

**Supporting Early Communication Skills of Children with Developmental Disorders
in South Africa: Caregiver and Clinician Perspectives about Mobile Health
Applications**

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Abstract

Using a mobile health application (i.e. app) to empower primary caregivers of young children with developmental disorders in low- and middle-income countries is opening up new avenues for early childhood intervention. Thirteen caregivers and ten speech-language pathologists participated in three focus groups to explore their perspectives about the potential benefits and suitability of a mobile health app as part of intervention, its features, the likelihood of using and recommending it, as well as potential pitfalls to be avoided. Both participant groups were generally positive, although there was little overlap between their responses. Caregivers generally focused on increased knowledge and skills (of all family members), as well as on empowerment and reduced costs. Speech-language pathologists on the other hand focused on how current service delivery would be enriched by increasing the dosage of therapy and enhancing parental cooperation. They also expected that the reach of service delivery would be expanded as more children and caregivers could potentially benefit. Although technology (i.e. mobile apps) could open up new possibilities for service delivery in this population, the perspectives of all stakeholder groups should be considered to ensure successful adoption of such technologies.

Keywords

Beginning communicators; developmental disabilities; early communication intervention, focus groups; low- and middle-income country; mobile health technology; parent training, primary caregiver; speech-language pathologist.

Introduction

Many early intervention programs attend to the world's most vulnerable children (Guralnick, 2000; 2008). Research estimates that more than 200 million children under five years of age in low- and middle-income countries (LMICs) are not fulfilling their developmental potential (Morelli et al., 2017). This number includes children with developmental disorders (DD), which comprise intellectual disability, autism spectrum disorder, cerebral palsy and other genetic disorders. These children are at extremely high risk for developing speech and language disorders secondary to their primary condition. Speech and language disorders do not only result in great difficulty communicating with others including caregivers, families, peers, and health care providers and further negatively impact the child's growth, long-term development, and contribution to society. One component of Early communication intervention for these children may include teaching parents and other primary caregivers to provide communication opportunities in play and in activities of daily living to stimulate the development of beginning communication skills (Adamson, Ronski, Bakeman, & Sevcik, 2010; Kaiser & Hancock, 2003; Roberts & Kaiser, 2015; Ronski, Sevcik, Adamson, Smith, Cheslock & Bakeman, 2011; Sevcik, Ronski, & Adamson, 2004).

Early intervention services, including parent instruction, are challenging in LMICs due to a plethora of factors. South Africa, for example, is a country characterized by language, cultural, ethnic and religious diversity that faces enormous challenges due to the legacy of apartheid in the form of limited access to education, social and health services (Huus, Dada, Bornman, & Lyngnegård, 2016). For children under 6 years of age, rehabilitation services are typically provided in public hospitals (government-funded) as part of primary health care, at a rate of once a month and very often in a group setting. At the age of 6 – 9 years old, children with disability

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will start attending special schools. Research also shows that that a significant number of children with disabilities are either not identified, or do not access healthcare (Redfern, Westwood & Donald, 2016). Moreover, these services are typically fragmented (without integration between different sectors of service delivery and disciplines) and not family – focused, negatively impacting the quality of care, and underscoring the important role of the family. A small minority of urban parents (not the focus of this paper) are able to afford private health care. High maternal and infant mortality rates as well as high incidence of communicable diseases such as HIV/Aids and tuberculosis prevail; literacy levels are poor, unemployment rates are high and many people live below the poverty line (Statistics South Africa, 2011). As a result of impoverishment, many South African families cannot afford the resources that are required to support their children’s development (Nelson Mandela Foundation, 2005).

The contextual factors mentioned above cause critical barriers in LMICs that seriously hamper interventions aimed at remediating children’s communication difficulties. For example, in South Africa, children with developmental disorders (and their families) often live far from rehabilitation hospitals where speech and language intervention services are provided. They typically live in extended families with many adults and children (Donohue, Bornman, & Granlund, 2015). With 11 languages granted official status, families and speech language pathologists (SLPs) often have diverse linguistic backgrounds, which sometimes necessitates the use of interpreters. Moreover, health care providers like SLPs have overwhelmingly large caseloads that result in reduced access to interventions (Kathard & Pillay, 2013).

Many early communication intervention programs are grounded in a transactional theory that teaches parents to maximize children’s development by creating engaging and stimulating learning opportunities (Stockwell et al., 2019). These authors describe specific strategies such as

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taking equal turns in communication, starting interactions, responding contingently and increasing the range of communication purposes for children. Their strategies for parents include reducing the directiveness of their communications and increasing their responsiveness to the children's communication attempts (Brady, Warren, & Sterling, 2009).

In order to optimize parent participation, a variety of instructional approaches have been used, such as didactic presentations, home visits, coaching, group discussions, role play, instructional videos and problem-solving tasks. More recently, the increased use of smartphones globally has been changing service delivery. Clinicians in the United States (US) have reported that parents are sharing video recordings with their SLPs to show examples of their child's behavior (Stockwell, 2019). Mobile phones also have been used with some success as a vehicle for promoting parent engagement and enhancing parenting outcomes with 371 mothers and their 3.5 – 5.5-year-old children in low-income families in the US (Carta, Lefever, Bigelow, Borkowski, & Warren, 2013). The randomized control trial used by Carta et al. (2013) successfully demonstrated that the mothers who received supportive text messages (in addition to the traditional parent training) implemented the strategies to encourage child interaction more frequently than the mothers who did not receive such messages. The mothers who received the text messages also experienced not only greater reductions in stress and depression, but also enhanced maternal responsiveness. Despite some studies focusing on parents in low-income families, much of what we currently know about positive parenting is based on research in high-income English-speaking countries (Morelli et al., 2017).

The central aim of this study was to explore the perspectives of both primary caregivers and speech language pathologists in South Africa, who provide services to preschool children with developmental disabilities, about the use of an application (i.e. app) on a mobile device to

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support beginning communication skills. The study investigated the potential benefits and suitability of this type of app and examined its envisaged features in a multi-lingual LMIC context as well as the potential pitfalls that should be avoided in app development. The collection of stakeholder perspectives is an important first step towards the development of mobile health applications when using a participatory design approach. Participatory design permits a focus on partnership and equality and will directly affect the content and clinical usability of new technology applications (Smith, Wallengren, & Öhlén, 2017).

Methods

Study Design

When the aim of a study is to explore stakeholder perspectives as part of a participatory design process, focus groups are particularly effective. The interaction between group members encourages participants to query one another and explain themselves, thus allowing their reasoning to become apparent (John, Knott, & Harvey, 2018). Focus group methodology was selected for the current study, as group dynamics can stimulate discussion and help participants conceptualize issues in greater depth than can be done with other methodologies (Wibeck, Abrandt Dahlgren, & Öberg, 2007). It also permits the collection of a rich data set of primary (caregivers of pre-school children with DD) and secondary (SLPs with expertise in providing services to children with DD) stakeholder perspectives (Whittingham, Wee, Sanders, & Boyd, 2011). The analytic methodology used for this study was thematic analysis, a widely used descriptive qualitative methodology (Clarke & Braun, 2013).

Participants

Purposive sampling that ensures rich data was used to recruit participants with a wide range of experiences and/or knowledge of service delivery to so-called “beginning

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communicators". Caregivers were recruited from a parent support group for children with DD in the Gauteng province of South Africa, while SLPs were recruited from public hospitals in the same geographical area providing services to these families. Researchers visited one of the monthly meetings of both the parent support group and the SLP staff meeting, and explained the purpose of the research, as well as what would be required from potential participants. The informed consent letters were distributed, and a time, later on the same day, was set for the focus groups. At the agreed upon time, the participants completed the informed consent letters as well as a short custom-designed demographic questionnaire prior to participating in the focus groups. Primary caregivers with low literacy were supported by the fourth author (who also acted as the focus group moderator).

Ten primary caregivers of children with DD (Mean age = 4;9 years; range from 2;0 to 6;11 years) from a low socio-economic peri-urban context participated in Focus Group 1. They were mostly mothers ($n=8$), although one grandmother and one aunt also participated. Their ages varied with three being between 21-30 years of age, two being between 31 and 40, four being between 41 and 50, while one was older than 60 years of age (Mean =39;3 years SD =12;7 years). Two of the participants had no formal education, four had some schooling (Gr 1 – Gr 11) and two completed twelfth grade. One was employed on a full-time and four on a part-time basis, and five were unemployed.

Thirteen SLPs, all registered with the Health Professions Council of South Africa (HPCSA) and working as service to beginning communicators and their families at public hospitals in low-income peri-urban areas, volunteered to participate. They were split into two separate but comparable focus groups, seeing that focus groups with more than ten participants may disintegrate and become difficult to manage. For this reason, Nyumba, Wilson, Derrick and

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Mukherjee (2018) suggest a group size of between five and eight participants. The age of the 13 SLPs varied with three being between 20 and 25 years of age, six being between 26 and 30 and four being 31 years old or older (Mean =29;7 years SD =7;2 years). Eleven of them had bachelors level SLP qualifications with one each holding a Masters and PhD degree respectively. Regarding experience, three had less than one year's experience, six between one and six years, one between seven and ten years and three had 11 or more years of experience (Mean years of experience = 5;2 years). Twelve had only hospital experience and one also had prior experience in private practice.

Procedures and Materials

Ethics approval to conduct the study was obtained from the relevant Ethics Committees and Institutional Review Boards in both South Africa and the US before participant recruitment commenced. To ensure meaningful and valid informed consent from the research participants, the informed consent letter used short, concise sentences, without technical terms, with pictorial support, in both written and spoken format (Kadam, 2017).

Three 60 to 90-minute focus group discussions were held. Focus Group 1 (with primary caregivers) was conducted in the community hall where members of the support group typically meet on a monthly basis. As the focus group was conducted directly after a regular monthly meeting, participants incurred no additional travel costs. Focus Groups 2 and 3 (SLPs) were conducted at two different hospitals, at a time convenient for the SLPs in order to not disrupt their service delivery.

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Table 1: Focus group script

Aspect	Detail (purpose and content)
Welcoming	Welcome participants and thank them for their time and participation. Establish a friendly, open and inclusive atmosphere to put all at ease and to establish rapport.
Purpose statement	Discuss the purpose of the study in an accessible manner (using informed consent letter) to ensure that informed consent is upheld.
Setting ground rules	Provide instructions of what is expected from participants and set ground rules such as: all ideas are welcome; sidebars (separate conversations, or eye-rolling) are not acceptable; they have the right to challenge, respectfully criticize and/or disagree with other participants during the focus group and they may ask for clarity of examples.
Asking key questions to elicit information relevant to the aims of this research	Ask the following four key questions for the purpose of this research: <ol style="list-style-type: none">1. Do you think than an app that suggests communication strategies, similar to a SLP home program, between the monthly hospital visits would be valuable? Why /Why not?2. What should an app look like (features) to help you/the families you work with as much as possible?3. What are the potential problems we should avoid if we develop such an app?4. If the app was available, would you recommend it to other caregivers like yourself or to the caregivers that you serve?
Closing	Summarize the answers for the four questions and invite participants to add any additional comments or make any corrections. Conclude the focus group by thanking participants for sharing their ideas.

Prior to data collection, a focus group script with five broad sections was developed (see Table 1) to ensure consistency across the three groups (Naudé & Bornman, 2017). The focus groups began with brief introductions as part of welcoming participants followed by an outline of the purpose of the study during which participants were reassured that no prior experience with mobile health practices was needed and they were encouraged to base their discussion on their

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own experiences. The key questions were then asked as shown in Table 1. Participants in all three focus groups became involved in the process and generated interesting ideas. Questions were terminated when participants agreed that they had nothing further to add. At the end of each of the four key questions, the moderator provided a summary of the discussion. Participants confirmed that this was a true representation of their experiences and added more information where applicable – in other words, member checking was done. All participants were actively involved in this process, which increased the accuracy of the data (Johnson, Nilsson, & Adolfsson, 2015). Groups were audio-recorded and the discussions were subsequently transcribed verbatim.

Data Analysis

Conventional qualitative analysis is an appropriate content analysis method for studies that aim to describe a phenomenon, or for concept development. Using the verbatim transcripts, the participants' discussions were analyzed qualitatively using a conventional descriptive thematic analysis (Clarke & Braun, 2013; Hsieh & Shannon, 2005). During the thematic analysis, patterns within the data (themes) were identified by reviewing and comparing the transcripts. The data was reported in a manner that maintained the rich detail of the group interaction (Whittingham et al., 2011).

The researchers initially familiarized themselves with the data by reading each transcript from beginning to end and exploring the essence of the three focus group discussions. Next a careful, in-depth line-by-line reading was done, highlighting in the margin key words or phrases that appeared to describe a specific theme related to the question asked. These developing themes were grouped across the three focus groups by similarity of content and/or meaning to answer the four specific questions. As the authors worked through the transcripts and searched

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for themes, they attempted to limit these developing themes as much as possible. Thereafter, the themes were reviewed, and a coding framework was created to reflect the main themes and subthemes, based on their linkages (Hsieh & Shannon, 2005). All transcripts were then coded using this framework.

Trustworthiness

The study was designed to maximize trustworthiness. Credibility (internal validity) was obtained through peer examination and detailed discussions among the authors during the different phases of the study. They attempted to ensure a valid interpretation of the data that did not reflect a biased perspective and, through member checking, provided participants an opportunity to correct factual mistakes and volunteer new information (Lincoln & Guba, 1985). Transferability (external validity) was increased by using three independent groups from two different stakeholder groups to ensure multiple perspectives (John et al., 2018).

Results

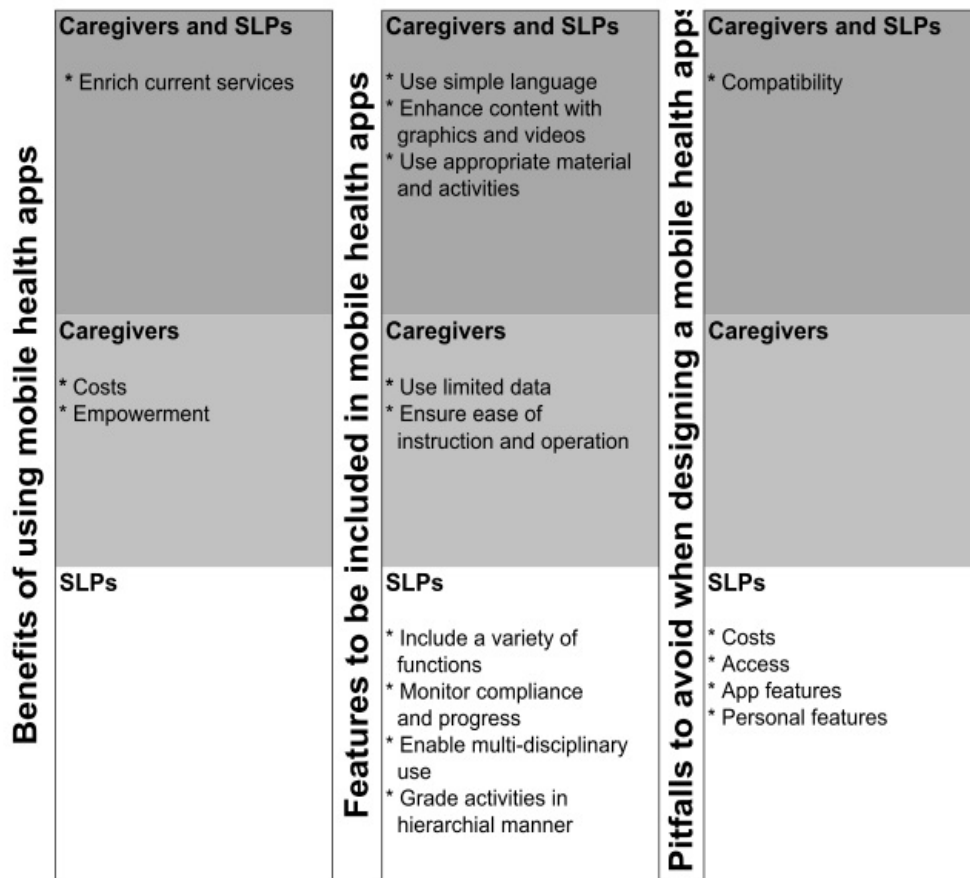
Participants were asked to describe their internet access and smartphone use. The ten primary caregivers and thirteen SLPs respectively accessed the internet either through Wi-Fi only (0%, 85); through Wi-Fi and 3G coverage (40%, 15%), or through mobile carrier only (40%, 0%). Twenty percent of primary caregivers did not use a smartphone for internet access. Primary caregivers and SLPs respectively typically used smartphones at home (40%; 100%), in the city (30%; 38%), or elsewhere (30%; 46%). SLPs indicated more than one place in which they typically used their smartphones. Both groups reported that the main limitation to using the internet on their smartphones was cost (70%, 77%). Only 10% and 15% respectively reported internet connectivity and coverage as the main limitation. Primary caregivers typically spend between R0 – R50 (approx. \$3.50 USD) on data per month, while all SLPs reported spending

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more than R50. While 90% of primary caregivers reported that they were willing to spend up to R30 on an app, 77% of SLPs usually only download free apps.

The following results are organized and discussed according to the themes that were identified for each of the four key focus group questions. A schematic overview is presented in Figure 1.

Figure 1: Schematic representation of results



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Table 2: Potential benefits and suitability of using an app as part of service delivery

Themes	Sub-themes	Primary caregivers	SLPs
Costs	Reduce costs	<ul style="list-style-type: none"> • Save on transport costs 	
Empowerment	Empowerment	<ul style="list-style-type: none"> • Empower mothers 	
	Increase knowledge and skills	<ul style="list-style-type: none"> • Complement mother’s existing knowledge • Increase mother’s knowledge and skills 	
	Provide knowledge on stimulation activities	<ul style="list-style-type: none"> • Provide ideas for new activities to do with child at home 	
	Enhance problem-solving skills	<ul style="list-style-type: none"> • Enable on-the-spot problem solving 	
	Increase motivation		<ul style="list-style-type: none"> • Act as motivation for parents when they see improvement in children
Enrich current services	Increase intervention opportunities	<ul style="list-style-type: none"> • Help other family members (e.g. dads) to do therapy at home when mom is away 	<ul style="list-style-type: none"> • Other family members can participate in intervention goals
	Reminder of therapy goals		<ul style="list-style-type: none"> • Can act as a reminder for parents of therapy goals
	Track progress		<ul style="list-style-type: none"> • Will assist with generalization of intervention goals and track progress
	Provide alternative to paper-bound home programs		<ul style="list-style-type: none"> • Hard-copy therapy programs get lost • Will decrease printing costs of home programs

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Increase compliance	<ul style="list-style-type: none">• Will increase parent cooperation and` compliance
Increase dosage	<ul style="list-style-type: none">• Will increase amount of input child is receiving
Facilitate transition between therapists	<ul style="list-style-type: none">• Can assist with continuity of intervention if hospital SLP changes
Increase reach of service delivery	<ul style="list-style-type: none">• Act as alternative method of providing more resources to children in public health care

Firstly, participants were asked to describe the potential benefits and suitability of using an app on a mobile device that would coach caregiver techniques when prompting beginning communication skills (Table 2). Many benefits were identified by the primary caregivers and the SLPs, although there was little overlap between them. The only overlap involved increasing intervention opportunities to a broader set of family members. Caregivers reported that mobile health applications empowered mothers by increasing their knowledge and skills. Using mobile apps also reduced the costs of therapy, as transport costs would be reduced. SLPs reported that current service delivery would be enriched when dosage of therapy, parental cooperation, and reach of service delivery could be extended to more children and caregivers.

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Table 3: Features of a mobile health app as part of service delivery to ensure suitability in the current context

Themes	Primary caregivers	SLPs
Use simple language	<ul style="list-style-type: none"> • Should use simple English to allow easy translation to first language 	<ul style="list-style-type: none"> • Should be in the first language of the family • Should use easy language
Enhance content with graphics and video	<ul style="list-style-type: none"> • Must use pictures and videos with voice guidance 	<ul style="list-style-type: none"> • Should enable both parents and SLPs to upload photos and videos • Activities should have voice overs to describe activity (pictures with sounds) • Can have same videos but with different voice overs
Use limited data	<ul style="list-style-type: none"> • Apps must use little data 	
Use appropriate materials and activities	<ul style="list-style-type: none"> • Materials used in app must be readily available at home, not complicated toys or items 	<ul style="list-style-type: none"> • Use culturally appropriate and applicable activities and toys
Grade activities (hierarchical)		<ul style="list-style-type: none"> • Should be able to grade activities from easy to more complex
Ease of instruction and operation	<ul style="list-style-type: none"> • Must be user friendly and easy to understand, e.g. step-by-step instructions 	
Include a variety of functions		<ul style="list-style-type: none"> • Should have many activities and strategies to allow SLP to select interactive tool between parents and SLP (calling, voice messages, texting) • Can be a tool for parent to ask therapist questions • Can act as a reminder of interventions with pop-up notifications

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Monitor compliance and progress	<ul style="list-style-type: none">• Can record parents while performing activities so that SLP can watch – this will show child in home and familiar environment• Should have a notification feature to remind parents• Can be used for data logging• To know that parents received the message (two blue ticks on WhatsApp)• To act as monitoring system to show that parents actually performed activities• To check as a checklist for tracking progress (e.g. completed five of the ten activities)
Enable multi-disciplinary use	<ul style="list-style-type: none">• Can assist multiple professionals (not only SLPs) as we work in multi-disciplinary teams
Include personal aspects	<ul style="list-style-type: none">• Should portray SLP as a warm and caring professional

Secondly, questions were asked regarding what participants thought the features of such an app should be (Table 3). Both caregivers and SLPs suggested that the app should use pictures and videos with voice guidance. The materials used in the app must also be culturally appropriate and readily available in the home. The primary caregivers suggested Easy English, a style of writing that has been developed to provide understandable, concise information for people with low English literacy, so that they could readily translate messages into their first language. Although the SLPs also suggested easy language, they thought the app should be in the family's first language. The primary caregivers further recommended that the app should use little data and that instructions should be user friendly and easy to understand. The SLPs suggested that additional features be included to facilitate regular communication between themselves and the

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caregivers, to monitor parent implementation of the home program and to track the child’s progress.

Participants were then asked if such an app existed – they would be willing to recommend it (Table 4). Both groups of participants indicated that they would recommend the app, if it had the benefits and features that were previously discussed.

Table 4: Likelihood to recommend an app as part of service delivery in the current context

Themes	Sub-themes	Primary caregivers	SLPs
Knowledge, skills and needs	Addresses knowledge, skills and needs of the family	<ul style="list-style-type: none"> • Yes, if new things are addressed that enhance mother’s experience • Yes, it will help others with less knowledge if you share • Yes, mothers of children with disability think that therapy doesn’t work for their children – if I pass on the knowledge about having an app for therapy activities, they might want to use it rather than take their children to therapy. 	<ul style="list-style-type: none"> • Yes, if applicable to family and child’s needs • Yes, if it provides option of customization to meet individual therapy goals and clients’ needs
	Building infrastructure for intervention	<ul style="list-style-type: none"> • Yes, if you tell others, it might be their first access to resources (SLP services at hospital), even in rural areas 	

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	Facilitating frequency of early intervention	<ul style="list-style-type: none"> • Yes, if it gives the opportunity to start intervention earlier and more times
	Compliance	<ul style="list-style-type: none"> • Yes, if it has the potential to increase therapy compliance
	Multi-disciplinary usage	<ul style="list-style-type: none"> • Yes, if it can translate to strategies used in other disciplines, as a whole team works with child
Practical aspects	Acceptance by family	<ul style="list-style-type: none"> • Yes, if family accepts it and is willing to use it
	Costs	<ul style="list-style-type: none"> • Yes, if its affordable, available and feasible and if family already has a smartphone
	Relevance and suitability	<ul style="list-style-type: none"> • Yes, if app provides good strategies and solutions • Yes, even if activities don't work for my child, because other children might still benefit
	Ease of use and training	<ul style="list-style-type: none"> • Yes, if specific design features are considered • No, not if it shows strategies, but if it shows activities then yes – then I will support it • Yes, if training is provided to SLPs on how to use the app

Finally, participants were asked to think about the potential pitfalls (related to a mobile health app that supplements existing interventions) that should be avoided during the app development phase (Table 5). The primary caregivers focused on challenges such as the compatibility of networks and devices. The SLPs, on the other hand, emphasized cost, access, and features of the device and the app, as well as the dangers of losing interpersonal interaction.

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Table 5: Potential pitfalls to be avoided during app development

Themes	Sub-themes	Primary caregivers	SLPs
Compatibility	Network challenges	<ul style="list-style-type: none"> • Different networks exist – app needs to be comparable with all 	<ul style="list-style-type: none"> • Should be able to use app even when there is no network available
	Smartphone challenges	<ul style="list-style-type: none"> • App should be able to run on different smartphones 	
	Compatibility across devices	<ul style="list-style-type: none"> • App should be compatible with other devices (e.g. tablet) if smartphone fails 	
Costs	Cost of device (smartphones)		<ul style="list-style-type: none"> • Smartphones are not freely available because of cost
	Costs of app		<ul style="list-style-type: none"> • App should not increase financial costs
	Cost of data		<ul style="list-style-type: none"> • Data should be accessible and costs of downloading and uploading information must be minimized • Avoid activities that will require downloading because of data cost implications
Access	Electricity		<ul style="list-style-type: none"> • Limited access to electricity
App features	Contained information		<ul style="list-style-type: none"> • Be user-friendly • Shouldn't provide too much information
	Appropriate language use		<ul style="list-style-type: none"> • Don't use difficult language • Avoid medical jargon on app
	Cultural appropriateness		<ul style="list-style-type: none"> • Activities should be culturally and functionally appropriate and applicable

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	Literacy level	<ul style="list-style-type: none"> • Should not require high level of literacy skills
	Novelty	<ul style="list-style-type: none"> • App should offer something new that distinguishes it from other apps
	Limit device interference	<ul style="list-style-type: none"> • App shouldn't freeze or crash the smartphone • App shouldn't drain phone's battery • Consider app size - if app is too big, phone is slowed down
	Therapist controlled	<ul style="list-style-type: none"> • SLPs should first be taught how the app works • Therapists should control activities – only activities selected by therapists should be available
Personal features	Therapist-family interaction	<ul style="list-style-type: none"> • Personal interaction between carer and SLPs could be lost • Should have a “privacy setting” – should not allow parents to contact SLP outside working hours • The app shouldn't discourage parent from continuing with monthly intervention at hospital and “replace” the SLP

Discussion

Primary caregivers of young children with DD and SLPs in South Africa clearly had different perspectives about the value and use of such an app. Much of these areas of difference (tensions) involved power (knowledge and mandate to decide), content (who controls what should be included on the app; form of language used; enhancing app with videos; pictures and voice overs), organization (layout content and activities used; user interaction) and clinical usability (applicability to the context).

The caregivers' views on the potential of an app as part of their child's intervention were extremely positive and they regarded it as an empowering tool. They expected the app to build their knowledge and skills, and to meet some of their intervention needs regarding how to communicate with their child, and how to engage with their child in a stimulating way (e.g., through learning specific strategies and activities). They also spoke about the potential of such an app, stating that even if they did not think that it would work for their child, they could see the potential worth for others. In other words, caregivers saw this potential app as a way to increase their competence with regard to participation in their child's intervention at home. In his seminal work on parent-professional work, Rosetti (2001) described how caregivers often feel "disenfranchised" as they are expected to relinquish control to others, such as the SLP – without any real control over the process taking place – becoming mere spectators. Therefore, it is interesting to note that caregivers saw such a potential app as equipping them with specific competencies through teaching them communication strategies which ultimately lead to empowerment. SLPs on the other hand voiced concerns that the app may be seen as a replacement for traditional home therapy programs, but acknowledged that it could be used to monitor compliance with therapy and track the child's progress.

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Smith et al. (2017) argue that power and knowledge and the relationship between them can be explained in at least three ways: i) as a resource owned by the powerful experts (in this case SLPs) and transformed to the powerless (in this case the caregivers); ii) as being controlled by the powerful, where the powerless are sometimes invited to participate in the agenda set by the experts; and iii) as being co-constructed by all parties participating in knowledge production. Although the aim of this paper was to look at knowledge and power from the third viewpoint (i.e. including both the caregiver and SLP stakeholder groups), it appeared as if the participants focused on the first two viewpoints, with the caregivers frequently mentioning their need for “empowerment”.

Strengths and Limitations of the Study

Using focus groups as part of a larger participatory design approach is productive but time consuming. Although we cannot be sure that this study captured the complexity of all potential aspects that should be considered when attempting to develop an appropriate person-centered app, the fact that it explored the perceptions of 23 heterogeneous stakeholders (both primary caregivers and SLPs) definitely broadened the depth and enhanced the appropriateness of the information obtained. It would have been helpful to also hold a focus group discussion with app developers, as their perspectives regarding what is practical and feasible regarding this type of app development would have enhanced the general understanding of this topic.

Future Research Directions

Based on the results of this study, a mobile health app aimed at empowering caregivers of children with DD by providing them with custom-designed and appropriate knowledge and skills to develop their children’s beginning communication abilities should be developed. Regarding the features of the app, a number of considerations should be incorporated. The app should work

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across different devices and platforms (iOS and Android); it should integrate multiple languages based on location; it should include culturally appropriate content; it should use both photographs and video; and it should be able to track progress (e.g. with a weekly satisfaction score and a progress bar).

Following the development of such an app, assessment of its potential to enhance speech and language intervention services in LMICs like South Africa will be important. Assessment should not only consider how the addition of a parent-training app changes the child's communication development, but also how caregivers and SLPs view the app. The following hypothesis can be tested: *Children with DD whose primary caregivers receive a communication intervention that includes the parent training app will have more developed beginning communication skills than a comparable cohort of children with DD whose caregivers do not receive the app.* For example, a randomized control trial should be conducted in which child and caregiver communication skills, as well as caregiver and SLP satisfaction with child communication intervention, could be measured pre- and post-intervention.

The current study should also be replicated in a high-income country (HIC) to determine stakeholder perspectives, as the aspects addressed may or may not be the same. Maneuvering between existing knowledge in two different contexts (e.g. LMIC and HIC) and reflecting on the differences and similarities between them, forms part of building an on-going global knowledge base that will have a positive impact on future research and service delivery.

Clinical implications

The study in hand addressed a critical question related to SLP service delivery in LMICs and thus the results hold significant clinical implications. The advances in technology brought about by the Fourth Industrial Revolution, such as using apps as part of intervention, open up

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new avenues of service delivery for SLPs. Incorporating mobile technologies into service delivery would however require SLPs to think of innovative and creative strategies of partnering and collaborating with families, beyond the traditional way in which many SLPs were trained in South Africa and elsewhere. Strong positive partnerships between SLPs and parents will permit an understanding of how families feel about incorporating apps into their child's communication intervention. Such partnerships are critical to ensure successful child communication outcomes.

In conclusion, this study found similarities and differences in the viewpoints of caregivers and SLPs about the inclusion of apps in early communication interventions. It will be essential to integrate feedback from these critical stakeholders if mobile health apps are to be successful.

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