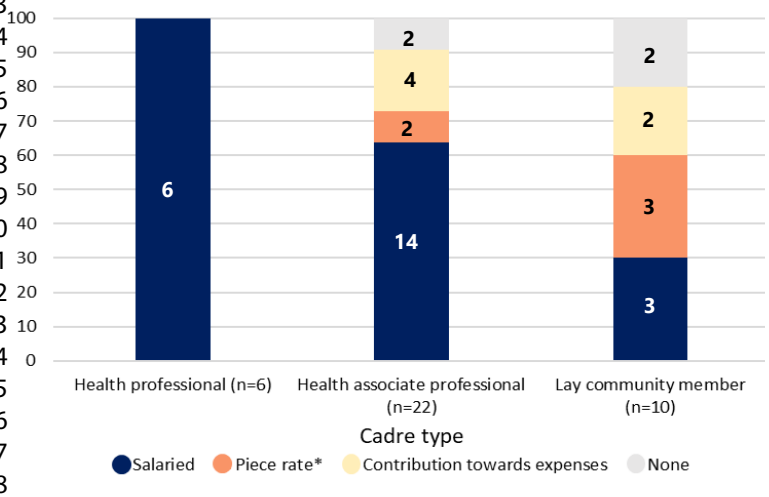
No missing data (N=32 projects). Figures on bars represent number of projects. 'Other'=teaching professionals, social work professionals, personal care workers and combinations of occupation types.

b) Reported level of education / qualification of frontline workers across all responsive care and early learning (RCEL) projects (N=32 projects)



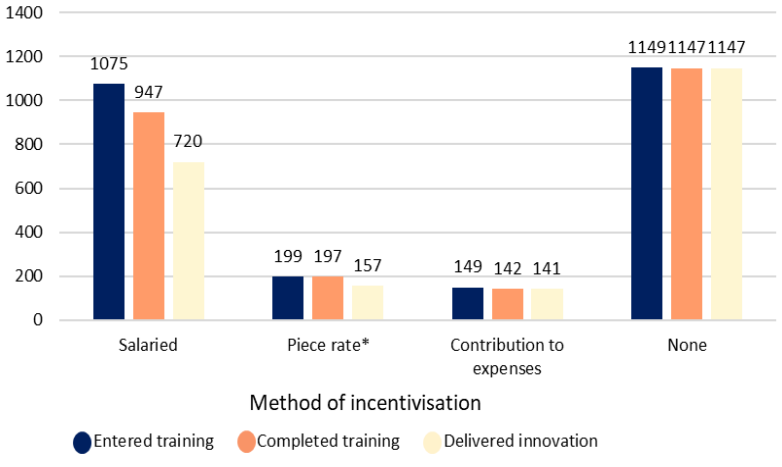
Data reported from Service Delivery Forms which reports on the level of education or qualifications that front-line workers had (rather than what implementers felt that they needed). No missing data.

c) Incentivisation of front-line workers delivering responsive care and early learning (RCEL) projects according to cadre of worker (N=25 projects)



Total 'n' is greater than number of projects included (N=25) as several projects used more than one occupation as workers. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

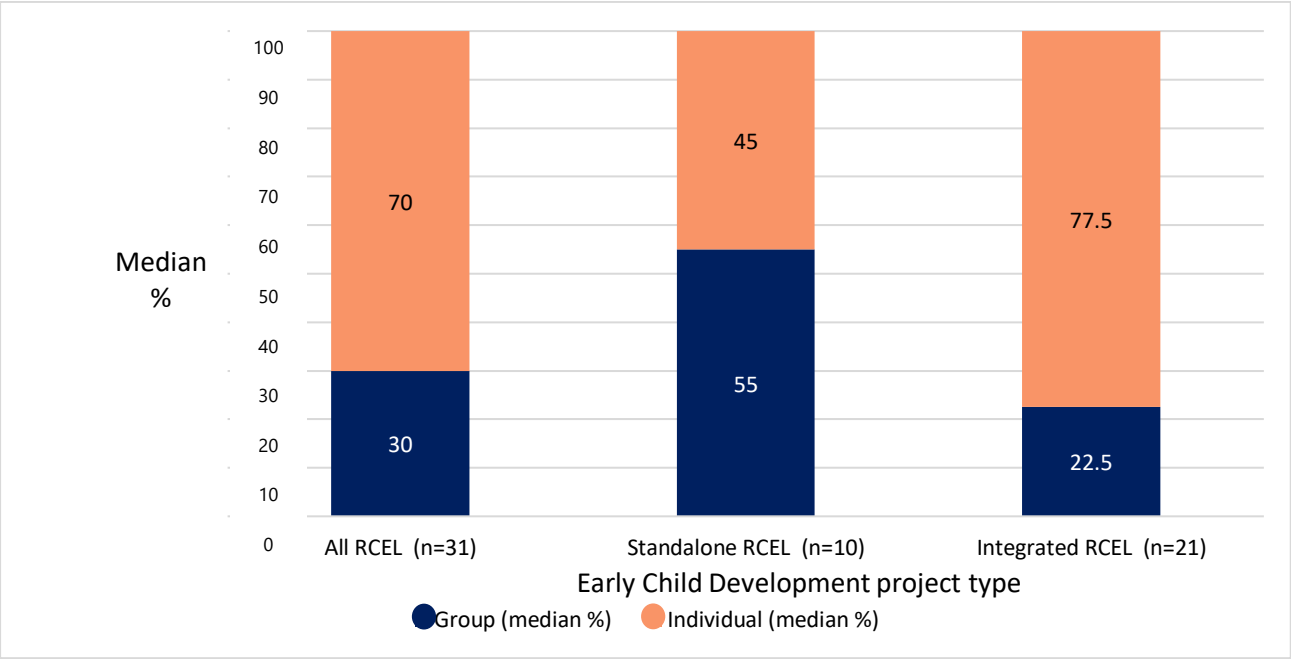
d) Retention of worker amongst responsive care and early learning (RCEL) projects according to method of incentivisation (N=29 projects)



Data reported from the Results-based Management and Analysis Framework (Web Annex Table A) reported from each project. Missing data from 3 projects. Piece rate=any irregular payment where pay is per task rather than fixed salary payment.

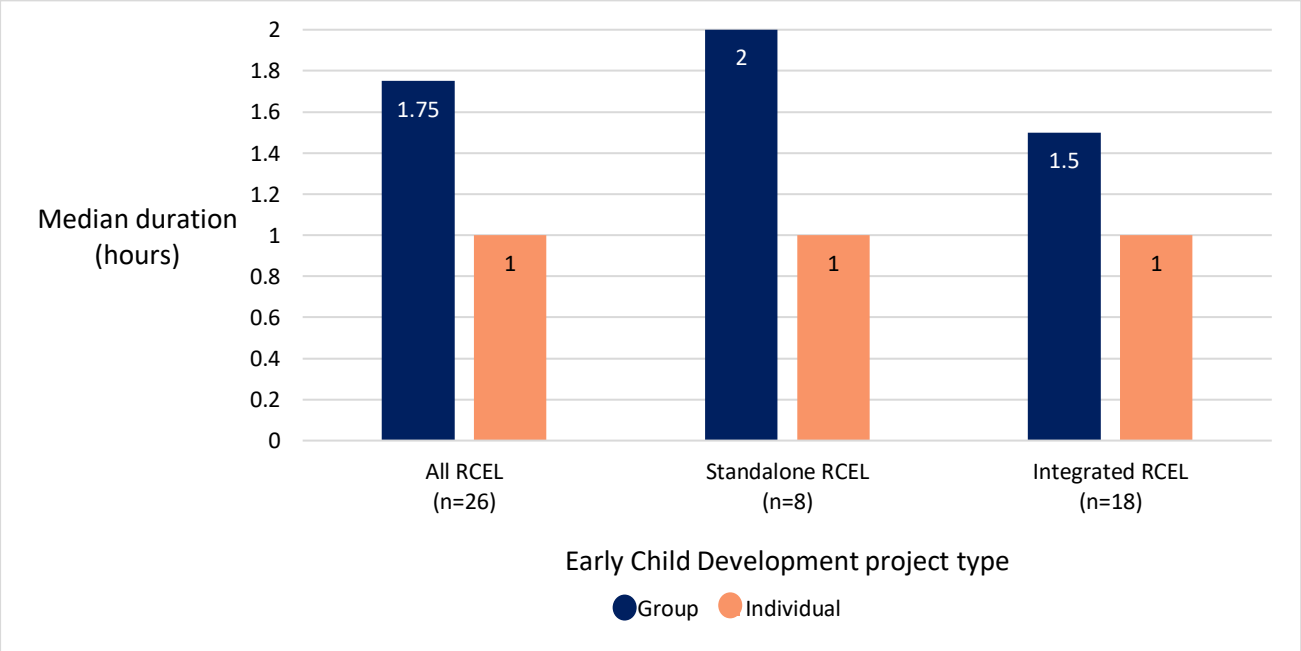
Figure 4: Method and duration of delivery of intervention curricula amongst Saving Brains portfolio responsive care and early learning (RCEL) projects

a) Method of project delivery: group vs individual by type of RCEL intervention project (N=31 projects)



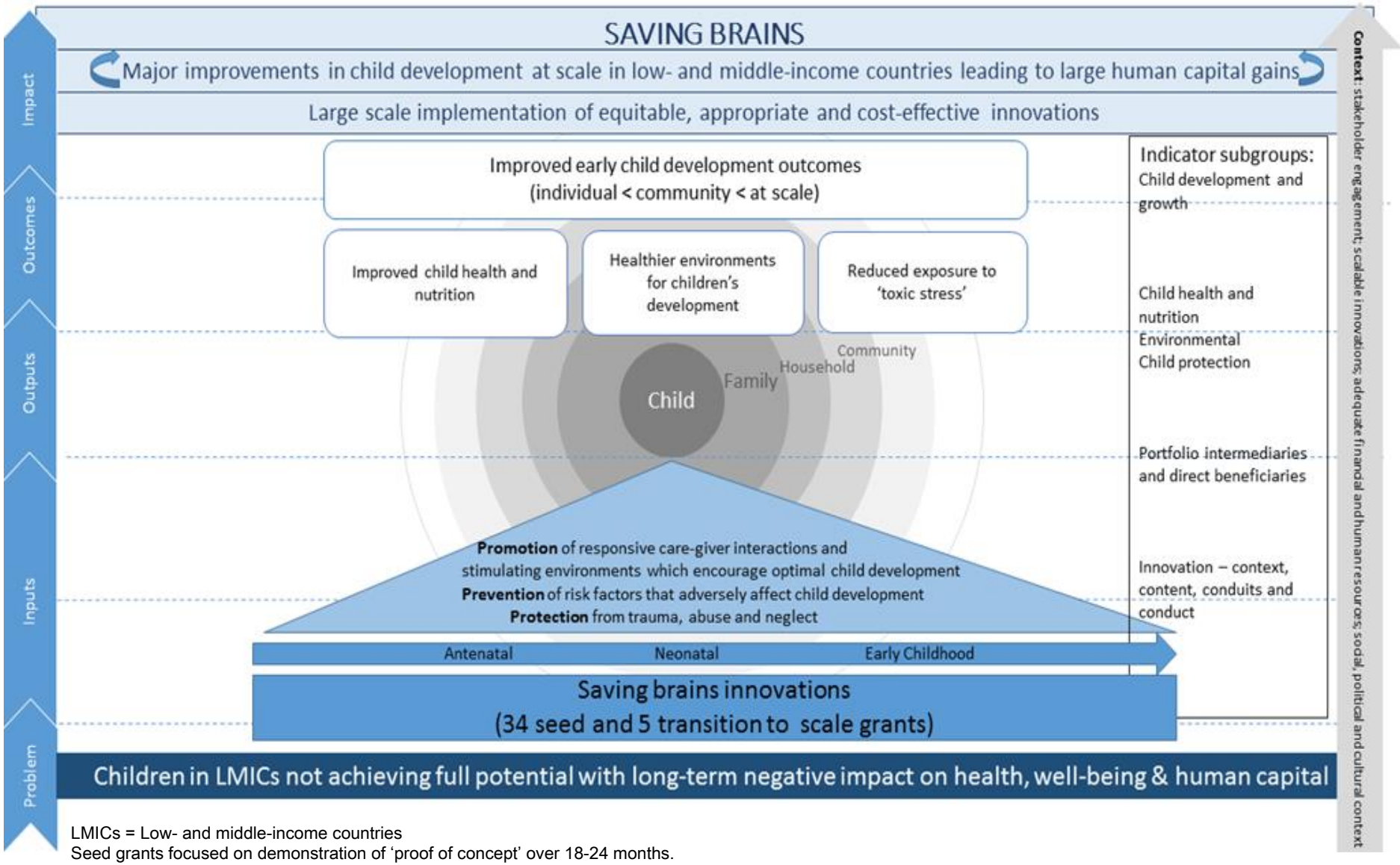
Missing data from 1 project.

b) Median duration of project sessions comparing projects delivering curricula in group vs individual sessions by type of RECL intervention project (N=26 projects)



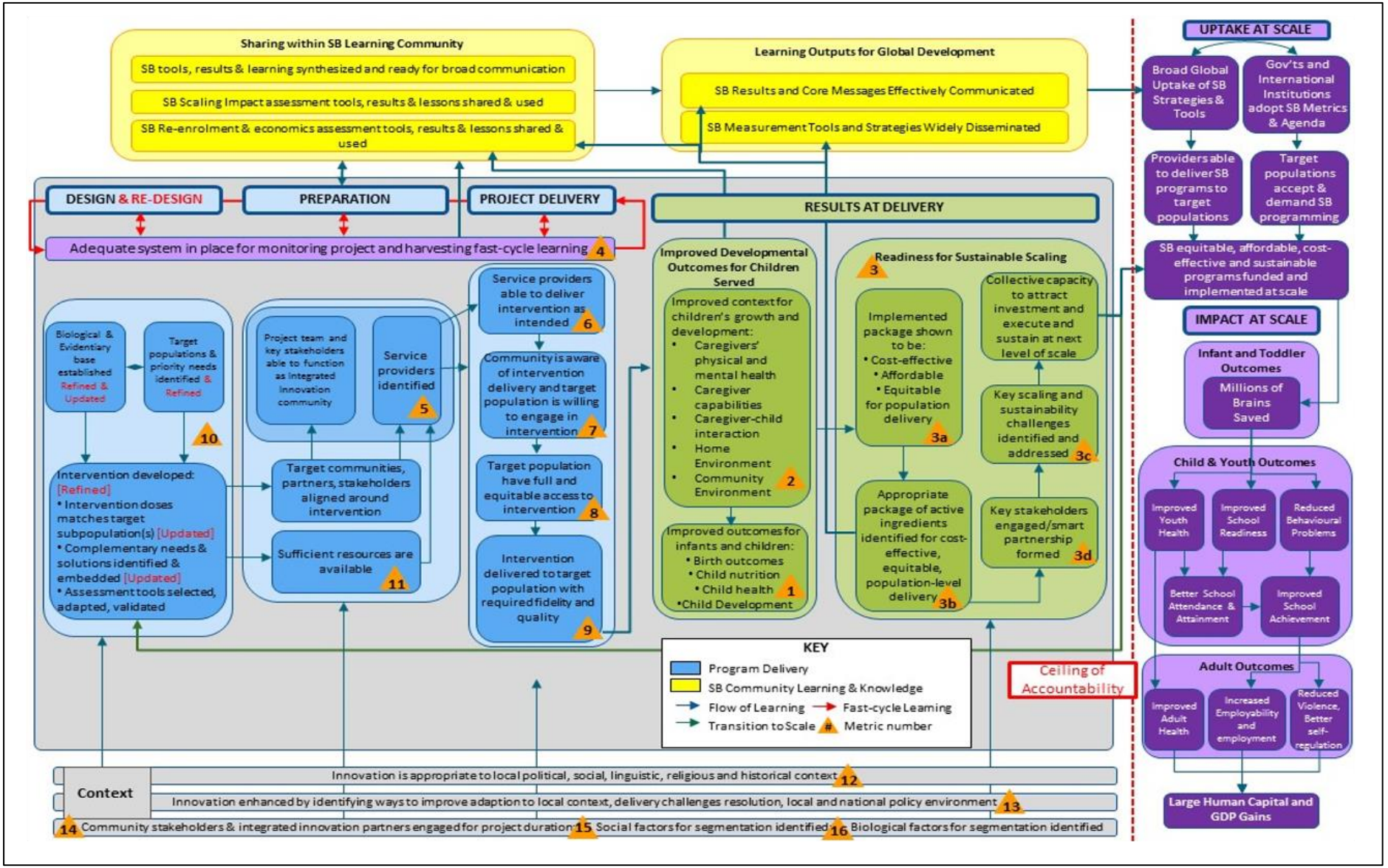
Missing data from 6 projects.

Web Appendix Figure A: Portfolio Conceptual Evaluation Framework



LMICs = Low- and middle-income countries
Seed grants focused on demonstration of 'proof of concept' over 18-24 months.
Transition to scale grants focused on progression towards scale in partnership with other organisations over 3 years.

Web Appendix Figure B: Saving Brains portfolio level Theory of Change



SB=Saving Brains

Note: Theory of Change was developed by Grand Challenges Canada Saving Brains platform members.

Web Appendix Table A: Data sources utilised for the Saving Brains portfolio evaluation

Data Source	Description	Timing of data collection	Organisation receiving data	Data type	Number of data source items
Service delivery forms	Document completed by grantees used to collect projected, interim and/or final and quantitative information on workforce and intervention delivery	Yearly	Grand Challenges Canada	Quantitative & Qualitative	32 (Endpoint service delivery forms)
Results-based Management and Accountability Framework (RMAF)	Framework completed by grantee which facilitates the collection of data and comparison of results around core metrics	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative	7
RMAF+	Framework completed by grantee developed from the original RMAF and Theory of Change containing more detailed metrics on impact, process and context of innovations (Round 3 onwards)	Six-monthly	Grand Challenges Canada	Quantitative & Qualitative	25
Progress reports	Narrative reports completed by grantees detailing project progression, challenges, lessons learned, results, dissemination and next steps	Six-monthly	Grand Challenges Canada	Qualitative	32
Research proposals	Proposal of innovation design completed by potential grantees	Point of application for grant	Grand Challenges Canada	Qualitative	32
Saving Brains community meeting transcripts	Transcripts from discussions between grantees and platform members at two Saving Brains community meetings	21st-22nd Jun 2016 25th-26th Oct 2016	London School of Hygiene & Tropical Medicine (LSHTM)	Qualitative	2
Key informant interviews	Key informants, including Saving Brains project leads, identified through professional networks and approached for interview on relevant themes	Jun-Oct 2016	World Health Organization & LSHTM	Qualitative	19
Grantee interviews	Grantees identified by LSHTM and platform members for thematic discussion	Jul-Sept 2016	LSHTM Qualitative	Qualitative	21
Focus group discussions	Grantees selected and invited to focus group discussions, either online or during Saving Brains community meetings, on workforce choices, supervision and training, and monitoring quality and coverage	Jun-Oct 2016	LSHTM	Qualitative	13 (4-10 participants per focus group discussion)

Web Appendix Table B: Interview and focus group topic guides from Saving Brains evaluation

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
Impact and outcome metrics question guide
Background Limitations of child development metrics pose a major challenge in policy and programming efforts to improve early child development outcomes in low- and middle-income country (LMIC) settings. Various initiatives are underway to improve measurement of outcomes at population and individual level (e.g. newly published data from McCoy *et al*, funded by the Saving Brains® Programme, Grand Challenges Canada®, providing the first global and regional estimates of the number of children failing to reach developmental milestones based on parent report measures.(1) However major challenges remain and collaboration is required to improve measurement of impact of interventions on child development outcomes at scale in low-resources settings.
Objectives To discuss as a group; 1. Different approaches to impact measurement that have been taken across the Saving Brains portfolio 2. Challenges and benefits of different approaches taken 3. Lessons learned for policy makers and programmers attempting to measure impact of early child development (ECD) interventions at scale
Questions 1. How has impact been measured across the Saving Brains portfolio? 2. How were decisions reached about impact measures used? What factors influenced these decisions? 3. How has use of these impact measures worked in practice? 4. How about intermediary outcome measurement in terms of environment, caregiver relationships etc.? 5. What have been the programming requirements to support this in terms of human resources, cost, timeline etc.? 6. Have measures used required translation and adaptation in your local context and if so, how has this been managed? 7. Do measures used include children less than 3 years and children with disabilities? 8. Could measures used within the Saving Brains portfolio be used if innovations were scaled up at National level? If so, how and what would be required to support this? If not, what alternatives would you recommend for programmers and policy makers? 9. Given the range of players involved, how can coordination within ECD networks be improved to support development of improved metrics? 10. Any other aspects of impact measurement that you think are important considerations which we have not covered?
Cadre question guide
Background Choices around human resources for implementation of ECD interventions have significant implications for effectiveness, sustainability and scale-up. Across the Savings Brains portfolio, a broad range of workers have been used to implement innovations with potential lessons for policy makers and programmers aiming to implement ECD interventions at scale in a range of contexts.
Objectives 1. To discuss the range of workers used to implement innovations across settings. 2. To discuss rationale for choice of workers used across settings. 3. To discuss programming implications with use of different cadres of workers.
Questions 1. What was the rationale for selection of worker type across different SB innovations?

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).

2. What challenges and benefits were noted with use of various cadres of workers across settings?
3. Where pre-existing categories of workers were used, what were the pros and cons experienced? How was the overall workload for individual workers managed when implementing 'additional' ECD intervention?
4. Where new worker groups were used, what were the pros and cons of this approach? How were issues of financing, governance and sustainability managed?
5. How were decisions around incentivisation reached?
6. Where community health workers were used, how were decisions reached around type of community health worker, level of training, supervision, equipment and incentivisation?
7. Where community health workers were used with the goal of improving equity and coverage of interventions, were these tracked? And if so, provisional recommendations or findings?
8. When thinking about decisions at a national scale, are there additional factors that need to be considered about human resources for implementation of ECD interventions?

Content (positive stimulation interventions) question guide

Background

Available evidence provides general guidance to policy makers and programmers about elements of positive stimulation interventions associated with increased effectiveness.(2) In particular, use of a structured evidence based curriculum, provision of opportunity to practice skills with the child, provision of feedback to the parent, adequate training and supervision for staff, integrated health, nutrition and ECD elements and both community and government support are thought to be important in intervention effectiveness.(2) There are also an increasing range of resources available to programmers implementing ECD interventions.(3, 4) However, from a practical perspective programmers still face detailed choices about intervention design and pros and cons of alternate choices in different settings may not be clear.

Objectives

1. To consider key intervention design questions raised when implementing positive stimulation interventions across the Saving Brains portfolio.
2. To consider how choices were made around these intervention design elements.
3. To consider relevance of lessons learned to programmers developing models for ECD interventions at national scale.

Questions

1. Across the Saving Brains portfolio what factors have informed choices about the following elements of positive stimulation interventions;
2. Target of intervention (e.g. parent, parent and child, child only)
3. Age of children
4. Number of contacts
5. Frequency of contacts
6. Duration of contacts
7. Chosen curriculum (with as much detail re actual curriculum as possible)
8. With regards to choices made, what has worked well and why?
9. Are there areas which have not worked well and if so, please describe?
10. Are there design elements that need to change to enable scale up and if so, please provide examples?
11. Any other elements that you consider important for programmers at national level to consider when developing models for implementation at scale?

NB *That questions re universal vs targeted and integration of interventions are asked elsewhere but could also be covered here.*

Delivery setting question guide

Background

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
ECD interventions are delivered in diverse settings in terms of geography, rural/urban, different sectors, facility/communities or home or often a mix of settings. Decisions about setting have implications for policy and on many aspects of programming.
Objectives To discuss as a group; 1. How decisions about implementation setting were made across the portfolio 2. Implications of those decisions, both positive and negative on program implementation and scale-up 3. Lessons learned for policy makers and programmers designing ECD programmes at national
Questions 1. How were decisions about the setting for implementation of your ECD programme reached (e.g. convenience, targeting of vulnerable subgroup, prior involvement with that sector etc.)? 2. What information did you use in deciding about the setting of implementation for your program? 3. Was there any information that if you'd had it earlier, would have altered your decision about setting? 4. Benefits specific to your setting? 5. Challenges specific to your setting? 6. What implications has setting choice had on the ease of program implementation? 7. What recommendations about delivery setting would you make to policy makers and programmers designing ECD programmes at national scale? 8. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Universal and targeted approaches
Background Universal approaches to improving ECD aim to increase protective factors and reduced risks for adverse child development at a whole population level. Targeted approaches are aimed specifically at children identified as having a higher-than-population-baseline risk of adverse developmental outcomes. While systems which provide both universal and targeted ECD interventions are ideal, in resource limited settings, some have suggested that services should initially be targeted to the most vulnerable.(5) Further, from a rights perspective, it can be argued that ensuring equity through inclusion of children with specific additional risk factors (e.g. disability, membership to ethnic minority subgroups etc.) is a priority, regardless of setting. There are however many challenges. While effectiveness of interventions may be greatest for certain vulnerable population sub-groups, with potentially favourable 'benefit to cost ratio' for investment, scaling up services to include those 'hardest to reach' may involve higher initial costs.2 These complexities pose challenges for policy makers trying to develop ECD programmes which are equitable but also provide sustainable coverage at scale.
Objectives To discuss as a group; 1. The rationale for selection of targeted versus universal approaches to ECD implementation in different settings within the Saving Brains portfolio. 2. Programming implications for both approaches 3. Requirements to inform policy makers in decisions about either universal or targeted approach to implementation
Questions 1. What was the rationale for selection of targeted versus universal approaches to ECD implementation in your context? 2. In interventions where a targeted approach was taken, how was the target population

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
identified (e.g. data driven, empirically, opportunistically)? 3. What are the benefits and disadvantages of a targeted approach in different settings? 4. What are the benefits and disadvantages of a universal approach in different settings? 5. What have been the programming implications of different approaches taken (e.g. human resources, training and supervision, financial)? 6. Have there been implications for financial sustainability and if so, moving forward, what strategies might be used to address these? 7. For interventions taking a universal approach, what strategies have been implemented to ensure inclusion of disadvantaged population subgroups including children with disabilities? 8. What recommendations about intervention targeting would you make to policy makers and programmers designing ECD programmes at national scale? 9. Anything further that you would like to highlight about implementation setting that we have not covered so far?
Processes for monitoring coverage and quality at scale
Background Processes to ensure quality and coverage are important for effective and equitable implementation of ECD interventions.(2) However, review by Yousafzai et al has highlighted the need for further consideration of implementation processes to facilitate more comprehensive guidance as to how to effectively implement interventions.(6, 7) The Saving Brains portfolio provides a unique opportunity to consider implementation processes in order to provide more detailed guidance for programming at scale.
Objectives To discuss: 1. Priorities in measuring quality and coverage of intervention. 2. Approaches used to monitor quality and coverage across the portfolio. 3. Considerations for monitoring coverage and quality of ECD interventions at scale.
Questions 1. What do you think are the 3 most important elements of 'quality' of implementation to measure? 2. What indicators have been most helpful in measuring these? 3. What processes of supervision and training have been developed to support this? (As much detail as possible re number of supervisors per worker, frequency, duration and mode of supervision) 4. What has been required to support monitoring of quality and coverage in terms of; 5. Data sources - are these procedures integrated into existing national data collection systems or stand-alone systems? 6. Technical and funding support? 7. Incentivisation of workers? 8. How have findings from monitoring been incorporated into ongoing implementation? 9. Would these approaches to monitoring of quality be feasible and appropriate for interventions delivered at national scale? 10. What strategies have been used to ensure equitable coverage of interventions? 11. What strategies have been used to reach the most difficult to reach populations including children with disabilities? 12. What challenges have been faced with regard to retention of participants? How have these challenges been overcome? 13. How would these approaches need modified for implementation at national scale?
Integration
Background Integrated delivery of ECD with interventions in other sectors is often recommended to promote holistic care of children and their families, to maximise synergies of interventions and for efficiency.

Thematic questions for key informant interviews and focus groups (Toronto Saving Brains Community Meeting (June 21-22 2016) and webinars (August 17, 24 and September 2 2016).
However, an integrated approach to service delivery also has many implications for programming.
Objectives To consider as a group; 1. Experience with integrated innovations across the Saving Brains portfolio in terms.
Questions 1. What has been the rationale for choosing ECD specific or integrated ECD approaches in different settings across the portfolio? 2. Where integrated approaches have been taken, how has this worked? 3. What have been the programmatic implications of an integrated approach in terms of; 4. Work-load for workers? 5. Training and supervision? 6. Equipment? 7. Cost? 8. Monitoring and evaluation? 9. How has governance across sectors been managed? 10. What are the implications of an integrated approach for implementation at national scale? 11. Are there other elements of an integrated approach which are important to consider in implementation of ECD programmes at national scale?
Questions for experts in the field
1. What do you consider to be priority needs for policy makers and programmers in implementing ECD programming at national scale, once a decision has been made to invest in early child development? 2. With regards to ECD programmes at scale, what do you consider to be the key design decisions for policy makers and programmers? 3. Given the challenges of measuring impact in ECD programmes and the constraints that this poses to progress in policy and planning, what do you see as next steps in improving developmental outcome metrics within programmes and at national scale? 4. If it were possible to monitor 3 indicators on the pathway to improving ECD at a national level, what would you measure and why? 5. What key lessons can be learned about cadres of worker for delivery of ECD interventions from other global child health interventions? In particular, what lessons around use of Community Health Workers (CHWs) are relevant for CHWs delivery of positive stimulation interventions in home settings?

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Web Appendix Table C: Key informants contributing to qualitative components of portfolio evaluation

	Organisation Type/Name	Position	Question theme
EARLY CHILD DEVELOPMENT (ECD) POLICY AND PROGRAMMING			
1	Saving Brains	Executive	ECD research, policy and programming; contemporary challenges and future directions.
2.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
3.	Multilateral UN organisation	Policy and programming.	ECD research, policy and programming; contemporary challenges and future directions.
4.	Private international ECD foundation	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
5.	International Financial Institution.	Policy maker.	ECD research, policy and programming; contemporary challenges and future directions.
6.	Multilateral non-government organisation.	Policy &programming.	ECD programming, iNGO perspective on what is needed to progress the field
7.	International Child Health Research Institution	Policy, programming & research.	ECD in global child health – challenges and future directions.
8.	Non-government disability-ECD organisation - national level.	Policy and programming.	Inclusion in ECD programming – iNGO perspective
9.	Ministry of Health, sub-Saharan African country.	Policy and Programming	ECD in global child health, health perspectives.
OTHER EXPERTS IN FIELD			
	General		
10.	Public health academic institution, UK	Senior Researcher	Research priorities in ECD
11.	Public health academic institution, USA.	Senior Researcher.	Challenges, priorities and approaches in future ECD research.
	Specific technical		
12.	Public health academic institution, USA.	Senior Researcher.	Impact metrics
13.	Public health academic institution, USA.	Researcher.	Impact metrics
14.	Public health academic institution, UK	Senior Researcher.	Impact metrics
15.	Multilateral UN organisation.	Senior Researcher.	Impact metrics
16.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, human resourcing.
17.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Implementation process metrics, cost-effectiveness
18.	Saving Brains Grant Recipient Research Institution.	Senior Researcher.	Integration.
19.	Academic Centre, USA.	Senior Researcher.	Implementation process knowledge gaps, priority questions and research methodology.
	Saving Brains Platform		
Members of the Saving Brains Platform team who were consulted about various aspects of the evaluation, their experiences working within the Saving Brains portfolio and in regard to specific technical, programming and research related themes.			
	Grantees		
Twenty-one of thirty-nine (54%) of research teams were specifically interviewed regarding their innovation and various aspects of their experiences within the Saving Brains portfolio.			

ECD=Early Child Development

Web Appendix Table D: Saving Brains responsive care and early learning (RCEL) Transition-to-Scale projects: Summary of challenges and course correction

Project Name	Transition to scale of an integrated program of nutritional care and psychosocial stimulation to improve malnourished children's development	An integrated intervention targeted at deprived pre-school children in rural areas	Home visiting programs to improve early child development and maternal mental health	Saving Brains, Changing Mindsets
HUMAN RESOURCES: CHALLENGES AND COURSE CORRECTION				
Interaction with existing services	Integration and coordination with health services in rural Bangladesh.	Competition from a new government-run parenting program, ICBF.	Integration into existing family health strategy home-visits increased visit frequency but reduced number of families visited. Local workers demanded financial incentives to deliver new project and prioritized pre-existing activities.	Issues encountered were gaining confidence and trust of construction companies, quality assurance of individual NGOs, securing adequate infrastructure, particularly as a decline in the construction industry slowed project progress
Adaptation for implementation	-	Shift required from didactic learning to 'demonstration and practice' method of learning. Supervision forms were adapted to type of data collected.	Busy schedule of Community Health Workers (CHWs) meant missed appointments were not rescheduled. Child Development Agents (CDAs) more frequently rescheduled visits. Supervision was jeopardised by existing heavy workloads and required intervention by project coordinator.	During scale-up, the focus remained on strengthening supervision quality of partner NGOs.
Training time commitment	Training schedule difficulty for government clinic workers was mitigated by split of training schedules to maintain clinic duty cover.	Long training time commitment was mitigated by incentivisation.	-	-
Staff recruitment / remuneration / retention	Salaried government workers expected incentivisation for additional work and some refused to conduct sessions; this was mitigated by motivational meetings and supervision.	Attrition of workers was mitigated through fast-track training programme. Workers in one affluent town did not value RCEL project, and tasks were unfamiliar to these workers (<3% of sample).	Difficulty in identifying CHWs to deliver intervention in addition to existing routine. High turnover of CHWs considering intervention too time consuming.	Difficulties in identifying sufficiently qualified workers, but not overqualified and viewed RCEL as 'beneath their station'. Initial high attrition rates as workers apprehensive about working with children <3 yrs. Changes made to training modules and selection criteria.
Supervision	-	Reticence from providers unfamiliar with close coaching was mitigated by promoting positive tutoring relationships. Implications and impacts from rurality of workers on supervision.	Supervision not considered a priority by supervisor priority requiring project coordinator to intervene, holding meetings with CDAs and performing supervised visits.	-
CONTENT: CHALLENGES AND COURSE CORRECTION				
Adaptation for implementation	Minor adaptations to Reach-up for the pair study and major adaptation for the group study. Adapted for use in community clinics instead of homes and to be used for fortnightly visits instead of weekly in both studies.	Simplification of curricula language to facilitate provider use. Reluctance to lend toys/materials led to introduction of toy library. Wide developmental age range in groups led to adaptation with more baby-friendly routines and sub-groups by age.	Reach-Up was adapted for twice monthly visits instead of the original weekly visit. Mothers did not like the toy's original appearance which they considered poor. Toy was redesigned to be more appealing.	During scale-up in other regions of India e.g. Bangalore, training module was contextualized, and nutrition menu adapted to the local context.
Materials	Complaints regarding quality of toys (parents) led to extended provider training to facilitate more 'fun' interactive	Initial reluctance for recyclable toy materials but toy-making workshops changed perceptions. Toy library	Materials required cultural adaptation. Adaptation guide needed to be clear regarding exactly what could be adapted	Materials were translated for regions requiring the desired learning materials.

	sessions and directions for making new toys.	developed to promote unrestricted use which was appreciated by caregivers.	and what concepts had to be maintained to guarantee fidelity.	
Recipient attendance, retention & incentivisation	Attendance challenges included distance to clinic, late start to sessions, and expectation of nutritional supplement. More timely attendance and stricter time-keeping encouraged. Incentivisation included oil supplementation distribution & caregiver motivational meetings.	High value of project nutritional package incentivised attendance. Tutors and providers supported problem-solving to overcome barriers to attendance (i.e. long distances, travel costs, job responsibilities etc.). Encouraging positive social interactions meant beneficiaries more motivated.	Beneficiaries had no other incentives but the program itself. The major cause of attrition was mobile populations due to rental accommodation. Mothers enjoyed and wanted to complete the programme.	-
References	(1-3)	(1, 4)	(1, 4)	(1, 5)

CDA=Child development agent, CHW=Community health worker, RCEL=Responsive caregiving and early learning

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