Utilisation of ICT in the South African milk banking process via *Milk Matters*

A review of relevant literature regarding milk banking

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ABSTRACT

This paper discusses the work done by the *University of Cape Town* (UCT) with the milk banking organization *Milk Matters*. UCT's work with *Milk Matters* produced an application that was successful during its initial deployment but fell into obsolescence due to its static nature and the difficulty in updating its content. In an attempt to formulate improvements to this application, various aspects of the milk banking industry are explored. New mothers are found to be attracted to internet resources, such as social media, due to their usefulness as both an education platform and a social support net. "Co-design" is considered, and the caveats in utilizing young mothers in its processes are explored. It is noted that altruism and testimonials, both emotional and professional, are the main motivators behind milk donation. Finally, the concept of a donor chatroom hosted by *Milk Matters* is interrogated, and it is determined that issues surrounding its moderation and liability are ultimately too great to allow for its implementation.

KEYWORDS

HCI, Human Milk Banking, Donor Mothers, Designing for Mothers, ICT

1 Introduction

Information and Communication Technologies (ICT) have become incredibly integrated into our everyday lives, with multiple industries cropping up based around certain aspects of human existence. One of these new, burgeoning fields is that of maternity care applications: software designed to aid mothers during the experiences of childbirth and early childcare. Additionally, ICT is starting to see increased prevalence in the world of social work, with many charities adopting computerized solutions to increase their efficiency. In 2018, Wardle et al. [26] worked with the breast milk-donation charity *Milk Matters* to design an application to aid donors, both current and potential. Wardle continued work with the organization, further exploring themes encountered during her previous work, and ultimately attempted to develop a donor "chatroom" to enhance their application [27]. This work represents an investigation into further improvements that could be included into the application, with a focus on the motivations and needs of donor mothers: needs that occasionally conflict with those of the human milk bank itself.

In this literature review, we first explore some background by recounting the history of *Milk Matters,* and the University of Cape Town's work with them. We also discuss the currently understood motivations for milk bank donors. Blood donation clinics and their practices are explored, as they represent a parallel field that has been the subject of much study. We examine what mothers look for in an ICT solution, how an ICT solution could be used to appeal to milk donor motivators, the impact ICTs have had on the milk banking industry so far, and finally what considerations need to be kept in mind when designing a social-network solution for *Milk Matters* in particular. Finally, based on these findings, we recommend some improvements to the current *Milk Matters* mobile application. Additionally, we also explore appropriate methods of conducting research during the COVID-19 pandemic.

2 Background

2.1 Milk Matters: A History

Milk donation is ultimately a recourse for mothers unable to supply enough milk themselves to their infants, for whatever reason. It is not the only available alternative, however: milk formula is often used by mothers to supplement their milk production where needed, and sometimes replaces breast milk entirely [2]. However, many medical boards recommend breast milk over other alternatives, including *The European Society for Paediatric Gastroenterology Hepatology and Nutrition* (ESPGHAN) [1]. Breast-feeding (and by extension breast milk) has been found to reduce the risk of diarrhea, prevent infections, and improve cognitive development in infants, among other benefits [1]. Furthermore, research suggests that the use of formula in lieu of breast milk to feed preterm infants can result in a higher risk of contracting NEC (necrotizing entero-colitis) [14].

Milk Matters is a South African nonprofit organization specializing in the collection, storage, and distribution of human breast milk [15]. Operating mainly in the Western Cape,

Milk Matters focuses on supplying breast milk to hospitals, particularly to premature babies. While initially supplying older babies in an orphanage, they pivoted to premature births, stating: "Rather than use 1 liter of milk to feed just one 7kg baby for 1 day, that same liter of milk could feed 21 premature babies of less than 1kg for 24 hours each – and very likely save their lives." [15]

Milk Matters is a relatively small-scale operation, with only about 20 donors contributing milk at any time [27]. Additionally, the organization is only composed of about 5 staff members: a nurse, a dietician, a lactation consultant, and 2 additional support staff [27]. Milk donors tend to be short term, partly due to their window of breastmilk production ending but also due to an overriding sense of futility. Donors often feel frustrated by the lack of feedback associated with their donations, and often do not realize just how important their donations are. In fact, one of the goals of the 2018 UCT collaboration was to provide some additional form of feedback to donors about their donations [26].

Despite this, *Milk Matters* boasts a relatively large base of invested non-donors. They have an e-mailing list of 1016 members, made up of a mixture of previous donors, supporters, and other otherwise interested parties [27]. Additionally, this mailing list currently represents Milk Matters main form of communication with its base.

2.2 Past Work with Milk Matters

In 2016, Wardle et al. published "Exploring Co-design with Breastfeeding Mothers", representing the first instance of cooperation between the *University of Cape Town* (UCT) and *Milk Matters* [26]. In order to explore design with this little-researched group, the researchers decided to collaborate with *Milk Matters* in designing an application to help donor mothers. After consulting with both *Milk Matters* staff, and donor mothers, the researchers decided to create an application with 3 main features: an individual milk-donation tracker for each mother, a milk-drop off depot locator, a breastfeeding-topic screen, and a general motherhood-topic screen [26]. The choice of features was informed by a 3-stage co-design process.

These features were all implemented as static content, entirely self-contained to the local application data itself [26]. While this implementation was ultimately the quickest and easiest approach, considering the timeframe in which it was developed in, it severely impacted the application's longevity. As content was entirely hard-coded, any changes or updates would require the manual modification of the application's source code, something the *Milk Matters* staff had no experience with. Additionally, the application was not maintained, and currently can no longer be downloaded from the Google Play Store, where it was originally published.

For Wardle's thesis, she decided to revisit her work with Milk Matters in an attempt to further explore the relationship between milk-donating mothers and milk banks, what motivates a mother to donate, and how best could computing be used to enhance the relationship between donors and their support networks [27]. From her research, Wardle pursued the implementation of a donor chat room within the pre-existing application [27]. Unfortunately, while a high-fidelity prototype demonstrating this functionality was produced, the donor chatroom (and by extension the server infrastructure to support it) was never properly implemented into the existing application. This decision was driven by Milk Matters concerns about the concept. Milk Matters were worried that a chatroom would allow the spread of misinformation, which they felt they would ultimately be held liable for [27]. They also were worried about the additional manpower required to moderate a chat room, as Milk Matters consists of very few staff.

2.3 Currently Understood Milk Donor Motivations

During their research with *Milk Matters* donors, Wardle et al. noted the mothers claimed that altruism was a strong motivator towards their decision to donate breast milk [26]. This motivation has been corroborated by other studies [8]. Additionally, mothers stated that they were motivated by testimonials and success stories relating to milk banking, particularly those about the recipients of the milk [26]. Finally, the mothers stated that positive reinforcement about their donations played a strong role in encouraging them to continue donating [26]. In fact, some mothers stated that they disliked donating to milk banks due to the lack of feedback associated with donating to them, preferring instead to stick to informal peer-to-peer donation networks [7].

During another study, conducted by Thomaz et al., some alternative motivations for donating were discovered. They found that most mothers donated due to being recommended to do so by a medical professional, with …"[being aware of] the needs of the babies the banks serve" being the next highest reason [20]. While the 2nd motivation can be easily classified under the same banner as "altruism" from the Wardle et al. study, the 1st points to the existence of a new motivation: professional testimony. This differs from the testimonials encountered by Wardle et al. in that its effectiveness is tied specifically to the perceived knowledge of and trust in a medical professional, as opposed to the more emotional appeal of a traditional testimonial.

While blood donation has seen much success with monetary renumeration in exchange for donations, many are wary of applying the same model to breast milk donations. The biggest concern is that this would encourage mothers to excessively donate milk, to the point where they could not provide for their own children [20].

3 Methods

Numerous papers surrounding the field of breast milk banking were analyzed, with a focus on those that explored the donor experience. Initial focus was on the papers by Wardle and Wardle et al. as they chronicled the work done so far with *Milk Matters* [26,27]. Afterwards, while some papers previously

cited in these works were explored, an effort was made to find works not cited, as to expand the horizons of this paper beyond that which was done before. Significant focus was placed on papers detailing projects involving mothers, as these findings can also apply to the given topic. Additionally, blood donation as a parallel field was also explored, and literature exploring blood donor motivations was of particular focus. This researcher used a process of summarizing each paper down to their most relevant points, and later consulted with these summaries while writing this review. All literature surveyed was peer reviewed, and websites were only consulted where information could not be found from a peer-reviewed source. Additionally, a meeting was conducted with *Milk Matters'* staff in order to gain some more insight on the workings of the organization.

4 Findings

4.1 Blood Donation as a Similar Field

Blood donation has been cited as a similar field to that of milk donation [20], as both involve the donation, preservation, and distribution of bodily fluids. The main difference between them, then, would be the populations they are able to target for donation: milk donation can only be solicited from lactating mothers, while blood donations can, by and large, be gathered from any suitably healthy person. Due to this, blood donation has a larger presence in the global consciousness, and its donors have been the subject of more study [20].

Blood donors and their motivations have been the subject of several studies [5,12]. Altruism has been one of the most consistently defined motivators, repeatedly emerging across multiple studies [5,6]. Additionally, incentives offered in exchange for donations have emerged as another strong motivator, particularly for first-time donors [5]. Many blood donation clinics have adapted to this and offer monetary renumeration to donors [5]. However, this form of incentive has also been found to increase the rate at which donors with an increased risk of transfusion-related infections apply [5]. Finally, social pressure has been found to be a strong motivator for donation [5,6]. This can take multiple, wildly different forms: from friends encouraging one-another to donate, to cold-calling canvassers soliciting donations for a clinic. However, it is generally agreed that the more personal and intimate the social pressure, the more effective a motivator it is [5].

In a study covering blood donation in 4 Canadian cities, it was observed that many of these clinics devoted significant resources to fostering a social media presence, in order to encourage blood donation [23]. Some of these centers found great success in specifically targeting workplaces, usually by leveraging experienced donors embedded in these communities to convince their coworkers to donate [23]. This made the experience of donating much less intimidating for first-time donors, as there was now an underlying sense of camaraderie associated with the act. Additionally, by exerting a gentle "peer-pressure", the experienced donors were able to make their coworkers feel a moral obligation to donate [23]. This is incredibly effective, as it has been found that one of the most effective motivations for first-time blood donation is "influence from a friend or relative" [24]. According to This leverage was made possible by how deeply the clinics had integrated themselves into their communities. In fact, many staff members credited this as the number one reason for their success, due to a perceived link between the public visibility of a clinic and their donor rates [23].

4.2 Mothers and ICTs

Gibson and Hanson found that many mothers found the internet to be an indispensable tool, often using it to seek advice on various aspects of motherhood [4]. Mothers would often use it to search for answers to questions they would feel too embarrassed to ask non-anonymously, as they felt they were too basic. Often, they could find their questions already answered, and in this way receive instant feedback. Chelsea et al discovered a similar sentiment, in that the mothers they prototyped their application with were extremely interested in the inclusion of some form of educational component [26]. Additionally, some mothers praised the educational aspect of the application after its release, stating that it was their favorite feature [26].

In Gibson and Hanson's study, some mothers disliked using traditional internet forums to access advice, as they were difficult to navigate on anything other than a laptop or desktop computer [4]. Instead, they preferred to use Facebook and other social networking platforms, in part due to their better user interface on mobile devices. Mothers often prefer mobile devices, as they are readily available (e.g. do not need to be booted up for use) [26]. Additionally, they can be operated with one hand, which is useful for mothers who wanted to use the device while tending to their child [26]. This implies to us that usability trumps anonymity, especially as platforms such as Facebook allow them to limit their interactions to specific social circles, limiting any embarrassment that might have emerged due to their lack of anonymity.

New mothers would often turn to social media, both for advice and for social support groups [16,26,27]. In a survey conducted by Morris, mothers of children aged 3 or less were queried about their social media use [16]. While this survey includes a broader demographic than what concerns this literature review, its insights are useful. For example, it was observed that most mothers preferred discussing their children on Facebook, as opposed to Twitter [16]. This may be due to the perceived "privacy" of the former, where for the most part only friends and family interact with one's content. Twitter is also perceived to be a primarily text--based service, resulting in mothers preferring to share images of their children on Facebook [16]. Despite this, Wardle et al. found that mothers disliked audibly noisy applications, as they would often distract their babies [26]. Additionally, McDaniel and Coyne found that

many mothers felt a stronger association between social support and traditional blogging than with other forms of social media [13]. Mothers felt that blogging allowed them to keep in touch with their friends and family, while also allowing them to both find parenting information (through other blogs and comments), and to share any parenting tips they had personally encountered [13].

4.3 Appealing to Donor Motivators with ICTs

While more general donor motivations were discussed earlier in this review, it is important to examine how these can be influenced through the use of ICT systems.

A popular design mechanism as of late is that of Gamification. Gamification refers to the design practice of applying a reward structure to some activity, often mimicking the design of a video game [18]. Huotari and Hamari define it as "a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation."[9] While gamification has been used to great success in other fields, it does not cleanly apply in the case of human milk donation. One concern echoes those of the process of monetary renumeration, where the reward structure may unintentionally persuade mothers to donate more than they can afford to. Additionally, many attempts at reward-based gamification only result in immediate, short term behavior changes [18]. The moment the rewards are removed, the users revert from any behavior reinforced by them. While this may seem to work to the benefit of milk donation, as a mother's lactation period is relatively short term and thus the change in behavior need only be temporary, this has negative implications for any post-donation interaction with *Milk Matters*.

We seek a deeper, more influential change of behavior then. Wardle et al. aimed to increase motivation through the simple application of more feedback mechanisms: mothers could visualize and track their milk donations, allowing them to better understand the impact they were having through their contributions, ultimately appealing to the altruism motivator [26]. Additionally, this inclusion directly addresses a common complaint from donors, where they were unsure as to the impact they were making. One route to take, then, may be to pursue this angle further by enhancing this already implemented feedback even more.

Fogg proposes that computers can be mapped to a "Functional Triad", representing their purpose to the user [3]. Depending on the category it falls into a computer can have different persuasive affordances associated with it [3]. In our case, the *Milk Matters* application as is currently can be classified as a "tool", which implies that it is afforded the ability to change mental models, reduce barriers, inform decision making, and increase self-efficacy [3]. If we were to expand the application into the category of "social actor", by including some form of community-driven aspect to it, we could expand these affordances to include the ability to establish social norms and rules, and the ability to provide social support. Some of this support could, for example, come in the form of user testimonials, appealing to yet another motivator.

4.4 Breast Milk Donation and ICTs

While milk banks have not been radically changed by the emergence of ICT systems, informal milk donation has gained a new-found popularity due to the introduction of social networking services. Known as peer-to-peer milk sharing, this process used to be relatively unpopular, mostly due to a lack of adequate communication: even if a mother had milk to spare and was willing to share, the odds of them finding another mother in need were relatively low [7]. This tells us that the introduction of enhanced communication tools (in this case, social media networks) can allow for the creation and maintenance of communities that previously could not exist.

Milk Matters, in its current iteration, relies heavily on a few key technologies afforded to them by the internet. As previously stated, their main method of communication with their base is a comprehensive emailing list, used to distribute a newsletter. Additionally, *Milk Matters* operates a Facebook page, which is used to promote the organization as well as solicit interaction from their community (eg: a post asking the question "Who made a difference to your breastfeeding / donating journey?", with followers answering in the comments). Furthermore, *Milk Matters* is not concerned about being held liable for comments made on their Facebook posts by mothers, as it is commonly accepted that any miscellaneous bad actors in the comments would do not speak for the organization itself. As such, moderation of the Facebook group is relatively lax, which suits their small staff size.

4.5 Moms, *Milk Matters*, and Chatrooms

As stated earlier, mothers have flocked to social media services as of late, mainly due to the ease of access to educational resources as well as its presence as a social support network. Additionally, multiple blood banks have found great success in the establishment of and integration in communities. This success has been repeated by peer-to-peer milk donation services, using online communication platforms.

The possible creation and hosting of an online community in the form of a chatroom was explored by Wardle [27]. During her research, Wardle identified several key themes regarding donors likes and dislikes of online communication platforms. While most of these mothers already used online resources to find educational materials, they still felt anxiety with regards to the act of contributing to this communication [27]. This was, in part, due to mothers not wanting to unintentionally solicit negative comments from other mothers. Additionally, some mothers had been the victims of cyberbullying on these platforms. However, many mothers also agreed that these resources could ultimately be beneficial, providing not only educational and social resources, but also simply being a way to pass the time [4]. As such, the recreational aspect of such an online platform cannot be understated.

However, despite their established acceptance of Facebook as a social platform, *Milk Matters* have been weary of establishing any other "official" platforms of communication. The reasons stated for this are twofold. Firstly, and most importantly, *Milk Matters* do not want to be held liable for any incorrect or harmful advice shared on such a platform. Secondly, *Milk Matters* does not currently have the manpower to effectively moderate such a platform and are not interested in expanding their staff to accommodate this responsibility.

4.6 Methods Used in Research with Mothers

The previous Milk Matters application was designed using a 3-stage "co-design" approach, where mothers were consulted about what features the application should contain [26]. "Co-design" refers to the practice of having trained application designers participate with potential users in designing a product and is defined by Sanders and Stappers as "the creativity of designers and people not trained in design working together in the design development process." [21] This method of design is distinct from "co-creation", which simply refers to any act of creativity stemming from the collaboration of two or more designers. This contrasts with classical design theory, in which the line between designer and user is strict and unbroken: Classical design treats the user simply as an object of study [21]. "Co-design" usually takes place at the very beginning of a product and is used to define the key deliverables expected from it. After these are decided upon, a more traditional design process ensues, with designers crafting a product that meets these criteria. Compared to classical design, "Co-design" possesses a few key advantages. The most plainly obvious is that, by integrating feedback from a userbase early in the design process, a project's functional and non-functional requirements will more closely align with what the userbase desires. Designers will emerge with a better idea of their users' needs, and this will ultimately result in an improved product. This process has also been found to generally result in more successful innovations in product design, particularly with regards to service design [25]. Additionally, "Co-Design" is associated with overall better decision making, lower development costs, and a lower time-to-market.

In utilizing co-design, Chelsea's team decided to incorporate current donors of breastmilk as their user-participants [26]. In doing so, they discovered multiple challenges stemming from these participants' roles as mothers. Mothers of newborns would often have most of their time taken by looking after their child, and often could not fit research sessions into their schedules [26]. This made more traditional co-design processes, such as workshops and interviews, difficult to organize. This resulted in the scrapping of larger workshops, and a pivot towards individual interviews. These interviews were used as they could be scheduled individually for each mother, which ultimately allowed for more flexibility timewise. Gibson and Hanson encountered similar problems [4]. However, this study differed in that the researcher was currently on maternity leave themselves, and so she herself fell into the demographic to be studied. This aided her, in that this shared experience helped encourage the research participants to relate and communicate to her [4]. Additionally, the researcher was able to observe multiple mothers at once by attending multiple "parent-child" support groups. These groups existed to "...provide a place for parents to bring their babies to meet new people and find support." [4] However, their study had planned from the start to conduct individual interviews, and as such they were not conducted as a "compromise" when another option fell through. The interviews focused on a small group of mothers, 6 in total, gathered from 5 different "parent-child" support groups [4]. Again, meetings would often have to be informally organized, in order to fit into each mother's varied schedule. Additionally, mothers would often be distracted by their children mid-interview, resulting in whatever answer being given at that instance becoming sub-standard. This problem was also encountered by Chelsea's team [26].

5 Discussion

5.1 Possible Solutions

While the initial application developed by Wardle et al. was successful in providing enhanced feedback to donor mothers, and in turn improving the donor experience somewhat, the application itself has multiple issues. It initially only targeted the Android operating system, resulting in many mothers not having access to it. It also was comprised of entirely static content, with no mechanism provided to update said content remotely. Finally, as of writing this, it no longer appears in the Google Play Store, having been delisted for an unknown reason. While Wardle did attempt to improve upon it with the introduction of a donor chatroom, she ultimately failed to get approval from *Milk Matters* for this feature [27].

In order to ensure that the application could target as many phones as possible, two avenues are available. The first, and most obvious, would be to simply develop multiple versions of the application for different operating systems. However, while multiple cross-platform application development tools exist, this would still require developer licenses on multiple application stores, which is a costly proposition. Additionally, it would still require occasional further development on each application, in order to keep them working on new versions of each operating system. An alternative solution, then, would be to implement the application as a progressive web application. Progressive web applications are, for all intents and purposes, websites with enhanced functionality comparable to a native application [11]. Since these use common web technologies to function, they are inherently cross platform, and the only upkeep cost associated with them is like that required to host a webpage. Although they need to be accessed via a URL initially, they can be used online afterwards, as the application will locally cache any required data [11]. However, the possibility remains that an application of this nature will be perceived by

users as less-functional than a natively developed one, due to its inherent web-based nature.

In order to allow for the delivery of updated content to the application, a backend presents the most obvious solution. By implementing a client-server model, content could be uploaded to the server from *Milk Matters*' side, which would in turn be distributed automatically to all clients currently connected to the internet. Additionally, clients could have the functionality to upload their own contributions to the server, allowing for the possibility of user-driven content.

Finally, the implementation of a backend could call into question the inclusion of some form of social networking again. As *Milk Matters* has already expressed their reservations about the concept, any attempt at it would need to support extremely low-effort and hands-off moderation, as least from their staff (owing to their small numbers). Considering *Milk Matters* is already comfortable with the existence of their Facebook group, a possible alternative to a fully-fledged chatroom would be some form of Facebook integration, linking users of the application to said group.

5.2 Limitations on Research Imposed by COVID-19

At the time of writing this literature review, the world is currently experiencing an extreme health crisis in the form of the COVID-19 pandemic[1]. In response, the South African government has instituted a nation-wide lockdown, to span from the 26th of March 2020 to the 30th April 2020[2]. This period, already, is the result of an extension to the original end date of the 16th of March 2019, and as such further extensions are possible. Faced with both the logistical challenges of conducting field research during a lockdown, as well as the ethical challenges of meeting participants face-to-face during a pandemic, we need to seriously consider any remote research methods available to us.

The first obvious solution would be to conduct interviews over an online video-conferencing platform, such as Skype or Zoom. Teleconferencing relies on both parties having the required equipment and computing devices. As such, by committing to teleconferencing we will be unable to interview anyone without access to some form of personal computing device. However, many video-conferencing platforms are multiplatform by nature, supporting both mobile smart-devices and traditional home computers alike. Since our study will be based around the use of a smart-phone application, we can safely assume that any study participant will have access to suitable hardware.

One positive aspect of using videoconferencing is the increased availability it provides to both parties. For a video-call to take place, both parties simply need to agree on a time in which they are both free. Furthermore, when scheduled in advance with a set time duration, video calls tend to be more strictly structured timewise than in-person meetings [22]. This could work to our favor, however, as often mothers have little available time to share [26], and so this stricter adherence to time limits may be more appealing to them. Compared to traditional face-to-face meetings, however, teleconferencing meetings do not have a completely identical "flow" of conversation. Often, breaks in connectivity can result in disruptions to the conversation, either due to gaps in communication from one party, or delays in transmission from one party resulting in overlapping speech [19]. Additionally, teleconferencing will often fall into a pattern of explicit "handovers", where participants will often speak one at a time, and explicitly state when the next participant can speak (often by referring to them by name) [19]. However, in a question-answer format of conversation, such as that found in a one-on-one interview, this won't have a huge impact, as the flow of conversation already follows an explicit "call and response" ("question, then answer") structure.

In addition to interviews, surveys present a no-contact solution for interacting with research participants. Surveys are described by Muller et al. as "… a method of gathering information by asking questions to a subset of people, the results of which can be generalized to the wider target population." [17] For the purposes of this review, we define an "Online Survey" as a questionnaire distributed over email to a predetermined set of recipients. One of the most important differences between surveys and interviews are their rigidity. A survey's questions cannot be changed mid-session, while an interviewer may decide to do so in an interview. Additionally, an interviewer is usually able to perform some limited form of observation of participants, noting down interesting physical tics, for example. In contrast, a survey will only provide the researcher with answers to the questions provided, no more. Another caveat is time: when answering a survey, participants can take as much time as they need to formulate their answers to their questions. During an interview, the participant is instead put "on the spot", and the interviewer is privy to their initial "gut reaction" to the question. Finally, surveys run the risk or not being completed by enough participants if distributed en-masse, such as what occurred to Chelsea et al in their initial study [26].

In an HCI context, surveys have proven to be an effective method of collecting user attitudes, intents, characteristics, and experience feedback [17]. This is due to their ability to incorporate a large participant size, along with the relative rigidity of their question structure. Overall, surveys are generally more "quantitative" than traditional interviews and are most effective when utilized to research an entire population [10,17]. Surveys often provide a layer of anonymity not present in traditional interviews, which can sometimes encourage participants to share opinions which may not be considered "socially desirable" [10]. On the other hand, this

[1] World Health Organization. 2020. Rolling updates on coronavirus disease (COVID-19). Retrieved May 11, 2020 from *https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen*.

[2] SAnews.gov.za. 2020. Nationwide lockdown extended by two weeks. Retrieved May 11, 2020 from *https://www.sanews.gov.za/south-africa/nationwide-lockdown-extended-two-weeks*.

also limits the degree to which interpersonal trust can be developed between the researcher and the participant, potentially hindering the honesty of their answers [10]. If a survey is electronically distributed, its participants are limited to those with suitable devices and internet access. However, as stated before, we can safely assume our participants have access to a compatible smart device.

6 Conclusions and Future Work

Milk Banks as an industry have not fully embraced ICTs yet, but that is slowly changing. The potential impact these technologies could have on the industry has already partially revealed itself: peer-to-peer milk banking, once an obscure practice, has found new popularity in the age of social media. This is mainly due to the effectiveness ICT's possess at forming and maintaining communities. This community building is an important aspect, as can be seen with the success found not only by these milk sharing groups, but also by several blood clinics. While the latter did not explicitly rely on ICTs to do so, they still made a huge effort to integrate themselves into their local communities, to great effect.

ICTs are also very useful to mothers in general. For instance, many mothers consider the internet to be an extremely valuable tool, as they can access educational resources as well as social support on it. However, there are some requirements from these technologies that are exclusive to mothers: they must be easily usable while tending to a baby (while often leaves only one hand free), they must not be distracting to the baby, and they must support a sufficient level of privacy towards the mother. Additionally, mothers tend to associate traditional blogging services with stronger levels of social support than newer social networks, such as Facebook.

In terms of donor motivators, two main ones have been established: altruism and testimony (both emotional and professional). In designing to appeal to these motivators, we can use the concepts provided to us by Fogg [3]. The current *Milk Matters* application can most accurately be described as a "tool", according to his paradigm. This category theoretically allows for influence using testimonies. However, if we were to shift the application towards the "social actor" category, we would also be able to provide increased social support for these mothers, and in addition appeal to their altruism through other donor mothers. We could achieve this shift by implementing socialization features, but this has it's own issues.

Milk Matters has found great success in the formation and use of a Facebook group. Nevertheless, they are still mostly unwilling to create and moderate a social platform of their own. This is mainly due to concerns over liability with regards to incorrect advice that may be shared there, and the moderation duties that would entail. Thus, any attempt to create a *Milk Matters* social platform of any form would need to adhere strictly to their concerns.

Additionally, the research methods used by Wardle et al. are by and large still accepted as effective. A Co-Design process, in collaboration with current donor mothers, still seems to be the strongest method of design available to us.

Finally, we propose several changes to the current *Milk Matters* application. We recommend that the application become available on multiple mobile operating systems. This expands the market of the application to encompass every donor under *Milk Matters* wing and will no longer result in some donors missing out due to their model of cellphone. There are multiple ways this could be carried out: the application could either be created using multiplatform-development-tools, or it could be developed as a progressive web application.

We also recommend the implementation of a client-server model, effectively creating a backend for the application. This will result in *Milk Matters* having the ability to dynamically update content within the application, which will positively impact the longevity of it. This also raises the possibility of user-generated content being collected by the server, allowing for more community-driven features. This backend would also allow for the implementation of some form of social platform, but as mentioned previously this would have to designed incredibly carefully.

Ultimately, this paper mostly limited itself to issues and concerns faced by *Milk Matters* in the ongoing support of their own application. There is still a large academic void regarding the general use of ICT systems by milk banks, and the unique ethical implications surrounding them. Currently, most research has been directed towards peer-to-peer milk banks, and the general motivations of those who choose to donate milk. While Wardle's work has begun to make inroads into this field, there is still much to be explored by further research.

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REFERENCES

[1] Carlo Agostoni, Christian Braegger, Tamas Decsi, Sanja Kolacek, Berthold Koletzko, Kim Fleischer Michaelsen, Walter Mihatsch, Luis A Moreno, John Puntis, Raanan Shamir, Hania Szajewska, Dominique Turck, and Johannes van Goudoever. 2009. Special Feature Breast-feeding: A Commentary by the ESPGHAN Committee on Nutrition ESPGHAN Committee on Nutrition. *Journal of pediatric gastroenterology and nutrition* 49, 1 (2009), 112–125. DOI:https://doi.org/10.1097/MPG.0b013e31819f1e05

[2] Sertac Arslanoglu, Willemijn Corpeleijn, Guido Moro, Christian Braegger, Cristina Campoy, Virginie Colomb, Tamas Decsi, Magnus Domellöf, Mary Fewtrell, Iva Hojsak, Walter Mihatsch, Christian Mølgaard, Raanan Shamir, Dominique Turck, and Johannes van Goudoever. 2013. Donor human milk for preterm infants: Current evidence and research directions. *Journal of Pediatric Gastroenterology and Nutrition 57*, 535–542. DOI: https://doi.org/10.1097/MPG.0b013e3182a3af0a

[3] Brian J. Fogg. 1998. Persuasive Computers: Perspectives and Research Directions. *Proceedings of the SIGCHI conference on Human factors in computing systems* (1998), 225–232. DOI: https://doi.org/10.1145/274644.274677

[4] Lorna Gibson and Vicki L. Hanson. 2013. Digital motherhood: how does technology help new mothers? *CHI '13: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2013), 313–322. DOI: https://doi.org/10.1145/2470654.2470700

[5] Theresa W. Gillespie and Christopher D. Hillyer. 2002. Blood donors and factors impacting the blood donation decision. *Transfusion Medicine Reviews* 16, 2 (2002), 115–130. DOI: https://doi.org/10.1053/tmrv.2002.31461

[6] Simone A. Glynn, Steven H. Kleinman, George B. Schreiber, Thomas Zuck, Suzanne Mc Combs, James Bethel, George Garratty, and Alan E. Williams. 2002. Motivations to donate blood: demographic comparisons. *Transfusion* 42, 2 (2002), 216–225. DOI: https://doi.org/10.1046/j.1537-2995.2002.00008.x

[7] Karleen D. Gribble. 2013. Peer-to-Peer Milk Donors' and Recipients' experiences and perceptions of donor milk banks. *JOGNN - Journal of Obstetric, Gynecologic, and Neonatal Nursing* 42, 4 (2013), 451–461. DOI: https://doi.org/10.1111/1552-6909.12220

[8] Karleen D. Gribble. 2014. "I'm happy to be able to help:" Why women donate milk to a peer via internet-based milk sharing networks. *Breastfeeding Medicine* 9, 5 (June 2014), 251–256. DOI: https://doi.org/10.1089/bfm.2014.0009

[9] Kai Huotari and Juho Hamari. 2012. Defining gamification: a service marketing perspective. In *Proceeding of the 16th international academic MindTrek conference*, October 3 – 5, 2012, Tampere, Finland, 17–22. DOI: https://doi.org/10.1145/2393132.2393137

[10] Henrik Lindhjem and Ståle Navrud. 2011. Are Internet surveys an alternative to face-to-face interviews in contingent valuation? *Ecological Economics* 70, 9 (July 2011), 1628–1637. DOI: https://doi.org/10.1016/j.ecolecon.2011.04.002

[11] Tim A Majchrzak, Andreas Biørn-Hansen, and Tor-Morten Grønli. 2018. Progressive Web Apps: the Definite Approach to Cross-Platform Development? In *Proceedings of the 51st Hawaii International Conference on System Sciences*, January 3 – 6, 2018, Hilton Waikoloa Village, Hawaii, 5735-5744. DOI: https://doi.org/10.24251/HICSS.2018.718

[12] Barbara M. Masser, Katherine M. White, Melissa K. Hyde, and Deborah J. Terry. 2008. The Psychology of Blood Donation: Current Research and Future Directions. *Transfusion Medicine Reviews* 22, 3 (July 2008), 215–233. DOI: https://doi.org/10.1016/j.tmrv.2008.02.005

[13] Brandon T. McDaniel, Sarah M. Coyne, and Erin K. Holmes. 2012. New mothers and media use: associations between blogging, social networking, and maternal well-being. *Maternal and Child Health Journal* 16, 7 (2012), 1509–1517. DOI: https://doi.org/10.1007/s10995-011-0918-2

[14] W. McGuire and M. Y. Anthony. 2003. Donor human milk versus formula for preventing necrotising enterocolitis in preterm infants: Systematic review. *Archives of Disease in Childhood: Fetal and Neonatal Edition* 88, 1 (January 2003), F11–F14. DOI: https://doi.org/10.1136/fn.88.1.f11

[15] Milk Matters. 2015. Milk Matters - History. Retrieved May 11, 2020 from *http://milkmatters.org/about/history/*.

[16] Meredith R. Morris. 2014. Social networking site use by mothers of young children. In *Proceedings of the ACM Conference on Computer Supported Cooperative Work, CSCW*, Feburary, 2014, 1272–1282. DOI: https://doi.org/10.1145/2531602.2531603

[17] Hendrik Müller, Aaron Sedley, and Elizabeth Ferrall-Nunge. 2014. Survey research in HCI. In *Ways of Knowing in HCI*. Springer New York, 229–266. DOI: https://doi.org/10.1007/978-1-4939-0378-8_10

[18] Scott Nicholson. 2015. A Recipe for Meaningful Gamification. In *Gamification in education and business*. Springer, Cham, 1–20. DOI: https://doi.org/10.1007/978-3-319-10208-5_1

[19] Brid O'Conaill, Steve Whittaker, and Sylvia Wilbur. 1993. Conversations Over Video Conferences: An Evaluation of the Spoken Aspects of Video-Mediated Communication. *Human-computer interaction* 8, 4 (1993), 389–428. DOI: https://doi.org/10.1207/s15327051hci0804_4

[20] Claire A. Pimenteira Thomaz, Luiz v. Maia Loureiro, Tathiane da Silva Oliveira, Norma C. de Mendonça Furtado Montenegro, Eglailson Dantas Almeida Júnior, Cláudio Fernando Rodrigues Soriano, and Jairo Calado Cavalcante. 2008. The human milk donation experience: Motives, influencing factors, and regular donation. *Journal of Human Lactation* 24, 1 (February 2008), 69–76. DOI: https://doi.org/10.1177/0890334407310580

[21] Elizabeth Sanders and Pieter Jan Stappers. 2008. Co-creation and the landscapes of design. *CoDesign* 4, 1 (2008), 5–18. DOI: https://doi.org/10.1080/15710880701875068

[22] Monique Sedgwick and Jude Spiers. 2009. The Use of Videoconferencing as a Medium for the Qualitative Interview. *International Journal of Qualitative Methods* 8, 1 (March 2009), 1–11. DOI: https://doi.org/10.1177/160940690900800101

[23] André Smith, Ralph Matthews, and Jay Fiddler. 2013. Recruitment and retention of blood donors in four Canadian cities: An analysis of the role of community and social networks. *Transfusion* 53, S5 (December 2013), 180S-184S. DOI: https://doi.org/10.1111/trf.12478

[24] B. Nilsson Sojka and P. Sojka. 2008. The blood donation experience: Self-reported motives and obstacles for donating blood. *Vox Sanguinis* 94, 1 (January 2008), 56–63. DOI:https://doi.org/10.1111/j.1423-0410.2007.00990.x

[25] Marc Steen, Menno Manschot, and Nicole de Koning. 2011. Benefits of Co-design in Service Design Projects. *International Journal of Design* 5, 2 (2011), 53–60.

[26] Chelsea Joy Wardle, Mitchell Green, Christine Wanjiru Mburu, and Melissa Densmore. 2018. Exploring co-design with breastfeeding mothers. In *Conference on Human Factors in Computing Systems - Proceedings*, Association for Computing Machinery. DOI: https://doi.org/10.1145/3173574.3174056

[27] Chelsea-Joy Wardle. 2019. Co-Designing with and for milk donors. Master's dissertation. University of Cape Town, Western Cape, South Africa.