



# Understanding How Parents Deal With the Health Advice They Receive: A Qualitative Study and Implications for the Design of Message-based Health Dissemination Systems for Child Health

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## ABSTRACT

Message-based health information dissemination systems can potentially improve maternal and child health (MCH). By conveying health information to parents, SMS- and chatbot-based systems can support parents' learning and empower them to make better health decisions for their children. However, there is limited design advice for creating message-based dissemination systems for MCH. To help address this gap, we conducted 14 participatory workshops with 42 parents from Portugal and South Africa, exploring how parents learned to care for their children's health. Our findings showed how parents reflected on the health advice they received, by assessing the fit of the advice to their child's characteristics, their values and beliefs, the advice's feasibility, or the intention and competence of the advice giver. Based on these insights, we propose four design implications for creating message-based health information dissemination systems tailored to parents and their children.

## CCS CONCEPTS

• **Human-centered computing** → Empirical studies in HCI; • **Applied computing** → Health informatics.

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*DIS '24, July 01–05, 2024, IT University of Copenhagen, Denmark*

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ACM ISBN 979-8-4007-0583-0/24/07  
<https://doi.org/10.1145/3643834.3661504>

## KEYWORDS

Parenting, Message-based health information dissemination, SMS, Chatbot, Child health, Child health care practices, Qualitative Research, Health Advice

### ACM Reference Format:

Beatriz Félix, Cristiana Braga, Xolani Ntinga, Sarina Till, Leina Meoli, Alastair Van Heerden, Ricardo Melo, Nervo Verdezoto, Melissa Densmore, and Francisco Nunes. 2024. Understanding How Parents Deal With the Health Advice They Receive: A Qualitative Study and Implications for the Design of Message-based Health Dissemination Systems for Child Health. In *Designing Interactive Systems Conference (DIS '24), July 01–05, 2024, IT University of Copenhagen, Denmark*. ACM, New York, NY, USA, 17 pages. <https://doi.org/10.1145/3643834.3661504>

## 1 INTRODUCTION

Health information dissemination is an important mechanism for health promotion which is paramount in maternal and child health (MCH) [116]. Child mortality is often caused by treatable conditions, such as measles, malnutrition, AIDS, or tuberculosis, conditions which can be prevented or have better outcomes when parents<sup>1</sup> have the necessary knowledge to support their health decisions [15, 69]. The shortage of healthcare professionals in many parts of the world [40, 118] and the inaccessibility to care [121] also requires parents to learn healthcare practices and assume responsibility over their children's health. In this context, accessible and accurate information can play a crucial role in empowering parents, families, and communities to make informed decisions regarding their health needs [86] and in learning how to care for their

<sup>1</sup>The term parents in this paper is used broadly to refer to people with child-rearing (and care) responsibilities, which can include parents, grandparents, friends, or other members of the community such as neighbours.

children [2]. Consequently, in recent years, significant investment has been used to research and develop interventions to improve the dissemination of MCH information through digital technology [77, 87, 108, 110].

Message-based health information dissemination systems, in particular, are seen as key to support parents in learning appropriate child health knowledge and care practices [6, 91, 98]. Considering the increased popularity and usage of smartphones in many countries, short-message text service (SMS)- and chatbot-based systems have shown potential to reach a broad audience in a scalable way [44]. Short messages help pace learning [18] and facilitate critical health information to help parents identify for example signs of malnutrition or the symptoms of diseases such as tuberculosis [31]. Moreover, these systems can send information at certain child development milestones and thus help parents implement specific healthcare practices [36, 68]. Nevertheless, and besides the increase of chatbots in healthcare [3, 94], we found limited recommendations for the design of message-based health information dissemination systems to support parents in maternal and child health. The most relevant related work consists of a report detailing the deployment of a chatbot designed for breastfeeding with design recommendations [120]. There are also few studies that have dissected the conversation-related design aspects when building chatbots for the broad healthcare context [23, 56]. While chatbots can indeed be a promising intervention for MCH [24], there is limited research exploring the design of message-based health information dissemination systems for this context.

This study explores how parents reflect on the child health advice they receive to inform the design of message-based health information dissemination systems. We held 14 participatory research workshops with 42 parents from Portugal and South Africa, to discuss their main child care challenges and concerns, their health information sources, and how parents learned to care for their child's health. One central theme in our analysis was how parents reflected on the advice provided to them. In particular, how parents assessed the received advice, according to their values or beliefs, their child's characteristics, the feasibility of the advice, the fit of the advice to the parents' or families' lives, and the perceived intention or competence of people offering the advice. Our findings complement prior work [47] that investigated the reactions of mothers to advice (accepting, resisting, or rejecting), adding the different factors being considered in the assessment. The findings also confirm the importance of personal values and parents' individual needs in assessing advice, as presented by Kirchner et al. [58] and Bartlett et al. [7].

This paper has two main contributions. First, the paper contributes with an in-depth understanding on how parents reflect or assess the MCH advice offered to them. Second, we present four design implications to inform the design of message-based health information dissemination systems for maternal and child health. Overall, our study encourages to think about new ways of tailoring message-based health information dissemination systems, ensuring the information provided respects the child's characteristics, family routines, and values. This work complements existing general conversational design recommendations [36, 103], and provides ideas of how to tailor technologies to end-users which is an important challenge in designing for healthcare technologies [85].

This study is structured in six sections. We begin by introducing parents' learning challenges and parent learning interventions, followed by a review of message-based health information dissemination systems for MCH. Section 3 describes the methods used in this study. We then delve into the practices parents from our study used to assess advice (Section 4). The fifth section compares our findings to existing literature, describes the study limitations, and presents four design implications to support the design of message-based health information dissemination systems for MCH. Section 6 concludes the paper and identifies areas for future work.

## 2 BACKGROUND

### 2.1 Learning child care practices: challenges and perspectives

As parents begin to learn how to care for their baby, they uncover a plethora of new practical skills that they must acquire. These skills range from common tasks, such as bathing their child, understanding signs of hunger, or dealing with colics [11, 21]. Throughout this learning process, parents are exposed to a wealth of information from many different sources [50, 63, 67] which can lead to information overload [32] and impact their confidence to care for their child [20, 30, 66, 79, 105].

Parents do not have much time to absorb all the necessary knowledge. They need to learn and apply all of the theoretical and practical information in a short period of time [7, 22, 101] while dealing with the emotional and physical exhaustion of caring for a newborn [48]. Sleep deprivation also impacts cognitive function which only complicates the process of effectively assimilating and retaining information [48]. Misinformation poses another significant challenge, as the unreliability and complexity of information [49, 100] can hinder parents from interpreting and applying advice to their specific situation [62, 64]. Additionally, some parents struggle with understanding basic health information about their child's well-being due to a low level of health literacy [2, 62].

Dealing with conflicting advice on feeding practices or sleep routines can also leave parents feeling overwhelmed and uncertain [20, 39, 114, 120]. Whether unsolicited or solicited, parents constantly receive advice from family members, friends, and even strangers [67]. When advice makes parents feel inept or judged, they tend to ignore it [47, 74]. This tendency persists when faced with conflicting advice from different sources, especially healthcare professionals [74].

Healthcare professionals and family members remain the most trusted sources of advice [9]. Parents tend to assess advice based on the source's experience with children, its relevance to their child's specific needs [19], and alignment with their values [58]. Seeking consensus, parents often look for multiple sources and tend to prefer evidence-based information [7, 20, 41, 95, 111].

In summary, parents need to learn a number of child care practices for appropriately caring for their child. This can be challenging according to the literature, due to information overload and the conflicting advice received from family, friends, or healthcare professionals. While the learning challenges for parents are known, there is a gap in the understanding of how parents practically assess the advice they are provided with.

## 2.2 Digital technologies for health information dissemination in maternal and child health

Digital technologies have the potential to provide equitable access to healthcare information, particularly in maternal and child health [27, 88, 108]. Parents often turn to digital sources, such as blogs, websites, social media, or apps, for support, guidance, and validation of their parenting practices [29, 32, 38, 55, 78, 84]. When using these resources, parents feel they are in a safe space, free of judgement [32], that they are not bothering anyone [78], and that they have the opportunity to get to know and share experiences with other parents [38, 78]. Easy to access and up-to-date information leads parents to use digital sources [112, 113] as well as the hope to improve their parenting skills [45, 102].

To support the design of digital technologies for MCH dissemination, Bartlett et al. [7] suggested using clear steps with evidence-based explanations. These technologies should offer practical strategies for parents to acquire parenting skills [34], displaying information in a clear and accessible fashion [7, 83]. An integral aspect is the incorporation of parents' cultural and religious beliefs into these systems [7, 83]. Recognizing the diversity of parenting beliefs, these systems should provide information not as a rigid set, but with a consideration of options and alternatives [7], acknowledging the unique perspectives and preferences of parents and their children.

Despite the great potential, there are important barriers to digital technologies for MCH in low- and middle-income countries. One key barrier is the access to technology, data or Wi-Fi connectivity, because it can hinder the use of potentially useful technologies [59, 83]. Digital literacy is also a barrier, in particular for those using technologies developed for languages in which they are not native or fluent speakers, as they might not fully grasp the concepts in the interface or the content [27]. Moreover, studies refer that barriers to connectivity, literacy, and cultural appropriateness can even motivate some parents to resort to traditional healers, who are within reach, speak their language, and respect their beliefs [26, 52, 83].

## 2.3 Message-based health information dissemination systems

Message-based health information dissemination systems consist of SMS- and chatbot-based technologies that primarily communicate with the user via messages. These systems present information through conversation, a natural and engaging way of communicating [75, 98]. By simplifying complex information and delivering it in a paced and timely manner, these technologies can reduce information overload and contribute to learning [60].

Table 1 provides an overview of different message-based health information dissemination systems found in the literature, detailing their topical focus, interaction characteristics, and implementation status. Most systems reviewed focus on breastfeeding or general care practices, but there are also some systems reminding of appointments or important milestones. The expected users of these systems are usually mothers, but apps also target pregnant women, parents, or even community members who are not healthcare professionals but who play a role in the care of the community. Tailoring is very varied, with some systems allowing the user to receive personalised content based on the mother's gestational age or the child's age [5, 6, 12, 76, 115]. As parents need to share details about their child

for content to be tailored, as for example photos or videos of the child, they often question with whom they are sharing the data and whether it is safe [72]. Over-personalised technologies can evoke discomfort, as they might be perceived as intrusive [65]. In contrast, systems devoided of personalisation tend to provide generic information that may not align with the specific needs of individual parents [19, 78]. It is a delicate balance where too much personalisation may raise concerns, but a lack of personalisation may result in information that lacks relevance to parents' unique situations.

Digital technologies, including SMS- and chatbot-based health dissemination systems, provide a promising opportunity for equitable healthcare access, especially in maternal and child health contexts [6]. However, the existing accessibility challenges, and digital illiteracy, especially in low- and middle-income countries along with the lack of personalisation, and privacy concerns of existing systems highlight the existing gap in realising the full potential of these technologies for supporting parents.

*2.3.1 SMS-based systems and their potential use for disseminating MCH information.* The first message-based health information dissemination systems were designed using SMS as a vehicle to convey information. These systems can be highly accessible as they work on any mobile phone and solely require cellular networks for communication, which is an advantage especially in low- and middle-income countries where internet more often does not cover geographical areas [89]. However, SMS also has limitations. Systems based on SMS are typically constrained by message character limits [6] and text content. SMS-based systems commonly use one-way communication, in which only the system sends messages and the user is not given the option to reply or ask questions [12]. SMS-based systems have been used in low- and middle-income countries to disseminate health information, such as vaccination information [53] and others such as COVID-19 [4] and mental health disorders [10]. The systems reviewed in Table 1 are either one-way communication, where users can only receive information [6, 12, 115], or two-way communication, where users are able to reply [98] or ask questions to an operator [54, 91].

An example of such a system is MomConnect [6, 92, 104] (see Table 1). This SMS-based system provides maternal and child health information to women in South Africa [6]. The content is personalised according to the age of the mother, the gestational age of the fetus or the age of the child, and the language of choice [6, 92]. The messages, sent twice a week, were developed by healthcare professionals and aligned with South African health policies [6, 92]. This initiative has empowered many mothers and allowed them to learn more about child care practices [104].

Implementing such SMS-based systems, as argued by Perrier et al. [91] and Ramachandran et al. [98], is anticipated to streamline health services by addressing parents' non-urgent questions. While such systems have been praised for empowering users in managing pregnancy and child care [98, 104], studies report limitations such as the challenges associated with SMS size and cost [12]. The absence of personalisation and, in certain instances, the lack of two-way interaction are also major drawbacks of these systems [6, 12]. For systems allowing two-way communication, Ramachandran et al. [98] suggests adopting a conversational approach with

**Table 1: Overview of message-based systems for maternal and child health.**

Technology name [ref]	Year	Information topic(s)	Tech	Users	Message tailor	Comm. mode	State
- [98]	2010	Maternal care	App, SMS	ASHAs	NA	2-way	P
Text4baby [115]	2012	MCH	SMS	Mothers	GA,CA	1-way	D
- [91]	2015	Appointments	SMS	Pregnant	GA,UA	2-way <sup>h</sup>	P
MomConnect [104]	2018	MCH	SMS	Mothers	GA,CA	1-way	D
XhosaBot [76]	2019	Child health	Chatbot	Mothers	None	2-way	P
Smart-bot [80]	2019	Maternal care	Chatbot	Pregnant	None	2-way	P
Feedpal [120]	2019	Breastfeeding	Chatbot	Mothers	None	2-way	WoO
- [12]	2020	Appointments	SMS	Mothers	GA	1-way	P
ALTCAl [33]	2021	MCH	Chatbot	Mothers	None	2-way	WoO
GISSA [5]	2021	Child health	Chatbot	Mothers	CA	2-way	P
- [94]	2022	Appointments	Chatbot	Mothers	None	2-way <sup>h</sup>	P
Lhia [28]	2023	Breastfeeding	Chatbot	Mothers	None	2-way	P
- [54]	2023	MCH	SMS	Mothers	None	2-way <sup>h</sup>	P
Rosie [70]	2023	Child health	Chatbot	Parents	GA, CA	2-way	P

**Information topic(s):** MCH - Maternal and child health, Appointments - appointment information and reminders. **Users:** ASHA - Accredited Social Health Activist **Message Tailor:** UA - users' age, GA - Gestational age, CA - Child's age. **Communication mode:** <sup>h</sup> - human assisted responses. **State:** P - Prototype, D - Prototype deployed, WoO - Wizard-of-Oz study prototype.

rhetorical questions to enhance user engagement and incorporating audiovisual elements for a more interactive communication compared to text-only formats [98].

**2.3.2 Chatbots and their potential for disseminating MCH information.** A chatbot is an automated system designed to mimic human conversations, often using natural language processing [13]. When compared to SMS-based systems, chatbots are more interactive and dynamic text-based communication systems, as they can support different types of media including emojis, buttons, images, videos, or even voice messages [37, 68, 103]. Chatbots can be deployed on messaging apps like WhatsApp or websites [3], and usually require an internet connection to work. Chatbots are two-way communication systems, making it possible to deliver content in a way that is intuitive, interactive, and potentially tailored to the characteristics of the users [104, 120].

One example of chatbot for child health is GISSA [5], which disseminates information about breastfeeding, nutrition, immunisation, and development of kids from birth to the age of two (see technology characteristics on Table 1). To facilitate the interaction this chatbot displays buttons with predefined answers such as “Yes” and “No” that help lead users into different flows of conversation, according to the provided answers.

Amidst their potential, chatbots face significant challenges, particularly in regions with poor network coverage as they do not usually work offline [33, 57]. The performance of chatbots is highly dependent on the language, and as chatbot engines are usually trained in English, they can have lower performance in other languages. Identifying slang words or colloquial expressions hinders the chatbot comprehension and consequently its adequate response [120]. Notably, the high costs associated with the development and maintenance of chatbot systems emerge as a significant barrier [5], potentially hindering their widespread adoption and implementation. Yadav et al. [120] emphasize the importance of developing chatbots with a clear scope and empathetic speech. The design

of chatbots requires the consideration of trust, privacy concerns, contextual, moral and societal factors, including sociocultural challenges related to gender stereotypes [99, 120].

In summary, message-based systems have the potential to support the dissemination of maternal and child health information, providing users with accessible and personalised content, even in areas without regular internet connection. Previous work has mentioned in the importance of including rich multimedia content, using empathetic speech, and tailoring content to users. Studies also identified the most common barriers faced when designing and implementing such systems. However, despite the growing research, a significant gap remains in the lack of design guidelines or advice for creating message-based health information dissemination systems for MCH.

### 3 METHODS

We held 14 participatory workshops to explore how parents learned to care and make healthcare decisions for their children. We chose to conduct participatory workshops to enable discussion and contrast different perspectives among participants [71]. Workshops involved two to six participants, took roughly 2 hours, and were led by two or three researchers who took notes in addition to moderating. The workshops took place in Portugal and South Africa and were conducted in Portuguese in Porto, in English in communities Oceanview and Mowbray Maternity Hospital, and isiZulu in Sweetwaters.

The workshops were conducted in person in South Africa (7) and remotely in Portugal (7), according to participants' preference and availability. In both contexts, participants were guided through the same activities, and provided with post-its, writing materials, and time to share their perspectives. Online sessions used a video-call platform and Mural<sup>2</sup>, a simple tool that enabled participants to work together on the exercises through virtual post-its. Moreover,

<sup>2</sup>MURAL is a digital workspace for visual collaboration where participants can interact with each other: <https://www.mural.co/>

all sessions were audio-recorded and the materials generated were saved for transcription and in-depth analysis.

### 3.1 Workshop activities

We started each workshop session by introducing the researchers and the project’s goals. To get to know each other and break the ice, participants were invited to share their name, their child’s name, their child’s age, and to choose an emoji to describe their child’s behaviour or personality.

The second activity focused on the challenges parents faced in caring for their child’s health. We prompted participants to think about their experiences, by reflecting on (a) barriers they had surpassed with experience, (b) things they thought would be harder to overcome, and (c) challenges that required professional help. Participants were provided with some minutes to reflect individually on each of the topics. After having time to reflect and write down some post-its, participants were asked to share their experiences with the group (Figure 1 displays materials from this activity). This activity helped elicit challenges, doubts, and health advice received in challenging situations.

The third activity invited parents to talk about the lessons they learned from different actors, including (i) family and friends, (ii) educators, (iii) obstetricians, paediatricians, and family doctors, (iv) nurses, and (v) pharmacists. We asked parents to recall specific tips they had been given by each actor. We tried to focus parents’ reflections on what specific knowledge the tip comprised, including whether they targeted the *what*, *when*, or *how* to do a certain child care activity, etc. Moreover, we listed shared difficulties among the group participants and invited further reflection from participants.

The fourth and final activity focused on exploring the material and digital information sources that participants usually relied on. We asked participants to think whether they relied on (i) books or magazines, (ii) blogs, forums, or newsletters, (iii) radio stations or podcasts, (iv) TV shows, (v) social networks, or (vi) other means. Participants were requested to fill in post-it bubbles with the names

of specific resources they usually resorted to whenever they sought information or needed help. After filling-in the post-its, we asked participants about both the positive characteristics that made them rely on some of the resources and the negative aspects which moved them away from others.

To conclude each workshop, we invited parents to share anything they thought was important about how they learned to take care of their child’s health which had not been previously addressed, and handed in a survey to collect socio-demographic data.

### 3.2 Setting and Participants

We involved parents with children up to 5 years old. We had a preference for first-time parents, who deal with most parenting learning challenges, but we also invited recent parents with more than one child to enrich discussions. We chose to involve participants from different countries and sociocultural backgrounds as a way to maximise the differences between participants and increase the depth of the qualitative analysis [42]. In fact, Portugal and South Africa have various important context differences. For example, the average age of first parenthood in Portugal is 31 and in South Africa is 27 [119]. Average number of children per woman is 2.37 in South Africa [107] compared to 1.38 in Portugal [106]. Another difference is the number of healthcare professionals, 0.8 physicians per 1000 people in South Africa, compared to 5.5 in Portugal [117]. Family context, and cultural and religious background are also different, and potentially an origin for different parenting learning practices.

In South Africa, we held sessions in Sweetwaters, Oceanview and Mowbray Maternity Hospital. Sweetwaters is located in the uMgungundlovu district, which is zoned as a rural area. It is representative of the Zulu population. The average household income is €1,392 per year. For the recruitment of participants in Sweetwaters, we first presented the study to the Community Advisory Board and key community stakeholders and thereafter visited homes, antenatal clinics and pre-schools in the area to share with parents



Figure 1: Materials from workshop activity. The left figure shows how the second activity of the workshop was conducted remotely in Portugal. The figure to the right depicts the same activity in an in-person workshop session held in South Africa. The images show similar materials and activity organisation, despite the distinct meeting format.

**Table 2: Participants' demographics.**

	Porto	Sweetwaters	Oceanview	Mowbray	Total
<b>Age</b>					
16-19	0	4	1	0	5
20-24	0	7	3	1	11
25-29	0	4	0	2	6
30-34	5	0	0	0	5
35-39	8	0	1	0	9
40-44	4	0	1	0	5
45+	0	0	0	1	1
<b>Role</b>					
Mother	12	15	6	4	37
Father	5	0	0	0	5
<b>Education</b>					
High School	0	13	4	4	21
College	9	2	1	0	12
PhD	8	0	0	0	8
<b>Number of children</b>					
1	14	15	6	2	36
2	3	0	0	1	5
3+	0	0	0	1	1
<b>Child's age</b>					
0-6 months	2	5	1	1	10
7-12 months	2	9	3	3	17
13+ months	16	1	2	0	19

information about the study and recruit participants. All participants who were interested in participating in the study gave their names to the institution and were later contacted to schedule the workshops. Oceanview, located in Anthlone, is an urban area with an average income of approximately €2,808 per year. Recruitment in this community was facilitated by an NGO that supports special needs children. Mowbray Maternity Hospital, situated in the urban Cape Town, has an average income of €11,300 annually, with the majority of the population being English speaking. Recruitment was done through convenience sampling at the hospital's postnatal clinics, where mothers in the waiting room were approached on the day of the workshops to participate in the study.

In South Africa, we had a total of 25 participants (see Table 2). At least six participants had more than one child. It is important to note that in South Africa only mothers participated. One father was recruited, however, changed his mind before starting the workshop.

In Portugal, most participants (12/17) were from the district of Porto, an urban community and the second largest city in the country. The average household income is €38,735 per year. Participants were recruited through convenience sampling, which resulted in most participants having higher academic education than the average of the country. In Portugal, we had 17 participants (see Table 2). Three participants had more than one child. It was the only site where fathers participated.

### 3.3 Analysis

The sessions were fully transcribed, omitting only off-topic discussions. Relevant quotes were translated to English and analysed using reflexive thematic analysis [14, 25]. Two researchers read

the transcripts and coded the data independently, discussing any differences in the analysis. These codes and initial themes were moved to post-its in a Mural board and organised into larger categories and ultimately themes. The analysis occurred concurrently with the workshops, making it possible to discuss in subsequent workshops issues that appeared in previous sessions. The resulting analysis themes ranged from doubts and concerns as a first-time parent, information sources to which parents resorted, and barriers that prevented them from establishing good parenting practices. To narrow down our research, we conducted multiple code-reviewing sessions and an affinity mapping workshop with four researchers from the project. During these sessions, it became clear that reflecting on advice was a salient theme in the data.

### 3.4 Context

This study occurred in the context of ParentCoach, a project which was creating a chatbot for first-time parents in Portugal and South Africa. One of the first phases of the project was understanding the needs and challenges of first-time parents in caring for their children, which was achieved with these first workshops. After these activities, we continued holding workshops to design the chatbot, as well as fieldwork with healthcare professionals and educators.

### 3.5 Ethics

We followed ethical guidelines and principles to protect participants' rights and welfare. All participants provided written informed consent before the sessions, after hearing about the project,

the activities proposed, and data management aspects. This study was approved by the ethics boards of Human Sciences Research Council (HSRC) and University of Cape Town (UCT). In Portugal, it is not mandatory to get an ethics review for this kind of study, and considering that Fraunhofer Portugal AICOS does not have an ethics board it was not locally reviewed. All data collected is confidential and was used exclusively within the scope of this study.

## 4 FINDINGS: HOW PARENTS REFLECT ON ADVICE THEY RECEIVE

Our participants reported dealing with an overwhelming amount of health advice. Ever since they had a child, parents were confronted with advice on how to care for their child, coming from family, friends, healthcare professionals, and even people on the street. Some parents listened more to the advice and tried it out without much hesitation, whereas others were more reluctant, dismissing people who advised without knowing much about their child. However, there seemed to be a pattern in the experiences of parents in our workshops. In the early months of parenthood, parents were usually excited to learn and grateful that many people were willing to share their experiences. With time and experience, parents realised that only a portion of the advice they received applied to their child and thus started to reflect further about the advice.

This section reviews the practices parents in our study used to assess advice provided to them. We discuss how parents assessed the alignment of the advice: with their child's characteristics, their own values and beliefs, their habits and routines, with their ability to understand and implement advice. The final two practices discussed relate to the advice-giver, specifically how parents assessed the advice-giver's intention and perceived competence.

### 4.1 Checking if advice is compatible with the characteristics of the child

One key aspect parents reflected on when considering health advice was whether it applied to their child. We were frequently told during the workshops that “every child is different” and that “what works well for one child might not be suitable for another” to call attention to the individual differences between children and how health advice worked differently in distinct cases. Some of the differences between children were physiological and had to do with certain physical features, diseases, or allergies. One of our participants mentioned the skin condition of her child and how she could not follow advice related to bathing or products for skin care.

*‘No, my child does not bathe with a [bar of] soap because they have a bad skin. They [doctors] said that I must [use] water only’ – Participant 30, mother, Sweetwaters*

The child from Participant 30 child had a skin condition and could not follow general advice on bathing or hydrating children's skin, and multiple attempts were needed before understanding that bathing with only water was the best option for her child at the time of the workshops. This led to the mother reflecting on how this characteristic separated her child from others, hindering her from following advice on the topic lightly. Other participants shared similar experiences when mentioning rashes caused by the recommended diaper brands, as these participants discovered that

only some diapers suited their children since different children react differently to these products.

Besides physiological characteristics, parents also reflected on how the received advice fitted their children's interests, preferences, or personality traits. One participant mentioned her grandchild's clinginess.

*‘You do get a clingy child, but they don't tell you, they say now leave the baby, the baby must sleep on its own, but they don't. (...) There are children that's clinging babies, and then children that wants to learn on their own' [to sleep by themselves] – Participant 39, mother, Mowbray Maternity Hospital*

Participant 39 shared that some children are more clingy than others and you do not know what implications that might have. For instances, the child only slept with the mother which had a direct impact on any advice she might receive. Due to the differences in children, parents attempt to follow advice that best suits the traits of their child.

### 4.2 Checking alignment of the advice with one's values and beliefs

Participants often reflected on the alignment of the received advice with their own values and beliefs. Some parents mentioned the importance of their parenting “approach”, “principles”, or “philosophy” in deciding the health advice they implemented. Traditional medicine or practices were mentioned in conversations and the remarks parents made about it made us conclude that the views of parents on these sociocultural practices impacted their decisions. Moreover, trust in one's parents' (child's grandparents) knowledge was also important for the decisions of some of the participants.

One participant mentioned how the advice she received on getting her child to sleep did not align with her own values.

*‘People would tell me “Do this” “Do that” or “Oh I know, you want him to sleep? You put him to bed and let him cry”, something that was entirely contrary to my philosophy and that they [specialists] actually say it shouldn't be done’ – Participant 2, mother, Porto*

As a result of value misalignment, for example, Participant 2 rejected the suggestion to use the cry-it-out method<sup>3</sup> because it went against her parenting principles. Despite her difficulties establishing a sleep routine for her child, Participant 2 did not want to implement this method because she was unwilling to put her child in a stressful situation and would rather soothe him to sleep. The sleep method choice is something that parents experiment with to see what works best for their children, themselves, and different situations [7]. However, what is particularly interesting in this situation is that the mother chose not to follow the advice on getting the child to sleep due to a value misalignment between the method and her approach to parenting.

Value misalignment also enables other aspects of culture to flourish. Some mothers from Sweetwaters mentioned using traditional medicine to help their children sleep. These sociocultural practices

<sup>3</sup>The cry-it-out or Ferber method consists of leaving children alone to cry for different periods before being comforted by their parents or until they fall asleep. The method is common, though not universally accepted, in some Western countries to introduce children to a sleep routine.

were ingrained in the community, and it was common for parents to receive advice from family or friends to implement traditional medicine approaches with their children.

[referring to advice provided by an aunt:] *I will have to burn the herb called izinyamazane when he can't sleep at night* – Participant 20, mother, Sweetwaters

In Sweetwaters, it is common for elders to advise mothers to burn izinyamazane. This incense is used in traditional medicine and is believed to soothe crying babies and protect them through the night from evil design or from bad spirits [35]. When parents trusted their own parents' or family members' knowledge, they were more prone to experimenting with incense burning, believing it would also work for them. If that failed, they would turn to healthcare clinics seeking other options. Traditional and western medicine seemed to coexist as viable resources for some of our participants, and the choice to go with one or the other was usually based on the situation, their beliefs, and their parenting approach.

In Porto, Oceanview and Mowbray Maternity Hospital, traditional medicine practices were also brought up in conversations. One parent from Porto told us that elders advised him not to use a scissor or any similar object the first time he cut his child's nails because it was thought to be harmful to the child's development. He did not see a justification, so he chose not to follow it. Another mother, from Oceanview explained how some of the practices have been passed down through generations and the majority of them have worked, to her knowledge, so she kept following it. These different examples show that parents reflected on the alignment of advice with their beliefs.

### 4.3 Assessing fit to the reality of parents' lives

Parental decisions were influenced by the participants' preferences, routines, and day-to-day activities. Even when advice was clear and generally agreed upon, such as the number of hours a child should sleep, there were practical arrangements, routines, or preferences that made parents decide to disregard advice.

*'there's that ambiguity: on the one hand I want him to go to sleep because I know it's important for him to have a restful sleep, he still needs a lot of sleep, on the other hand, I would like to be with him even a little longer.'* – Participant 17, mother, Porto

Participant 17 mentioned the dilemma she faced multiple times regarding when to put her child to sleep. While she knew that the child needed a good night of sleep to grow and develop adequately, she did not want to hinder the child from bonding with parents and family. In a context where both parents work, it can be hard for families to spend time together during the week; with the evening being the exception when all members are at home. In some situations, Participant 17 would put her child to sleep early to account for her physiological needs, but other times she would delay the child's sleep to enable richer family time, opening opportunities for emotional bonding. Moreover, parents' preferences and routines can change with time, causing them to reconsider or change the way they dealt with advice they previously received.

### 4.4 Assessing the feasibility of the advice

Another important factor in implementing advice had to do with its practical feasibility. Some advice might be easy to implement solely with a simple description, while other advice might be more complex and require specific training, resources, or repeated attempts. One parent mentioned to us that he used to be recommended to use nasal washing to deal with respiratory issues of the child, but despite his agreement with the strategy and having the conditions to use it, he was not able to implement it.

*'[The nasal washing technique] came about, again, from talking to friends (...) we decided to have an appointment at home. A nurse came, demonstrated [on the child] and then showed me how to do it'* – Participant 9, father, Porto

Performing nasal wash was not possible for Participant 9 because he could not understand the explanations provided by others. He needed to see a nurse using it with his child, commenting on the steps, to be able to do it himself. Before the demonstration, advice was unfeasible, but after it the situation changed.

Participant 22 described how her mother assisted her at the start of her parenting journey.

*'my mother taught me how to bathe a child, how you hold her and how warm the water should be.'* – Participant 22, mother, Sweetwaters

Many other participants, like Participant 22, stressed the importance of learning by watching someone do an unfamiliar activity. They hesitated to put some tips into practice until they could learn alongside others highlighting the importance of experiential learning and how health advice thus should be tailored not only to the children but also to the abilities of the parents.

### 4.5 Assessing perceived intention when receiving advice from others

When receiving advice, parents tried to understand the intention of the advice giver to assess whether they were acting on their best interests or not. If parents sensed that the advice giver was trying to help, they would be more open to consider it, however, if they sensed that the advice giver intended to judge them, through aggressive, condescending, or critical comments, they were more likely to disregard it.

Given judgemental or condescending advice not only influenced the acceptance of the advice but also the level of trustworthiness of the advice giver even if the advice came from healthcare professionals whom parents previously trusted.

*'So I didn't go to the clinic because they would say we don't feed children in the right way. So it happens that we met a rude nurse'* – Participant 26, mother, Sweetwaters

Another Participant (26) struggled with producing milk at the start of her breastfeeding journey. She started taking medication after consulting with hospital staff. Her child was not sleeping well after a while, so she went to the clinic, where she was asked how she was feeding her child. A nurse at the clinic implied that she was not feeding her child as she was supposed to after she explained her situation and how she was dealing with the problem. This



interaction left the mother with the impression that the healthcare professional intended to judge her rather than help her, prompting the mother to seek help at another clinic. It is important for parents that those who counsel them can put themselves in their shoes and, even if they cannot help them, demonstrate empathy and a willingness to help<sup>4</sup>.

Conversely, parents expressed appreciation and reliance on people willing to listen and help, and who conveyed confidence to them. One participant mentioned a friend who she always trusted the advice from.

*'Any questions [that I might have], I resort to her. (...) she shows me confidence, she is always helpful, (...) she always showed availability to help me.'* – Participant 15, mother, Porto

Participant 15 trusted a friend that she met recently for child care advice because she always listened and offered to help. While Participant 15 was a migrant and had her group of friends in another country, she did not resort to them for advice as she did not feel that they were as open and trustful as the friend she recently met. This friend was a mother as well, but what made her distinct was that she did not offer any unwanted advice and did not use ill-intended tones, so P15 developed trust in her.

Our findings show how the advice-giver's intention plays an important role when parents are assessing advice. Even when the content of the message was the right fit, if the perceived intention was not to help, parents ended up not following the advice.

#### 4.6 Assessing perceived competence of the advice-giver

Implementing child health advice can have detrimental consequences for the child and since parents do not possess the in-depth healthcare knowledge (at least not at the beginning of parenting) they may try to understand if the people offering them advice are competent to do it. In one of the activities performed in the workshops, parents were asked to share examples of advice they had received that had a significant impact on their lives. They were also asked to specify the sources that provided the advice. In the auxiliary materials, the reader will find a Table that categorises various advice mentioning the actors who recommended them.

Parents frequently justified the perceived credibility of the advice-givers by mentioning reasons why they believed they were competent. This section details the various reasons that led our participants to frame others as competent to provide advice.

*Knowledge of the child's history* was a key trust criterion for parents to assess the competence of the advisor. It assured them that the provided advice had been filtered to the specific situation at hand, and, so, parents could trust it. According to our participants, there were two ways someone could be aware of their child's history: either by closely following the child, since birth for a considerable time, or by asking questions to perform an adequate "diagnosis".

<sup>4</sup>Participants from Communities B and C reported receiving criticism and judgement because of their young parenthood. During their clinic appointments, nurses subjected them to judgement, which left them feeling discriminated against. Such behaviour raised concerns among parents about returning to a place where they previously felt judged [67].

*'It is a relationship of mutual trust that is created [with the paediatrician] (...) I ended up following her recommendation even though I knew that the most recent scientific evidence did not go in that direction.'* – Participant 8, mother, Porto

Participant 8 usually looked for scientific publications to help her make informed decisions regarding her daughter's healthcare. While the scientific knowledge was still a trusted source (an *evidence*, she said), Participant 8 followed the paediatrician's advice. This highlights that regardless of the latest scientific evidence, relying on a healthcare expert who was familiar with the child's background was more reassuring. The fact that the paediatrician accompanied this mother and her child since birth allowed her to develop a trusting relationship.

Competence was also interpreted as having an *appropriate profile*. In Portugal, we found that parents sought healthcare professionals with a speciality in paediatrics and who have a clinical practice. In South Africa, parents also turned to healthcare professionals for urgent and health-related care, by resorting to clinics or private doctors. South African participants, particularly in Sweetwaters, also mentioned resorting to traditional medicine healers, Sangomas, as they were perceived as competent actors who had knowledge and experience with traditional health practices and were usually more accessible than healthcare professionals.

Parents in the study stated that *people who underwent similar experiences* were also competent to help them.

*'You know there's a lot of people they don't have anyone to speak about experience about. So, you need to speak to someone that's in the same situation as you, that knows about, and you don't hear a lot about that'* – Participant 40, mother, Mowbray Maternity Hospital

Participant 40 highlights the value of exchanging experiences and learning from others who have gone through similar circumstances. During the same workshop, other participants talked about how they tried to support other mothers because they thought that getting support from other parents who have gone through similar experiences was a crucial part of learning how to care for their children. Participants reported finding themselves trusting people who had children with a similar profile, e.g. parents of similar age babies, parents of children with similar conditions, or people who had encountered other similar challenges.

## 5 DISCUSSION

### 5.1 Main findings

Our study showed how parents assess the advice they receive from others. The participants from our study assessed the received advice, according to their values or beliefs, their child's characteristics, the feasibility of the advice, the fit of the advice to the parents' or families' lives, and the perceived intention or competence of people offering the advice. Our findings complement prior work by Heritage and Sefi [47] who investigated the reactions of mothers to advice (accepting, resisting, or rejecting), adding the factors being considered in the assessment from parents. We confirmed the importance of personal values and parents' individual needs in assessing advice, as presented by Bartlett et al. [7], Kirchner et al.

[58], as well as the need to assess the compatibility of advice to them [1, 19, 58]. Similar to prior work [58, 82, 108], our participants often sought advice that aligned with their cultural and religious values, emphasising the inter-generational passing down of such beliefs. In some cases, parents dismissed advice from elders, mentioning that times have changed and the advice is no longer relevant as in prior work [111], but this was not the case for all parents in our study, as advice from parents was also seen as knowledge that has been successful for generations. The perceived intention of the advice-giver also influenced if the advice would be adopted, due to the feeling of being judged [16, 46, 47]. In this regard, our study confirms prior work showing that poorly delivered advice is more likely to be disregarded [47].

The importance of advice for learning to care for a child was also confirmed with our study. Our participants mentioned numerous situations where they benefited from the experience of others and the knowledge from healthcare professionals in addressing issues they found. The parents from our study mentioned they used a variety of information sources, including both digital [20, 38, 61, 84] and non-digital sources [8, 52, 63, 67, 93, 97]. Nevertheless, our participants seemed to rely mostly on people to support their learning. In a world where most parents use digital sources to seek information [52], close social networks and trusted professionals seemed to still be the key sources of advice.

Trust played a pivotal role in parental decision-making. Our findings highlight that parents are more likely to trust advice-givers who demonstrate competence and familiarity with the child's history. The relationship between the advice-giver and the parent, along with the practical success of past advice, influences the level of trust and reliance on these sources [7, 8]. Our participants stressed the importance of having a support network, such as friends who are parents and have gone through similar experiences as in prior work [78, 96]. Parents in our study also appreciated the feeling of talking with someone who could relate to them and give them advice they could trust and understand as reported in prior work [7, 50, 58].

The results from this study made us reflect about message-based health information dissemination systems. Our study encourages thinking about new ways of tailoring content that ensure that the information is provided in ways that respect the child's characteristics, family routines, and values. Reviewing existing technologies it became clear that message tailoring or personalisation has been limited. As Table 1 shows, half the systems do not personalise content in any way, and the ones that do usually rely on one data point like the child's age (e.g., [5]). We argue there is space for including further ways to tailoring messages accounting for the different factors that influence parents to accept or reject advice and outline a number of design implications to help achieve it.

## 5.2 Implications for design

This paper explored how parents assess advice they receive, making us reflect on the design of message-based health information dissemination systems. In this section, we detail four implications to inform the design of these systems. To illustrate the interplay of the design implications in a message-based health information

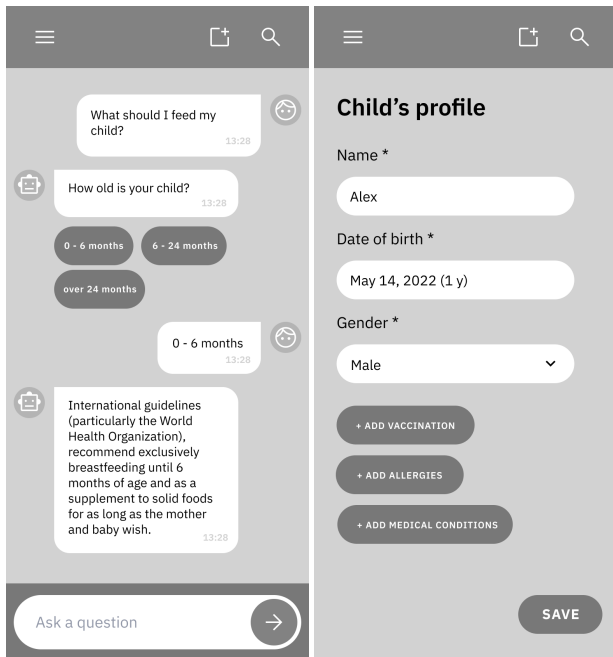
dissemination system, we designed some user interface archetypes<sup>5</sup> to demonstrate how the suggested design implications could be envisioned and implemented. It is important to emphasise that message-based health information dissemination systems are not usually intended to replace healthcare professionals or overrule them, but to provide parents with information validated by healthcare professionals that can empower parents to make informed decisions in MCH.

**5.2.1 Tailor content according to the child's characteristics.** According to our findings, parents carefully reflected whether the advice given to them applied to their child's characteristics (see Subsection 4.1). Participants in our study considered different physiological characteristics, such as medical conditions, allergies, as well as preferences from the child that could enable or reject the advice. To support parents in learning, message-based health information dissemination systems should tailor the messages to the characteristics of the child (e.g., age, sex, health conditions, preferred activities), as otherwise the advice might be rendered as non-applicable. Gathering information about the child's characteristics could be achieved in two main ways. One way would be for a message-based health information dissemination system to ask about the information that is needed when the user asks a question (see the left image of Figure 2). For example, if a parent asked the system what they should feed their child, the system would ask the child's age to ensure that the answer was as close to the child's characteristics as possible. The alternative would be to have a dedicated area of the app where parents would be able to enter data about their children, which would support the system in tailoring the message to the child's characteristics.

As mentioned before, half message-based health information dissemination systems personalise content in some way (see Table 1), but usually rely on one data point like the child's age (e.g., [5]). Parents tend to look for content that is specific to their needs and circumstances [78]. The novelty of this implication would be to query and store the information about the child during conversations with the message-based systems. Prior work usually requires users to enter information about their children during the onboarding (see [28, 104]), but without a justification parents might skip this step in favour of privacy [65]. If the system requests information about the child only when needed for personalisation, it will be more likely that parents share their data to have more tailored content [65, 112].

**5.2.2 Adapting content according to medical records.** Parents revealed that they were more willing to accept advice from someone who was familiar with their child's history (Subsection 4.6). Such tailored guidance is more appealing because it can be tailored to the specific needs of the child (Subsection 4.1). In light of this, we propose that message-based health information dissemination systems store relevant details related to the child's medical history. Consider a concerned parent seeking advice from the system because their child is running a fever. Fevers in babies can result from a variety of causes, including common viral infections and even heat exposure. Furthermore, fevers are frequently observed as a typical post-vaccination response. In a scenario where the parent

<sup>5</sup>These archetypes, while illustrative, have not been user tested or evaluated.

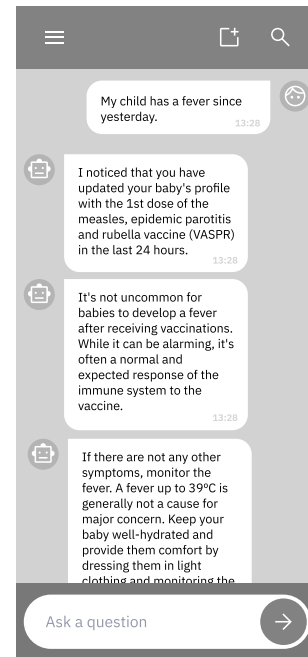


**Figure 2: Different ways of communicating characteristics of the child to a message-based health information dissemination system. The image on the left shows relevant information being asked in the conversation, to ensure content is tailored. The image on the right shows the possibility of entering data into a child's profile with health characteristics.**

has diligently updated the system with the most recent vaccination date, the system may proactively remind the parent that the fever may be caused by the vaccine's side effects (see Figure 3).

This implication is closely related to the previous one, as both provide content tailored to the child and both raise potential privacy and security concerns. In the context of health and well-being, clinical medical history can be an important source of information to provide situated advice [8]. However, accessing medical record data is typically a challenge with studies mentioning lack of access hinders the delivery of healthcare [87]. Accessing medical records potentially creates privacy and security issues for the child's personal data, but studies have shown that there are ways of accessing medical records guaranteeing privacy and security [90]. None of the message-based systems that were analysed included this feature for the child's medical history; but Barron et al. [6] and Bogale et al. [12] used the mothers' clinical records to tailor messages. Our suggestion is to use available information to further tailor responses to end-users while guaranteeing the system complies with security and privacy regulations.

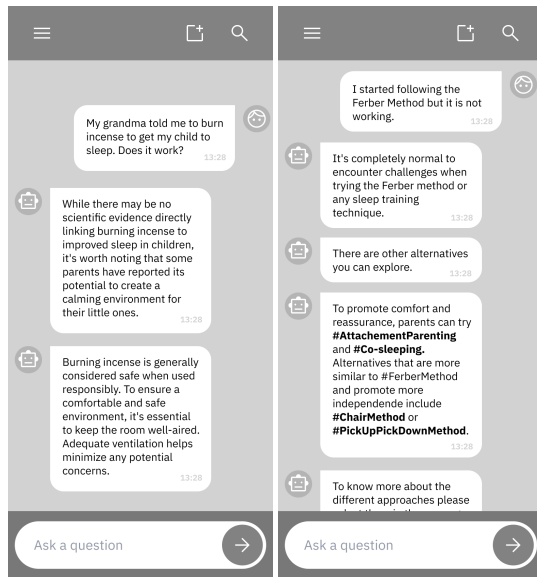
**5.2.3 Acknowledge parents' values and beliefs.** Parents in the study considered advice in light of their values and beliefs (Subsection 4.2). This could manifest in drawing on Western and traditional medicine, or in disregarding the cry-it-out method because it went against the mother's parenting philosophy. Message-based health information dissemination systems could also be designed to be sensitive to



**Figure 3: Adapting content according to the existing records. The image shows the system responding to a query from the user drawing on information previously entered into the system. We suggest using any available records to further tailor messages to the child's medical status or health history.**

parents' beliefs. The content of the app could be designed to be inclusive of different ways of seeing health, care, and parenting, to accommodate different types of parents. For example, if a parent asks a question about traditional medicine, the system could provide factual information while being inclusive to people who might adhere to traditional practices (see Figure 4). In fact, the system should strive to communicate evidence-based advice, but if a specific traditional medicine practice is not considered harmful for the child, it should not be disregarded, as the practice might have other roles besides treatment (e.g. calming parents, parent-child bonding). The goal of the system should be to convey information and help understand the benefits and inconveniences of different strategies, not to change the perspectives or beliefs of users.

Another way to be sensitive to parents' values is to offer multiple alternatives that parents can consider and choose, such as showing the benefits of emotional bonding or the benefits of sleep (see Subsection 4.3). By showing multiple strategies to address an issue, parents do not get the impression that only one approach works, validating that their current approach might also work. At the same time, it enables parents to consider other approaches if their current (alternative) strategy does not work, opening their reflection to alternatives. In any case, it is important to consider the burden of deciding between alternative strategies. May et al. [73]'s Burden of Treatment Theory argues that the patient's capacity to perform self-care depends not only on their performance but also on their social capital and social skills. By relating it to our situation, we can see that parents who lack health literacy lack the same knowledge



**Figure 4: A system should be sensitive to parents' beliefs. The image on the left addresses traditional medicine in an inclusive way. The image on the right provides parents with multiple alternative methods, enabling them to reflect on the option that best fits their values or preferences.**

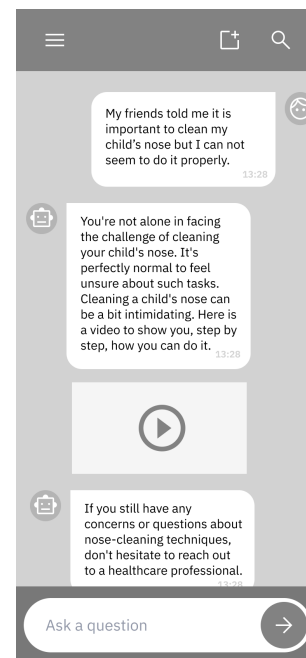
for making decisions as parents who do not struggle, which could favour more parents with higher health literacy [108].

In this implication, we propose that the system presents parents with different parenting strategies and viewpoints, allowing them to choose the ones that best align with their beliefs. This feature is new to the MCH message-based systems, since the system usually only has an answer for each topic and does not present alternatives to users. In their studies, Mustafa et al. [82] and Gupta et al. [43], found that traditional practices and beliefs are present in mothers' cultures and sometimes traditional medicine oversteps any other possible alternative. Muthelo et al. [83] debates the merits of incorporating traditional practices, such as traditional medicine, into existing systems. We suggest that a digital solution does not have to be universal. It does not need to hold the knowledge of traditional healers and traditional medicine but rather acknowledge the existence of these approaches and present users with other options besides the system [26]. We argue that the content of message-based health information dissemination systems should be local and adapted to the context of the region where it is being deployed as socio-cultural practices are situated. Furthermore, systems should be validated by local healthcare professionals to ensure that the local guidelines are being promoted and can be integrated with existing clinical care practices. Transparency is key to gaining the user's trust [36], so, disclosing the system's values and limitations will allow parents to choose what they feel is the best option for them.

*5.2.4 Complement the text-based messages with multimedia content.* Our findings suggested that some skills need to be explained in different ways in order to be learned by parents (Subsection 4.4),

as in the example of Participant 9. This father explained that he was only able to perform a nose wash on his child after someone demonstrated how to do so. In some cases, a written explanation may not suffice. We propose that, in addition to a written explanation of a skill, the system provides other types of media to aid in the explanation. Using Participant 9 as an example, if he went to the system with the same question, the system would show him a video that explained all of the steps involved in washing a baby's nose (see Figure 5). Multimedia content allows for the explanation of concepts that would be difficult to explain in writing or orally. Furthermore, images or videos can make parents feel more empowered to complete a specific task.

This feature is not new to message-based MCH systems [5, 120] or even to MCH digital systems [17, 81], however we believe in the importance multimedia has in learning and want to emphasize the importance of this feature along with the others. The mothers in the study by Muthelo et al. [83] emphasize the value of having video content for parents who struggle with reading. Davis et al. [29] found that parents' learning was enhanced when the information was delivered through videos as compared to written materials. Multimedia interactions are frequently used in chatbots [51]. However, sending multimedia content via other message-based systems, like SMS, is more expensive [59]. The poor internet coverage and high prices of mobile phone services, like data, are cited as the two biggest obstacles to the spread of health digital technology in low-



**Figure 5: A system should allow for different types of media, such as images and videos. The image shows how the system can provide a video to complement an explanation that would be too complex to describe in writing.**

and middle-income countries [87]. This poses a challenge for the integration of multimedia message-based health information dissemination systems. The need for offline resources is raised by Till et al. [108]. The multimedia resources could be stored on the phones as a simple way to make the system work offline. However, this brings up additional problems, such as occupying phone storage, which might hinder participants from installing or keeping installed an app that reduces the space available for pictures and other apps [83].

### 5.3 Limitations

The first limitation pertained to the representativeness of our study sample. In Portugal, our participants were predominantly researchers or knowledge workers residing in urban areas with high levels of academic education. It would be ideal to engage participants from rural areas of the country, as well as with a broader range of educational, professional, and economic backgrounds. In South Africa, our sample was limited to female participants living in lower-income areas. Future research should aim to involve participants from even more ethnic groups and communities in South Africa, as well as achieve a more balanced gender distribution to further include South African male parents' perspectives.

Secondly, we did not evaluate the impact of adapting the remote and digital-based materials to in-person delivery. Even though the sessions were conducted and organised in the same way, adapting the materials might have, in some way, affected the workshop dynamics and, consequently, the study results. In future work, it might be advisable to test the same materials in in-person and online sessions, before conducting all sessions, to understand if there was a potential impact on the results.

Third, our data collection lacked information regarding the personality types of parents, hindering our understanding of how different parent personalities impacted how parents assessed health advice. Future studies should collect data on personality types, to ensure parents with different types of personalities are recruited, as well as to support the design of a system that supports different parent groups.

Fourth limitation is related to the lack of validation of the design implications, with specific usability experiments or tests, which means they remain considerations to think with while designing. Subsequent studies should validate the design implications in real-world scenarios, with special attention to legal and privacy concerns, particularly in the regions where the study takes place. Furthermore, studies could explore how message-based health information dissemination systems should be integrated with existing healthcare organisations, collaborating with healthcare professionals to disseminate maternal and childcare information. By involving healthcare professionals, future studies could encourage communities to test out our design implications in their systems and report their findings. If they are confirmed, researchers could encourage governments and health departments to disseminate this information for future digital systems.

Fifth, our study did not specifically focus on characteristics that determine health advice and outcomes, including race, ethnicity, genetic and epigenetic history. Although the content of the application was validated by healthcare professionals, personalisation to accommodate these factors was not explored. While none of

our participants raised concerns regarding these factors, research shows their impact on clinical diagnosis and decision-making in healthcare [109]. Additionally, obtaining such sensitive information from participants is challenging due to ethical and privacy concerns. Future research should explore methods for collecting this data, possibly through collaboration with healthcare professionals. Moreover, researchers should collaborate closely with healthcare professionals to improve design implications, ensuring they are adaptable to various health-related factors and personalised to meet parents' needs effectively.

## 6 CONCLUSION

This paper highlights the importance of health dissemination in MCH. Understanding how parents reflect on advice they receive is essential for developing message-based health information dissemination systems that depend on their ability to share health knowledge. We provide insights into the practices and strategies parents employ to reflect on and assess advice and the factors that influence the acceptance of advice to inform the design of message-based health information dissemination systems for maternal and child health. Based on our findings we present implications for the design of such systems using several wireframes.

### 6.1 Future Work

Regarding the future work of the project, we plan on conducting more co-design workshops to better inform the design of the system. We also have planned on designing and developing a prototype that incorporates the findings from the workshops. After having a functional prototype we aim to evaluate it in a real-world setting, in both countries, through a field trial. This will allow us to validate this study's findings and implications.

As highlighted in the identified limitations, we believe future studies should broaden their samples to account for participants with different characteristics, demographics, personality types and health factors. Additionally, we underline the importance of validating the design implications in collaboration with healthcare professionals, while also addressing legal and privacy considerations, and explore them in real-world scenarios to understand the feasibility of integrating these systems with healthcare organisations.

Despite these limitations, our work opens several opportunities for future research and development in this field. Future research could focus on further validating our findings to communities in low- and middle-income countries, and engage in iterative design processes, such as co-design sessions, that actively involve end-users, parents, and healthcare professionals and expand the scope of message-based systems to include other potential users (e.g. teachers, educators). This approach will ensure that message-based systems continuously evolve to meet changing user requirements and preferences and adapt to the sociocultural context of parents.

## ACKNOWLEDGMENTS

This work was done under the scope of project ParentCoach (FCT AGA-KHAN / 541742216 / 2019) funded by Fundação para a Ciência e Tecnologia and Aga Khan Development Network. We would like to express our gratitude to Joana Couto Silva who created the

first draft version of the low-fidelity prototypes we present in the implications. We acknowledge the kindness and collaboration of every parent that participated in our study.

## REFERENCES

- [1] Tawfiq Ammari, Priya Kumar, Cliff Lampe, and Sarita Schoenebeck. 2015. Managing Children's Online Identities: How Parents Decide what to Disclose about their Children Online. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, Seoul Republic of Korea, 1895–1904. <https://doi.org/10.1145/2702123.2702325>
- [2] Amy Armstrong-Heimsoth, Melissa L. Johnson, Aubrey McCulley, Marisa Basinger, Kelly Maki, and Dakota Davison. 2017. Good Googling: A Consumer Health Literacy Program Empowering Parents to Find Quality Health Information Online. *Journal of Consumer Health on the Internet* 21, 2 (April 2017), 111–124. <https://doi.org/10.1080/15398285.2017.1308191> Publisher: Routledge eprint: <https://doi.org/10.1080/15398285.2017.1308191>
- [3] Alison M. El Ayadi, Pushpendra Singh, Mona Duggal, Vijay Kumar, Jasmeet Kaur, Preetika Sharma, Kathryn Bradford Vosburg, and Nadia G. Diamond-Smith. 2023. Feasibility and acceptability of Saheli, a WhatsApp Chatbot, on COVID-19 vaccination among pregnant and breastfeeding women in rural North India. *BMJ Innovations* 9 (Aug. 2023), bmjinnov. Issue 4. <https://doi.org/10.1136/bmjinnov-2022-001012> Publisher: BMJ Specialist Journals Section: Digital health.
- [4] Abdulaa Babili, Sabin Nsanzimana, Edson Rwagasore, and Richard T. Lester. 2023. SMS-based digital health intervention in Rwanda's home-based care program for remote management of COVID-19 cases and contacts: A qualitative study of sustainability and scalability. *Frontiers in Digital Health* 4 (Jan. 2023), 1071790. <https://doi.org/10.3389/fdgh.2022.1071790>
- [5] Ivana Cristina de Holanda Cunha Barreto, Nardelli Brenda Soares Barros, Rebecca Lucena Theophilo, Vielceketlin Franco Viana, Francisca Raquel de Vasconcelos Silveira, Osvaldo de Souza, Fábio José Gomes de Sousa, Antônio Mauro Barbosa de Oliveira, and Luiz Odorico Monteiro de Andrade. 2021. Development and evaluation of the GISSA Mother-Baby ChatBot application in promoting child health. *Ciência & Saúde Coletiva* 26 (May 2021), 1679–1690. <https://doi.org/10.1590/1413-81232021265.04072021> Publisher: ABRASCO - Associação Brasileira de Saúde Coletiva.
- [6] Peter Barron, Joanne Peter, Amnesty E. LeFevre, Jane Sebidi, Marcha Bekker, Robert Allen, Annie Neo Parsons, Peter Benjamin, and Yogan Pillay. 2018. Mobile health messaging service and helpdesk for South African mothers (MomConnect): history, successes and challenges. *BMJ Global Health* 3, Suppl 2 (April 2018), e000559. <https://doi.org/10.1136/bmjgh-2017-000559> Publisher: BMJ Specialist Journals Section: Analysis.
- [7] Jessica Dym Bartlett, Lina Guzman, and Maria A Ramos-Olagazaga. 2018. *Parenting Knowledge among First-time Parents of Young Children*. Research Brief 2018-28. Child Trends, 7315 Wisconsin Avenue Suite 1200 W. 1–10 pages. [childtrends.org](http://childtrends.org).
- [8] Isabel Baumann, Rebecca Jaks, Dominik Robin, Sibylle Juvalta, and Julia Dratva. 2020. Parents' health information seeking behaviour – does the child's health status play a role? *BMC Family Practice* 21, 1 (Dec. 2020), 266. <https://doi.org/10.1186/s12875-020-01342-3>
- [9] Theres Bellander and Zoe Nikolaidou. 2017. Building health knowledge online: Parents' online information searching on congenital heart defects. *Literacy and Numeracy Studies* 25 (Dec. 2017), 4. <https://doi.org/10.5130/lns.v25i1.5358>
- [10] Anvita Bhardwaj, Prasansa Subba, Sauharda Rai, Chaya Bhat, Renasha Ghimire, Mark J. D. Jordans, Eric Green, Lavanya Vasudevan, and Brandon A. Kohrt. 2020. Lessons learned through piloting a community-based SMS referral system for common mental health disorders used by female community health volunteers in rural Nepal. *BMC Research Notes* 13, 1 (July 2020), 309. <https://doi.org/10.1186/s13104-020-05148-5>
- [11] Maureen M Black and Frances E Aboud. 2011. Responsive feeding is embedded in a theoretical framework of responsive parenting. *The Journal of nutrition* 141, 3 (2011), 490–494.
- [12] Binyam Bogale, Kjersti Mørkrid, Brian O'Donnell, Buthaina Ghanem, Itimad Abu Ward, Khadija Abu Khader, Mervett Isbeih, Michael Frost, Mohammad Baniode, Taghreed Hijaz, Tamara Awwad, Yousef Rabah, and J. Frederik Frøen. 2020. Development of a targeted client communication intervention to women using an electronic maternal and child health registry: a qualitative study. *BMC Medical Informatics and Decision Making* 20, 1 (Jan. 2020), 1. <https://doi.org/10.1186/s12911-019-1002-x>
- [13] Petter Bae Brandtzaeg and Asbjørn Følstad. 2017. Why People Use Chatbots. In *Internet Science*, Ioannis Kompatsiaris, Jonathan Cave, Anna Satsiou, Georg Carle, Antonella Passani, Efstratios Kontopoulos, Sotiris Diplaris, and Donald McMillan (Eds.). Vol. 10673. Springer International Publishing, Cham, 377–392. [https://doi.org/10.1007/978-3-319-70284-1\\_30](https://doi.org/10.1007/978-3-319-70284-1_30)
- [14] Virginia Braun and Victoria Clarke. 2012. *Thematic analysis*. American Psychological Association, London, 57–71.
- [15] Lucia Breierova and Esther Duflo. 2004. *The Impact of Education on Fertility and Child Mortality: Do Fathers Really Matter Less Than Mothers?* Technical Report w10513. National Bureau of Economic Research. w10513 pages. <https://doi.org/10.3386/w10513>
- [16] Lauren Britton, Louise Barkhuus, and Bryan Semaan. 2019. "Mothers as Candy Wrappers": Critical Infrastructure Supporting the Transition into Motherhood. *Proceedings of the ACM on Human-Computer Interaction* 3, GROUP (Dec. 2019), 1–21. <https://doi.org/10.1145/3361113>
- [17] Sherri Lynn Bucher, Allison Young, Madison Dolan, Geetha Priya Padmanaban, Khushboo Chandnani, and Saptarshi Purkayastha. 2023. The NeoRoo mobile app: Initial design and prototyping of an Android-based digital health tool to support Kangaroo Mother Care in low/middle-income countries (LMICs). *PLOS Digital Health* 2, 10 (Oct. 2023), e0000216. <https://doi.org/10.1371/journal.pdig.0000216> Publisher: Public Library of Science.
- [18] Raluca Budiu. 2018. The User Experience of Chatbots. <https://www.nngroup.com/articles/chatbots/>
- [19] Grace Burleson, Mustafa Naseem, and Kentaro Toyama. 2020. An Exploration of African-American Pregnant Women's Information-Seeking Behavior in Detroit. In *Proceedings of the 2020 International Conference on Information and Communication Technologies and Development*. ACM, Guayaquil Ecuador, 1–12. <https://doi.org/10.1145/3392561.3394647>
- [20] C Bäckström, R Knez, M Fahlgren, M Synnergren, and V Larsson. 2022. In the need of a digital cicerone in healthcare? – Guidance for parents. *BMC Pregnancy and Childbirth* 22, 1 (Nov. 2022), 863. <https://doi.org/10.1186/s12884-022-05120-0>
- [21] Alexandrina Cardoso, Abel Silva, and Heimar Marín. 2015. Parenting competencies: development of an assessment instrument. *Revista de Enfermagem Referência IV Série*, No 4 (March 2015), 11–20. <https://doi.org/10.12707/RIV14012>
- [22] Bernie Carter. 2007. Parenting: a glut of information. *Journal of Child Health Care* 11, 2 (June 2007), 82–84. <https://doi.org/10.1177/1367493507079621> Publisher: SAGE Publications Ltd.
- [23] Han Shi Jocelyn Chew. 2022. The Use of Artificial Intelligence-Based Conversational Agents (Chatbots) for Weight Loss: Scoping Review and Practical Recommendations. *JMIR Medical Informatics* 10, 4 (April 2022), e32578. <https://doi.org/10.2196/32578>
- [24] Joelle Yan Xin Chua, Mahesh Choolani, Cornelia Yin Ing Chee, Yiong Huak Chan, Joan Gabrielle Lalor, Yap Seng Chong, and Shefaly Shorey. 2023. Insights of Parents and Parents-To-Be in Using Chatbots to Improve Their Preconception, Pregnancy, and Postpartum Health: A Mixed Studies Review. *Journal of Midwifery & Women's Health* 68 (Feb. 2023), jmw.13472. <https://doi.org/10.1111/jmwh.13472>
- [25] Victoria Clarke and Virginia Braun. 2013. *Successful Qualitative Research: A Practical Guide for Beginners*. Sage, Washington DC.
- [26] Toshka Coleman, Sarina Till, Jaydon Faraó, Londiwe Shandu, Nonkululeko Khuzwayo, Livhuwani Muthelo, Masenyani Mbombi, Mamare Bopape, Alastair van Heerden, Tebogo Mothiba, Shane Norris, Nervo Verdezoto, and Melissa Densmore. 2023. Reconsidering Priorities for Digital Maternal and Child Health: Community-centered Perspectives from South Africa. *Proc. ACM Hum.-Comput. Interact.* 7, CSCW2, Article 290 (oct 2023), 31 pages. <https://doi.org/10.1145/3610081>
- [27] Téa E Collins, Svetlana Akselrod, Aliina Altmysheva, Pham Thi Quynh Nga, Nick Banatvala, and Daria Berlina. 2023. The promise of digital health technologies for integrated care for maternal and child health and non-communicable diseases. *BMJ* 381 (May 2023), e071074. <https://doi.org/10.1136/bmj-2022-071074>
- [28] Joeckson Santos Corrêa, Ari Pereira de Araújo Neto, Giovanni Rebouças Pinto, Lucas Daniel Batista Lima, and Ariel Soares Teles. 2023. Lhia: A Smart Chatbot for Breastfeeding Education and Recruitment of Human Milk Donors. *Applied Sciences* 13, 12 (Jan. 2023), 6923. <https://doi.org/10.3390/app13126923> Number: 12 Publisher: Multidisciplinary Digital Publishing Institute.
- [29] Deborah Winders Davis, M Cynthia Logsdon, Krista Vogt, Jeff Rushton, John Myers, Adrian Lauf, and Felicia Hogan. 2017. *Parent Education is Changing: A Review of Smartphone Apps*. Technical Report. MCN in Advance.
- [30] Toity Deave, Debbie Johnson, and Jenny Ingram. 2008. Transition to parenthood: the needs of parents in pregnancy and early parenthood. *BMC pregnancy and childbirth* 8 (July 2008), 30. <https://doi.org/10.1186/1471-2393-8-30>
- [31] Republic of South Africa Department of Health. 2018. Road to Health. [https://www.westerncape.gov.za/assets/departments/health/rthb\\_booklet.pdf](https://www.westerncape.gov.za/assets/departments/health/rthb_booklet.pdf)
- [32] Lorie Donelle, Jodi Hall, Bradley Hiebert, Kimberley Jackson, Ewelina Stoyanovich, Jessica LaChance, and Danica Facca. 2021. Investigation of Digital Technology Use in the Transition to Parenting: Qualitative Study. *JMIR Pediatrics and Parenting* 4, 1 (Feb. 2021), e25388. <https://doi.org/10.2196/25388> Company: JMIR Pediatrics and Parenting Distributor: JMIR Pediatrics and Parenting Institution: JMIR Pediatrics and Parenting Label: JMIR Pediatrics and Parenting Publisher: JMIR Publications Inc., Toronto, Canada.
- [33] Joy Egede, Maria J. Galvez Trigo, Adrian Hazzard, Martin Porcheron, Edgar Bodiaj, Joel E. Fischer, Chris Greenhalgh, and Michel Valstar. 2021. Designing an Adaptive Embodied Conversational Agent for Health Literacy: a User Study. In *Proceedings of the 21st ACM International Conference on Intelligent Virtual Agents (IVA '21)*. Association for Computing Machinery, New York, NY, USA, 112–119. <https://doi.org/10.1145/3472306.3478350>

- [34] Angela Afua Entsieh and Inger Kristensson Hallström. 2016. First-time parents' prenatal needs for early parenthood preparation-A systematic review and meta-synthesis of qualitative literature. *Midwifery* 39 (2016), 1–11. <https://doi.org/10.1016/j.midw.2016.04.006>
- [35] Andrew Evans. 2012. Zulu Muthi Market. <https://www.nationalgeographic.com/travel/article/zulu-muthi-market> Section: Travel.
- [36] Ahmed Fadhil and Gianluca Schiavo. 2019. Designing for Health Chatbots. <https://doi.org/10.48550/arXiv.1902.09022> arXiv:1902.09022 [cs].
- [37] Ahmed Fadhil, Gianluca Schiavo, Yunlong Wang, and Bereket A. Yilma. 2018. The Effect of Emojis when interacting with Conversational Interface Assisted Health Coaching System. In *Proceedings of the 12th EAI International Conference on Pervasive Computing Technologies for Healthcare*. ACM, New York NY USA, 378–383. <https://doi.org/10.1145/3240925.3240965>
- [38] Erika Frey, Catriona Bonfiglioli, Melissa Brunner, and Jane Frawley. 2022. Parents' Use of Social Media as a Health Information Source for Their Children: A Scoping Review. *Academic Pediatrics* 22, 4 (2022), 526–539. <https://doi.org/10.1016/j.acap.2021.12.006>
- [39] Laura M. Gaydos, Sarah C. Blake, Julie A. Gazmararian, Whitney Woodruff, Winifred W. Thompson, and Safiya George Dalmida. 2015. Revisiting Safe Sleep Recommendations for African-American Infants: Why Current Counseling is Insufficient. *Maternal and Child Health Journal* 19, 3 (March 2015), 496–503. <https://doi.org/10.1007/s10995-014-1530-z>
- [40] Nancy Gerein, Andrew Green, and Stephen Pearson. 2006. The Implications of Shortages of Health Professionals for Maternal Health in Sub-Saharan Africa. *Reproductive Health Matters* 14, 27 (Jan. 2006), 40–50. [https://doi.org/10.1016/S0968-8080\(06\)27225-2](https://doi.org/10.1016/S0968-8080(06)27225-2)
- [41] Lorna Gibson and Vicki L. Hanson. 2013. Digital motherhood: how does technology help new mothers?. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Paris France, 313–322. <https://doi.org/10.1145/2470654.2470700>
- [42] B.G. Glaser and A.L. Strauss. 1967. *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Aldine. <https://books.google.pt/books?id=oUxEQAAlAAJ>
- [43] Mira L. Gupta, Raymond Akawire Aborigo, Philip Baba Adongo, Sarah Rominski, Abraham Hodgson, Cyril M. Engmann, and Cheryl A. Moyer. 2015. Grandmothers as gatekeepers? The role of grandmothers in influencing health-seeking for mothers and newborns in rural northern Ghana. *Global Public Health* 10, 9 (Oct. 2015), 1078–1091. <https://doi.org/10.1080/17441692.2014.1002413>
- [44] Amanda K Hall, Heather Cole-Lewis, and Jay M Bernhardt. 2015. Mobile text messaging for health: a systematic review of reviews. *Annual review of public health* 36 (March 2015), 393–415. <https://doi.org/10.1146/annurev-publhealth-031914-122855>
- [45] Cristin M. Hall and Karen L. Bierman. 2015. Technology-assisted interventions for parents of young children: Emerging practices, current research, and future directions. *Early Childhood Research Quarterly* 33 (2015), 21–32. <https://doi.org/10.1016/j.ecresq.2015.05.003>
- [46] Erin J. Henshaw, Marie A. Cooper, Manuela Jaramillo, Jane M. Lamp, Audrey L. Jones, and Teresa L. Wood. 2018. "Trying to Figure Out If You're Doing Things Right, and Where to Get the Info": Parents Recall Information and Support Needed During the First 6 weeks Postpartum. *Maternal and Child Health Journal* 22, 11 (Nov. 2018), 1668–1675. <https://doi.org/10.1007/s10995-018-2565-3>
- [47] John Heritage and Sue Sefi. 1992. Dilemmas of advice: Aspects of the delivery and reception of advice in interactions between Health Visitors and first-time mothers. In *Talk at Work: Interaction in Institutional Settings*. Cambridge University Press, Cambridge.
- [48] Lauren P. Hunter, Jacqueline D. Rychnovsky, and Susan M. Yount. 2009. A Selective Review of Maternal Sleep Characteristics in the Postpartum Period. *Journal of Obstetric, Gynecologic & Neonatal Nursing* 38, 1 (Jan. 2009), 60–68. <https://doi.org/10.1111/j.1552-6909.2008.00309.x>
- [49] P. Impicciatore, C. Pandolfini, N. Casella, and M. Bonati. 1997. Reliability of health information for the public on the world wide web: systematic survey of advice on managing fever in children at home. *BMJ* 314, 7098 (June 1997), 1875–1875. <https://doi.org/10.1136/bmj.314.7098.1875>
- [50] Cath Jackson, Francine M. Cheater, and Innes Reid. 2008. A systematic review of decision support needs of parents making child health decisions. *Health Expectations* 11, 3 (Sept. 2008), 232–251. <https://doi.org/10.1111/j.1369-7625.2008.00496.x>
- [51] Mohit Jain, Pratyush Kumar, Ramachandra Kota, and Shwetak N. Patel. 2018. Evaluating and Informing the Design of Chatbots. In *Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18)*. Association for Computing Machinery, New York, NY, USA, 895–906. <https://doi.org/10.1145/3196709.3196735>
- [52] Rebecca Jaks, Isabel Baumann, Sibylle Juvalta, and Julia Dratva. 2019. Parental digital health information seeking behavior in Switzerland: a cross-sectional study. *BMC Public Health* 19, 1 (Dec. 2019), 225. <https://doi.org/10.1186/s12889-019-6524-8>
- [53] Kamal Karkonasasi, Cheah Yu-N, Seyed Aliakbar Mousavi, and Ahmad Suhaimi Baharudin. 2020. Malaysian Health Centers' Intention to Use an SMS-Based Vaccination Reminder and Management System: A Conceptual Model. In *Emerging Trends in Intelligent Computing and Informatics (Advances in Intelligent Systems and Computing)*. Faisal Saeed, Fathey Mohammed, and Nadhmi Gazem (Eds.). Springer International Publishing, Cham, 960–969. [https://doi.org/10.1007/978-3-030-33582-3\\_90](https://doi.org/10.1007/978-3-030-33582-3_90)
- [54] Naveena Karusala, Victoria G. Shirley Yan, and Richard Anderson. 2023. Unsettling Care Infrastructures: From the Individual to the Structural in a Digital Maternal and Child Health Intervention. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*. ACM, Hamburg Germany, 1–16. <https://doi.org/10.1145/3544548.3581553>
- [55] Jasmeet Kaur and Pushpendra Singh. 2020. Understanding Engagement of Parents in Online Health Communities for Early Childhood. In *Proceedings of the 2020 International Conference on Information and Communication Technologies and Development*. ACM, Guayaquil Ecuador, 1–5. <https://doi.org/10.1145/3392561.3397582>
- [56] Liam Kettle and Yi-Ching Lee. 2023. User Experiences of Well-Being Chatbots. *Human Factors: The Journal of the Human Factors and Ergonomics Society* (March 2023), 001872082311624. <https://doi.org/10.1177/00187208231162453>
- [57] Enwonwu K.g, Ugwunna N, Ochor R, Odume U, John M, Oganya P, Ogbodo I, and Maduka B. 2023. Knowledge of Digital Technology, Its Access and Use to Enhance Dissemination of Health Information Among Residents of Ogui New Layout Enugu, Nigeria. *Journal of Progress in Engineering and Physical Science* 2, 1 (2023), 28–40.
- [58] Susanne Kirchner, Dawn K. Sakaguchi-Tang, Rebecca Michelson, Sean A. Munson, and Julie A. Kientz. 2020. "This just felt to me like the right thing to do": Decision-Making Experiences of Parents of Young Children. In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*. ACM, Eindhoven Netherlands, 489–503. <https://doi.org/10.1145/3357236.3395466>
- [59] Sonja Klingberg, Molebogeng Motlathledi, Gugulethu Mabena, Tebogo Mooki, Nervo Verdezoto, Melissa Densmore, Shane A. Norris, and on behalf of the CoMaCH network. 2022. "Must you make an app?" A qualitative exploration of socio-technical challenges and opportunities for designing digital maternal and child health solutions in Soweto, South Africa. *PLOS Global Public Health* 2, 12 (Dec. 2022), e0001280. <https://doi.org/10.1371/journal.pgph.0001280>
- [60] Ilya Kreynin, MohammedShabbar Manek, and Chirag Variawa. 2019. Creating a virtual chatbot to scaffold skills development in first-year engineering education. *Proceedings of the Canadian Engineering Education Association (CEEA)* (11 2019). <https://doi.org/10.24908/pceea.vi0.13784>
- [61] Christian Kubb and Heather M Foran. 2020. Online Health Information Seeking by Parents for Their Children: Systematic Review and Agenda for Further Research. *Journal of Medical Internet Research* 22, 8 (Aug. 2020), e19985. <https://doi.org/10.2196/19985>
- [62] Disha Kumar, Lee Sanders, Eliana M. Perrin, Nicole Lokker, Baron Patterson, Veronica Gunn, Joanne Finkle, Vivian Franco, Leena Choi, and Russell L. Rothman. 2010. Parental Understanding of Infant Health Information: Health Literacy, Numeracy, and the Parental Health Literacy Activities Test (PHLAT). *Academic Pediatrics* 10, 5 (Sept. 2010), 309–316. <https://doi.org/10.1016/j.acap.2010.06.007>
- [63] Hansel Stephanie Lee. 2016. Research trends in mothers' health information seeking behaviors: A review of the literature: Research Trends in Mothers' Health Information Seeking Behaviors: A Review of the Literature. *Proceedings of the Association for Information Science and Technology* 53, 1 (2016), 1–6. <https://doi.org/10.1002/pra2.2016.14505301130>
- [64] Carlee Lehna and Jack McNeil. 2008. Mixed-Methods Exploration of Parents' Health Information Understanding. *Clinical Nursing Research* 17, 2 (May 2008), 133–144. <https://doi.org/10.1177/1054773808316730>
- [65] Yu-li Liu, Wenjia Yan, Bo Hu, Zhuoyang Li, and Yik Ling Lai. 2022. Effects of personalization and source expertise on users' health beliefs and usage intention toward health chatbots: Evidence from an online experiment. *DIGITAL HEALTH* 8 (Jan. 2022), 20552076221129718. <https://doi.org/10.1177/20552076221129718> Publisher: SAGE Publications Ltd.
- [66] Nur Arina Liyana Amin, Wilson W. S. Tam, and Shefaly Shorey. 2018. Enhancing first-time parents' self-efficacy: A systematic review and meta-analysis of universal parent education interventions' efficacy. *International Journal of Nursing Studies* 82 (June 2018), 149–162. <https://doi.org/10.1016/j.ijnurstu.2018.03.021>
- [67] Katherine Loudon, Steven Buchanan, and Ian Ruthven. 2016. The everyday life information seeking behaviours of first-time mothers. *Journal of Documentation* 72, 1 (Jan. 2016), 24–46. <https://doi.org/10.1108/JD-06-2014-0080>
- [68] Bei Luo, Raymond Y. K. Lau, Chungping Li, and Yain-Whar Si. 2021. A critical review of state-of-the-art chatbot designs and applications. *WIREs Data Mining and Knowledge Discovery* 12, 1 (Sept. 2021), 1942–4787, 1942–4795. <https://doi.org/10.1002/widm.1434>
- [69] Gloria Macassa, Gebrnegus Hilagaber, Eva Bernhardt, Finn Diderichsen, and Bo Burström. 2003. Inequalities in child mortality in Mozambique: differentials by parental socio-economic position. *Social Science & Medicine* 57, 12 (Dec. 2003), 2255–2264. [https://doi.org/10.1016/S0277-9536\(02\)00545-2](https://doi.org/10.1016/S0277-9536(02)00545-2)
- [70] Heran Y. Mane, Amara Channell Doig, Francia Ximena Marin Gutierrez, Michelle Jasczynski, Xiaohe Yue, Neha Pundlik Srikanth, Sourabh Mane, Abby Sun, Rachel Ann Moats, Pragat Patel, Xin He, Jordan Lee Boyd-Graber, Elizabeth M.

- Aparicio, and Quynh C. Nguyen. 2023. Practical Guidance for the Development of Rosie, a Health Education Question-and-Answer Chatbot for New Mothers. *Journal of public health management and practice: JPHMP* 29, 5 (Oct. 2023), 663–670. <https://doi.org/10.1097/PHH.0000000000001781>
- [71] Ian Mansell, Glynis Bennett, Ruth Northway, Donna Mead, and Laurie Moseley. 2004. The learning curve: the advantages and disadvantages in the use of focus groups as a method of data collection. *Nurse Researcher* 11, 4 (July 2004), 79–88. <https://doi.org/10.7748/nr2004.07.11.4.79.c6217>
- [72] Stephen T. Margulis. 2003. Privacy as a Social Issue and Behavioral Concept: **Privacy as a Social Issue**. *Journal of Social Issues* 59, 2 (July 2003), 243–261. <https://doi.org/10.1111/1540-4560.00603>
- [73] Carl R. May, David T. Eton, Kasey Boehmer, Katie Gallacher, Katherine Hunt, Sara MacDonald, Frances S. Mair, Christine M. May, Victor M. Montori, Alison Richardson, Anne E. Rogers, and Nathan Shippee. 2014. Rethinking the patient: using Burden of Treatment Theory to understand the changing dynamics of illness. *BMC Health Services Research* 14, 1 (2014), 281. <https://doi.org/10.1186/1472-6963-14-281>
- [74] Jenny McLeish, Merryl Harvey, Maggie Redshaw, and Fiona Alderdice. 2021. A qualitative study of first time mothers' experiences of postnatal social support from health professionals in England. *Women and Birth* 34, 5 (Sept. 2021), e451–e460. <https://doi.org/10.1016/j.wombi.2020.10.012>
- [75] Alison Mildon and Daniel Sellen. 2019. Use of mobile phones for behavior change communication to improve maternal, newborn and child health: a scoping review. *Journal of Global Health* 9, 2 (2019), 020425. <https://doi.org/10.7189/jogh.09.020425>
- [76] Amit Mishra. 2019. *Chatbot in isiXhosa for Remote Pre/post-Natal Care*. preprint. engrXiv. <https://doi.org/10.31224/osf.io/jm54z>
- [77] Marc Mitchell and Lena Kan. 2019. Digital Technology and the Future of Health Systems. *Health Systems & Reform* 5, 2 (April 2019), 113–120. <https://doi.org/10.1080/23288604.2019.1583040>
- [78] Rachel Y. Moon, Anita Mathews, Rosalind Oden, and Rebecca Carlin. 2019. Mothers' Perceptions of the Internet and Social Media as Sources of Parenting and Health Information: Qualitative Study. *Journal of Medical Internet Research* 21, 7 (July 2019), e14289. <https://doi.org/10.2196/14289>
- [79] A. Morawska, L. Winter, and M. R. Sanders. 2009. Parenting knowledge and its role in the prediction of dysfunctional parenting and disruptive child behaviour. *Child: Care, Health and Development* 35, 2 (2009), 217–226. <https://doi.org/10.1111/j.1365-2214.2008.00929.x> <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-2214.2008.00929.x>
- [80] Kevin Mugoye, Henry Okoyo, and Sylvester Mcoyowo. 2019. Smart-bot Technology: Conversational Agents Role in Maternal Healthcare Support. In *2019 IST-Africa Week Conference (IST-Africa)*. IEEE, Nairobi, Kenya, 1–7. <https://doi.org/10.23919/ISTAfrICA.2019.8764817>
- [81] Angella Musiimenta, Wilson Tumuhimbise, Godfrey Mugenyi, Jane Katusiime, Esther C Atukunda, and Niels Pinkwart. 2020. Mobile phone-based Multimedia Application Could improve Maternal Health in Rural Southwestern Uganda: Mixed Methods Study. *Online Journal of Public Health Informatics* 12, 1 (July 2020), e8. <https://doi.org/10.5210/ojphi.v12i1.10557>
- [82] Maryam Mustafa, Amna Batool, Beenish Fatima, Fareeda Nawaz, Kentaro Toyama, and Agha Ali Raza. 2020. Patriarchy, Maternal Health and Spiritual Healing: Designing Maternal Health Interventions in Pakistan. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM, Honolulu HI USA, 1–13. <https://doi.org/10.1145/3313831.3376294>
- [83] Livhuwani Muthelo, Masenyani Oupa Mbombi, Mamare Adelaide Bopape, Tebogo M. Mothiba, Melissa Densmore, Alastair Van Heerden, Shane A. Norris, Nervo Verdezoto Dias, Paula Griffiths, and Nicola Mackintosh. 2023. Reflections on Digital Maternal and Child Health Support for Mothers and Community Health Workers in Rural Areas of Limpopo Province, South Africa. *International Journal of Environmental Research and Public Health* 20, 3 (Jan. 2023), 1842. <https://doi.org/10.3390/ijerph20031842>
- [84] Honor Nicholl, Catherine Tracey, Thelma Begley, Carole King, and Aileen M Lynch. 2017. Internet Use by Parents of Children With Rare Conditions: Findings From a Study on Parents' Web Information Needs. *Journal of Medical Internet Research* 19, 2 (Feb. 2017), e51. <https://doi.org/10.2196/jmir.5834>
- [85] Francisco Nunes, Nervo Verdezoto, Geraldine Fitzpatrick, Morten Kyng, Erik Grönvall, and Cristiano Storni. 2015. Self-Care Technologies in HCI: Trends, Tensions, and Opportunities. *ACM Trans. Comput.-Hum. Interact.* 22, 6, Article 33 (dec 2015), 45 pages. <https://doi.org/10.1145/2803173>
- [86] Oluwaseun Obasola and I.M. Mabawonku. 2017. Women's use of information and communication technology in accessing maternal and child health information in Nigeria. *African Journal of Library Archives and Information Science* 27 (01 2017), 1–15.
- [87] Oluwaseun Ireti Obasola, Iyabo Mabawonku, and Ikeoluwa Lagunju. 2015. A Review of e-Health Interventions for Maternal and Child Health in Sub-Saharan Africa. *Maternal and Child Health Journal* 19, 8 (Aug. 2015), 1813–1824. <https://doi.org/10.1007/s10995-015-1695-0>
- [88] Won-Oak Oh. 2023. Digital healthcare for child health nursing. *Child Health Nursing Research* 29, 2 (April 2023), 97–100. <https://doi.org/10.4094/chnr.2023.29.2.97>
- [89] Earl Oliver. 2007. Design and Implementation of a Short Message Service Data Channel for Mobile Systems. (2007), 1–10. <https://api.semanticscholar.org/CorpusID:352810>
- [90] Chase R Parsons, Jonathan D Hron, and Fabienne C Bourgeois. 2020. Preserving privacy for pediatric patients and families: use of confidential note types in pediatric ambulatory care. *Journal of the American Medical Informatics Association* 27, 11 (09 2020), 1705–1710. <https://doi.org/10.1093/jamia/ocaa202> <https://academic.oup.com/jamia/article-pdf/27/11/1705/34363886/ocaa202.pdf>
- [91] Trevor Perrier, Nicola Dell, Brian DeRenzi, Richard Anderson, John Kinuthia, Jennifer Unger, and Grace John-Stewart. 2015. Engaging Pregnant Women in Kenya with a Hybrid Computer-Human SMS Communication System. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (Seoul Republic of Korea). ACM, Seoul Republic of Korea, 1429–1438. <https://doi.org/10.1145/2702123.2702124>
- [92] Joanne Peter, Peter Benjamin, Amnesty Elizabeth LeFevre, Peter Barron, and Yogan Pillay. 2018. Taking digital health innovation to scale in South Africa: ten lessons from MomConnect. *BMJ Global Health* 3, Suppl 2 (April 2018), e000592. <https://doi.org/10.1136/bmjgh-2017-000592> Publisher: BMJ Specialist Journals Section: Editorial.
- [93] Sheri Lynn Price, Megan Aston, Joelle Monaghan, Meaghan Sim, Gail Tomblin Murphy, Josephine Etowa, Michelle Pickles, Andrea Hunter, and Victoria Little. 2018. Maternal Knowing and Social Networks: Understanding First-Time Mothers' Search for Information and Support Through Online and Offline Social Networks. *Qualitative Health Research* 28, 10 (Aug. 2018), 1552–1563. <https://doi.org/10.1177/1049732317748314>
- [94] Indriana Widya Puspitasari, Fedri Ruluwedrata Rinawan, Wanda Gusdya Purnama, Hadi Susiarno, and Ari Indra Susanti. 2022. Development of a Chatbot for Pregnant Women on a Posyandu Application in Indonesia: From Qualitative Approach to Decision Tree Method. *Informatics* 9, 4 (Oct. 2022), 88. <https://doi.org/10.3390/informatics9040088>
- [95] Petra Pålsson, Linda J. Kvist, Maria Ekelin, Inger Kristensson Hallström, and Eva K. Persson. 2018. "I Didn't Know What to Ask About": First-Time Mothers' Conceptions of Prenatal Preparation for the Early Parenthood Period. *The Journal of Perinatal Education* 27, 3 (June 2018), 163–174. <https://doi.org/10.1891/1058-1243.27.3.163>
- [96] Petra Pålsson, Linda J. Kvist, Maria Ekelin, Inger Kristensson Hallström, and Eva K. Persson. 2018. "I Didn't Know What to Ask About": First-Time Mothers' Conceptions of Prenatal Preparation for the Early Parenthood Period. *The Journal of Perinatal Education* 27, 3 (June 2018), 163–174. <https://doi.org/10.1891/1058-1243.27.3.163>
- [97] Melissa Radey and Karen A. Randolph. 2009. Parenting Sources: How Do Parents Differ in Their Efforts to Learn About Parenting? *Family Relations* 58, 5 (Dec. 2009), 536–548. <https://doi.org/10.1111/j.1741-3729.2009.00573.x>
- [98] Divya Ramachandran, Vivek Goswami, and John Canny. 2010. Research and reality: using mobile messages to promote maternal health in rural India. In *Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development* (London United Kingdom). ACM, London United Kingdom, 1–10. <https://doi.org/10.1145/2369220.2369253>
- [99] Amon Rapp, Lorenzo Curti, and Arianna Boldi. 2021. The human side of human-chatbot interaction: A systematic literature review of ten years of research on text-based chatbots. *International Journal of Human-Computer Studies* 151 (July 2021), 102630. <https://doi.org/10.1016/j.ijhcs.2021.102630>
- [100] P. Scullard, C. Peacock, and P. Davies. 2010. Googling children's health: reliability of medical advice on the internet. *Archives of Disease in Childhood* 95, 8 (Aug. 2010), 580–582. <https://doi.org/10.1136/adc.2009.168856>
- [101] Sarla Sethi. 1995. The Dialectic in Becoming a Mother: Experiencing a Postpartum Phenomenon. *Scandinavian Journal of Caring Sciences* 9, 4 (Dec. 1995), 235–244. <https://doi.org/10.1111/j.1471-6712.1995.tb00420.x>
- [102] Shefaly Shorey and Esperanza Debby Ng. 2019. Evaluation of Mothers' Perceptions of a Technology-Based Supportive Educational Parenting Program (Part 2): Qualitative Study. *Journal of Medical Internet Research* 21, 2 (Feb. 2019), e11065. <https://doi.org/10.2196/11065>
- [103] Geovana Ramos Sousa Silva and Edna Dias Canedo. 2022. Towards User-Centric Guidelines for Chatbot Conversational Design. *International Journal of Human-Computer Interaction* 0, 0 (Sept. 2022), 1–23. <https://doi.org/10.1080/10447318.2022.2118244> Publisher: Taylor & Francis <https://doi.org/10.1080/10447318.2022.2118244>
- [104] Donald Skinner, Peter Delobelle, Michele Pappin, Desiree Pieterse, Tonya Marianne Esterhuizen, Peter Barron, and Lilian Dudley. 2018. User assessments and the use of information from MomConnect, a mobile phone text-based information service, by pregnant women and new mothers in South Africa. *BMJ Global Health* 3, Suppl 2 (2018), e000561. <https://doi.org/10.1136/bmjgh-2017-000561>
- [105] J. Sloman, P. Emonts, L. Vigneron, A. Aconcia, F. Glowacz, J. Y. Reginster, M. Oumourgh, and O. Bruyère. 2017. Identifying maternal needs following childbirth: A qualitative study among mothers, fathers and professionals. *BMC pregnancy and childbirth* 17, 1 (July 2017), 213. <https://doi.org/10.1186/s12884-2017-2929-7>



- 017-1398-1
- [106] Statista. 2021. Portugal - fertility rate 2021. <https://www.statista.com/statistics/372093/fertility-rate-in-portugal/>
- [107] Statista. 2021. South Africa - fertility rate 2021. <https://www.statista.com/statistics/578912/fertility-rate-in-south-africa/>
- [108] Sarina Till, Mirriam Mkhize, Jaydon Farao, Londiwe Deborah Shandu, Livhuwani Muthelo, Toshka Lauren Coleman, Masenyani Mbombi, Mamara Bopape, Sonja Klingberg, Alastair van Heerden, Tebogo Mothiba, Melissa Densmore, Nervo Xavier Verdezoto Dias, and CoMaCH Network. 2023. Digital Health Technologies for Maternal and Child Health in Africa and Other Low- and Middle-Income Countries: Cross-disciplinary Scoping Review With Stakeholder Consultation. *Journal of Medical Internet Research* 25 (April 2023), e42161. <https://doi.org/10.2196/42161>
- [109] Michelle Tong and Samantha Artiga. 2021. Use of Race in Clinical Diagnosis and Decision Making: Overview and Implications. <https://www.kff.org/racial-equity-and-health-policy/issue-brief/use-of-race-in-clinical-diagnosis-and-decision-making-overview-and-implications/>
- [110] Ngozi B Ukachi and Stella NI Anasi. 2019. Information and communication technologies and access to maternal and child health information: Implications for sustainable development. *Information Development* 35, 4 (Sept. 2019), 524–534. <https://doi.org/10.1177/0266666918767482> Publisher: SAGE Publications Ltd.
- [111] Gerlieke Veltkamp, Mutsumi Karasaki, and Christian Bröer. 2020. Family health competence: Attachment, detachment and health practices in the early years of parenthood. *Social Science & Medicine* 266 (2020), 113351. <https://doi.org/10.1016/j.socscimed.2020.113351>
- [112] Anila Virani, Linda Duffett-Leger, and Nicole Letourneau. 2021. Parents' use of mobile applications in the first year of parenthood: a narrative review of the literature. *Health Technology* 5, 0 (Nov. 2021), 1–20. <https://doi.org/10.21037/ht-20-28> Number: 0 Publisher: AME Publishing Company.
- [113] Anne M Walsh, Kyra Hamilton, Katherine M White, and Melissa K Hyde. 2015. Use of online health information to manage children's health care: a prospective study investigating parental decisions. *BMC Health Services Research* 15, 1 (Dec. 2015), 131. <https://doi.org/10.1186/s12913-015-0793-4>
- [114] Margareta Wandel, Laura Terragni, Camilla Nguyen, Julianne Lyngstad, Marlen Amundsen, and Marina de Paoli. 2016. Breastfeeding among Somali mothers living in Norway: Attitudes, practices and challenges. *Women and Birth* 29, 6 (Dec. 2016), 487–493. <https://doi.org/10.1016/j.wombi.2016.04.006>
- [115] Robyn Whittaker, Sabrina Matoff-Stepp, Judy Meehan, Juliette Kendrick, Elizabeth Jordan, Paul Stange, Amanda Cash, Paul Meyer, Julie Baitty, Pamela Johnson, Scott Ratzan, and Kyu Rhee. 2012. Text4baby: Development and Implementation of a National Text Messaging Health Information Service. *American Journal of Public Health* 102, 12 (Dec. 2012), 2207–2213. <https://doi.org/10.2105/AJPH.2012.300736> Publisher: American Public Health Association.
- [116] World Health Organization. 2019. *WHO guideline: recommendations on digital interventions for health system strengthening*. Technical Report. World Health Organization. <https://apps.who.int/iris/handle/10665/311941> Section: xxii, 124 p.
- [117] World Health Organization. 2021. Global Health Observatory data repository. <http://www.who.int/gho/en/> Accessed on 2023-06-12.
- [118] World Health Organization. 2023. Chronic staff shortfalls stifle Africa's health systems: WHO study. <https://www.afro.who.int/news/chronic-staff-shortfalls-stifle-africas-health-systems-who-study>
- [119] WorldPopulationReview.com. 2024. Average Age of Having First Child by Country 2024. <https://worldpopulationreview.com/country-rankings/average-age-of-having-first-child-by-country>
- [120] Deepika Yadav, Prerna Malik, Kirti Dabas, and Pushpendra Singh. 2019. Feedpal: Understanding Opportunities for Chatbots in Breastfeeding Education of Women in India. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (Nov. 2019), 1–30. <https://doi.org/10.1145/3359272>
- [121] Sanni Yaya, Olalekan A. Uthman, Friday Okonofua, and Ghose Bishwajit. 2019. Decomposing the rural-urban gap in the factors of under-five mortality in sub-Saharan Africa? Evidence from 35 countries. *BMC Public Health* 19, 1 (May 2019), 616. <https://doi.org/10.1186/s12889-019-6940-9>