"Let Me Know If You Need Anything": Support Realities of New Mothers

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ABSTRACT

This paper presents findings from a study conducted with 48 pregnant and new mothers to understand their support needs and support sources. We engaged 10 first-time pregnant women, 20 pregnant mothers, and 18 new mothers in eight weeks of research activities using closed Facebook groups. The activities included surveys, open ended questions, creative tasks, and discussions. Our findings indicate that mothers most value instrumental support: physical help in tasks, such as laundry and cooking. Our findings also show that support needs and support sources of women evolve as they go through pregnancy, childbirth, and stages of motherhood. Informed by these findings, we propose a design framework - the Evolving Ecology of Support (EES) - and provide examples on how the Pervasive Health community can develop empowering and support enabling solutions.

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INTRODUCTION

There is considerable evidence indicating the positive effects social support has on individuals' health and quality of life [7]. There is also a strong connection between the well-being of new mothers and infants. Crokenberg, who conducted a longitudinal study of temperamentally difficult infants and their families, found that mothers who had high levels of social support were able to establish more secure attachments with their infants than mothers with low levels of social support [13]. Prior studies show a strong relationship between poor social support and Postpartum Depression (PPD) [33]. New mothers who lack adequate support have a higher risk of developing PPD [34]. While some mothers are able to find ways to actively mobilize support, barriers exist that prevent others from asking for and receiving the support they need. Women have also voiced concerns about how others would perceive their role or effectiveness as mothers if they asked for help [15].

Social support has been categorized as emotional support (ability to confide in someone), informational support (ability to receive information), and instrumental support (receiving tangible assistance) [11, 10]. Technical and non-technical interventions that provide emotional and informational support for new mothers include peer mentoring support [32], peer-to-peer telephone support [14], volunteer home support [4], and text messaging services (e.g., Text4baby, a text messaging service in the United States which sends text-messages to women who are pregnant or parenting) [18]. Many women consider instrumental support an essential component for physical and emotional well-being after childbirth [34], however interventions that facilitate seeking and receiving instrumental support for new mothers are lacking. *To this end, our study aims to understand the support needs, especially instrumental support, of new mothers.*

Using the Asynchronous Remote Community (ARC) method [28, 39], we engaged 48 pregnant women and new mothers in a research study using closed Facebook groups for eight weeks. In this paper, we: (1) present the findings from the largest ARC study to date; (2) propose a design framework for maternal support interventions; and (3) suggest design guidelines for developing socio-technical support interventions using the proposed framework.

RELATED WORK

In this section, we review the effects of new mothers' support networks on their well-being; barriers to seeking support; and technology solutions for mothers to identify the lack of systems that engage mothers' support networks.

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Social Support and Mothers' Well Being

Social support is essential for managing illness and maintaining good health, be it managing chronic diseases, undergoing cancer treatment, caring for people with disabilities or maintaining healthy habits [16, 23, 1]. There is strong correlation between the amount of postpartum support a woman receives and the risk of developing postpartum depression (PPD) [34]. Nuckolls et al. found that women with low social support and high stress suffered more complications than women with high stress but with high social support [35]. Access to social support and interactions has been linked to better maternal-child health outcomes [29].

In terms of social support, mothers cited their partner as the primary source of support and relied on them for emotional and instrumental support [34, 38]. Low partner support is a major risk factor for postpartum depression [30]. Indeed, the amount of support the partner gives to the mother can help lessen the risk of PPD and improve the relationship between them [40, 34]. Canadian teen mothers were twice as likely as adult mothers of having PPD (14% vs. 7.2%) largely because adult mothers had more partner support [27].

Barriers to Maternal Support Seeking

A major barrier for mothers seeking support was the fear of judgement from others. Women believed that society would view them as "bad mothers" because they needed help in raising a child, and it was assumed that a mother should handle child rearing on her own [34]. This fear stems from the high expectations mothers place upon themselves due to an idealized picture of parenting presented to them in the media [15]. Women feel that they must be "strong and organized" at all times [6]. Women fear a cycle of failure and they believe once they fail in one aspect of motherhood, such as breastfeeding, then they will fail in other aspects too. New mothers are often sleep deprived and hormonal changes affect their ability to ask for help [6, 17]. Understanding these barriers is essential to designing effective support intervention for mothers.

Technology for Mothers

There are many socio-technical systems that help mothers with pregnancy, childbirth, and infant care. "The prepared partner" [22] teaches labor and childbirth support techniques via a game. "Text4Baby,"[1] a free mobile service sends timely health information via SMS text messages to pregnant women and new mothers [36]. "Feedfinder," a mobile application helps women find breastfeeding locations. Mothers help each other by reviewing and sharing information about available designated breastfeeding locations using Feedfinder [3]. "Babysteps," another mobile application [26] with social media integration [41] helps parents track their children's developmental milestones. "Estrellita," a mobile application allows parents of premature babies track babies' health [21]. A majority of these solutions focus more on infant care rather than maternal care. There are no socio-technical solutions that focus solely on helping women seek and receive instrumental support, the type of support women value the most after childbirth [34, 38].

[1]https://www.text4baby.org/

	NP N(%)	EP N(%)	M N(%)
Education			
High School or less	0(0)	1(5)	0(0)
Some College	3(30)	5(25)	8(44)
Bachelor's	4(40)	8(40)	7(39)
Master's or Higher	3(30)	6(30)	3(17)
Race/ Ethnicity			
White	6(608)	16(80)	12(67)
Hispanic/Latino	0(0)	1(5)	6(33)
Black or African-American	1(10)	1(5)	0(0)
Asian or Asian American	2(20)	2(10)	0(0)
Declined to answer	1(10)	0(0)	0(0)
Employment Status			
Home Maker	0(0)	8(40)	6(33)
Unemployed	3(30)	2(10)	3(17)
Employed	7(70)	10(50)	9(50)
Marital Status			
Married	8(80)	19(95)	17(94)
Not Married	1(10)	1(5)	0(0)
Declined to Answer	1(10)	0(0)	1(6)
Combined Family Income			
Under $20,000	1(10)	2(10)	2(11)
$20,000 - $40,000	2(20)	3(15)	3(17)
$40,000 - $70,000	2(20)	4(20)	7(39)
$70,000 - $100,000	3(30)	4(20)	2(11)
Greater than $100,000	1(10)	7(35)	1(6)
Declined to answer	1(10)	0(0)	3(17)
Number of Children			
1	0(0)	10(50)	1(6)
2	0(0)	6(30)	3(17)
3	0(0)	2(10)	2(11)
4	0(0)	1(5)	0(0)
Declined to answer	0(0)	1(5)	12(67)
	N=10	N=20	N=18

NP: New (first-time) Pregnancy, EP: Experienced Pregnancy, M: Moms

Table 1: Demographic Information.

METHOD

We used the Asynchronous Remote Communities (ARC) method [28, 39] to understand the available support networks and support needs of pregnant women and new mothers. The ARC method uses closed Facebook groups as an alternate platform to engage participants who are limited by geographic and mobility constraints that prevent them from taking part in face-to-face research activities. A previous study by Morris et al. [31] found that new mothers remained engaged in Facebook activities even after childbirth, thus we concluded that the ARC method utilizing Facebook was a convenient way to engage our target population: pregnant and new mothers, who face time, location, and mobility constraints.

Participants

After getting approval from the Institutional Review Board (IRB), we recruited pregnant women who were in their third trimester of pregnancy and new mothers with a baby under 4 months old. For recruiting, we posted flyers at local stores and around XYZ University. We also posted the flyer on our Facebook pages and Twitter feeds. We targeted social media sites for pregnant women and mothers. A local birthing services center posted the study information on their website and Facebook page. We coordinated with BabyCenter.com staff who posted our recruitment message to relevant forums.

Sixty-three interested participants, who met our inclusion criteria, received a consent form. We received 52 signed consent forms, invited all 52 to participate; and enrolled 48 women from 11 different states in the United States - including eight

Activity	Week	Type	Topic
A1	1	Open Ended Discussion	Participant Introduction
A2	1	Poll	Preferred Time for Activity Post
A3	1	Open Ended Discussion	Things I wish I knew
A4	2	Survey	Edinburgh Postnatal Depression Scale 1
A5	2	Creative Task	Circle Diagram/ Support Network
A6	3	Open Ended Discussion	Talk about Support
A7	3	Survey	Social Support Communication
A8	4	Open Ended Discussion	Interactions Today
A9	4	Open Ended Discussion	Advice Columnist-Anxious
A10	4	Open Ended Discussion	Advice Columnist-Relationship
A11	5	Open Ended Discussion	Ask Me Anything
A12	5	Open Ended Discussion	Issues and Worries
A13	5	Open Ended Discussion	Helpful Resources
A14	6	Open Ended Discussion	Physical Help Needs
A15	6	Survey	Technology/ Resources
A16	7	Survey	Edinburgh Postnatal Depression Scale 1
A17	7	Survey	Support Needs Survey
A18	8	Creative Task	Google Search History
A19	8	Open Ended Discussion	Why Reluctant to Ask For Help?

Table 2: Study Activities.

international participants who currently reside in the United States. Detailed demographics are available in Table 1.

Based on participants' status in pregnancy and motherhood, we categorized them into three groups. The first group consisted of women who were pregnant for the first time and in their third trimester, hereafter referred to as "New Pregnancy," or NP ($N = 10$, age: M=28, SD=2.7). The second group consisted of women who were pregnant, but had at least one child, referred to as "Experienced Pregnancy," or EP ($N = 20$, age: M=32, SD=4.6). The final group consisted of women who had given birth recently to a child less than 4 months old, but were not currently pregnant, referred to as "Moms," or M ($N = 18$, age: M=30, SD=3.8). Recognizing that experienced mothers would have different experiences than first-time mothers, we planned to create separate groups for them. However, only six mothers met our inclusion criteria, thus, we combined experienced mothers and first-time mothers to a single group of Moms. Compensation of $50 was given to the participants at the conclusion of the study.

Procedure

We created three Facebook groups for the three participant groups (NP, EP and M) and invited participants to join their respective groups. The three groups were separate, closed groups, where participants in one group could not see the activities in another group. We engaged participants for eights weeks, using 19 activities posted in the Facebook groups (Table 2). Activities included open ended questions, surveys, validated instruments, and creative tasks. Researchers posted open ended questions on Facebook, prompting participants to discuss topics pertaining to their supporters, roles, expectations, and availability of help. Discussions were visible to everyone in the group. We posted links to surveys in Facebook and the responses were saved directly to Google Sheets, which were not visible to participants. Creative activities included drawing a circle of supporters in concentric circles and placing them in the order of support they provided, and sending or sharing the Google search history.

Researchers at Indiana University report on a similar study noting the performance of the ARC method for engaging pregnant women and new mothers [39]. Within this paper, we report only on the *needs* of pregnant women and the *data yielded* from the ARC method.

ANALYSIS

We used Dedoose (www.dedoose.com), a qualitative data analysis software program to analyze the data. Each week, we exported data from Facebook groups to Dedoose. As we exported the data, we used descriptors to properly identify and manage contributions from participants belonging to different groups.

We used an integrated approach that employs both inductive and deductive development of codes. Informed by prior research and the study aims, we developed an initial code framework. Next, we conducted open coding of the study data, where two researchers closely read the texts, labelled concepts, and developed categories [8]. Researchers coded the same data to keep bias at a minimum and to allow for different ways to analyze the data. During the axial coding phase, we related similar themes and concepts to come up with the initial code book. After multiple iterations, we finalized the code book for the data analysis. The agreement among the coders was confirmed by the inter-coder reliability score of >.84. We used open ended discussions and surveys to triangulate key concepts.

FINDINGS

In this section, we describe sources of support that pregnant women and mothers identified; the types of support they needed during their transition to motherhood; barriers to asking for help; and motherhood realities as participants described them. Finally, we discuss participants' use of technology and social media to seek informational and emotional support. We refer to the participants in the new pregnancy group as NP-P1 through NP-P10, experienced pregnancy group as EP-P1 through EP-P20, and Moms group as M-P1 through M-P18. We also include what activity number (A1-A19) the quote came from.

Sources of Support

We used triangulation to identify and confirm mothers' sources of support. First, we used a circle diagram activity (A5) where participants drew a diagram of their social support network as a series of concentric circles (Figure 1), placing themselves at the center and people who are closer to them in circles nearer to them. To verify the results from the circle diagram (A5), we posted an open ended question (A6), asking whom they talk to frequently. The third activity included for triangulation was a survey (A8) where we asked the participants to identify the people they turn to for specific situations - such as for financial, emotional, and health issues. We used two scenario activities (A9 & A10) along with A5 for further triangulation of data. As evidenced by the qualitative data reported in this section, we also used additional activities to collect rich data that elucidated participants' support needs and sources.

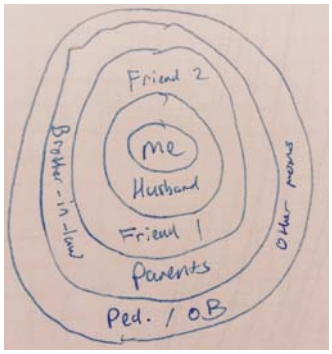

Figure 1: Circle Diagram of Supporters

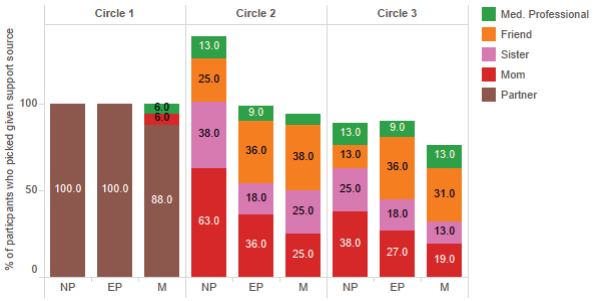

Figure 2: Supporters in the first three circles of Circle Diagram Activity. Participants could place multiple support types within each circle, thus the % of participants who chose a particular type of supporter may add up to more than 100%.

The Primary Supporter

Overall, participants identified their partner as their primary source of support, as shown in Figure 2, based on the circle diagram activity (A5). A majority (NP=100%, EP=100%, M=88%) of participants placed their partners in the inner most circle (circle 1), thus indicating them as the primary supporters. In the second circle, they placed their Mothers, sisters, and friends indicating a high level of support they expect or receive from family and friends. A small percentage of the participants included medical professionals.

While every participant in the NP and EP groups placed their partner in the inner most circle, the M participant who did not put her partner in the inner most circle was not married. Participants overwhelmingly selected their partner as their primary source of support in activities A6 (NP=100%, EP=91%, M=71%) and A8 (NP=88%, EP=89%, M=94%). These triangulation activities (A5, A6, and A8) confirmed their partner as the most trusted and most frequently engaged supporter.

NP participants expected a high level of support from their partners. Even if they noted other supporters, NP participants preferred and expected their partners to be the primary supporter. They discussed emotional support and assurance from their supporters, rather than instrumental support.

NP-P6 (A12): *"I expect my partner to be emotionally supportive during this period, as that's as much he will be able to do as I'll be exclusively breastfeeding."*

NP-P8 (A19) *"For the most part, I expect that my husband and I will take care of most things on our own."*

NP-P9 (A19): *"I think right now I feel confident I will be able to handle taking care of the baby and household duties, but I know I will be able to lean on my husband to help me out with both when I need it."*

Some participants said their partner was their only supporter:

NP-P4 (A7): *"I will not recruit anyone else as a helper. My husband will be the only one who helps me with the chores and our baby."*

NP-P7 (A7): *"Except for my husband, I don't feel that I have any other person that I am close enough with to share all of my thoughts/feelings/concerns/questions day-to-day."*

Mothers' (EP & M) responses reflected on their experiences and desire for instrumental support:

EP-P14 (A14): *"My husband was around for basically the first six weeks after our baby was born, which provided childcare for our older two kids - that was the most important thing that helped. Some help cleaning would have been really nice, but the state of my house just wasn't a priority at that time."*

EP-P13 (A12):*"My husband was very supportive with helping to position the baby, get up with her in the middle of the nights at times and would cook my favorite meals. He was always willing to talk through concerns I had...[to make decisions]*

M-P12 (A12) *"I wasn't prepared for how difficult postpartum recovery was going to be for me - I could barely walk across the rooms for a couple weeks. With a 2 year old and a 5 year old at home, I needed a lot of help and support from my spouse to fulfill my role in our family as a SAHM.*

Overall, participants expected high levels of support from their partners. EP and M participants expected more physical support compared to first-time mothers. NP women did not discuss the physical help they might need after childbirth.

Other Essential Supporters

Participants largely identified their mothers (including mothers-in-law), sisters, and friends as major sources of support during and after pregnancy, as shown in Figure 2. Participants did not consider medical professionals often as supporters.

NP women depended on their mothers for substantial help with their baby because they viewed their own mothers as sources of information about infant care:

NP-P3 (A14): *"I think I will need help with baby stuff I am unfamiliar with such as bathing the baby, changing it's [sic] diaper, watching the baby while I shower etc., breastfeeding. I think my mom will be a lot of help for such things."*

NP-P10 (A6): *"I will call my Mom more frequently with pregnancy questions. [smile emoticon]"*

EP and M participants discussed the substantial help they received from their own mothers and mothers-in-law. These

participants indicated that they depended on mothers in their lives for physical and emotional support following childbirth.

M-P11 A(12): *"I prepared myself for the worst. I seem to have handled it pretty well with husband and Mother in law taking care of house chores and cleaning in the 1st week."*

M-P10 (A6): *"I'm closest to my mom, so she would be up there as an emotional support. She and I joke, FaceTime almost daily, talk about day to day life and the ups and downs of being a mom."*

Another important group of supporters women depended on for pregnancy and postpartum support was their friends. Compared to the NP group, a higher percentage of EP and M participants put friends in circle 2 (Figure2), indicating the importance moms place on their friends for postpartum support. Friends played an important role in mobilizing support from their community. A common example was friends organizing meals with websites (e.g., www.mealtrain.com) to deliver food.

EP-P16 (A3): *"I feel very fortunate to have had a few close friends going through pregnancy at the same time and I felt pretty prepared and supported for motherhood (thus far)"*

M-P15 (A14) *"Cooking and cleaning–for the first two months, we had someone helping with the cleaning, and a friend organized a meal train to drop off food. This was a huge help..."*

M-P10: (A6) *"I can talk about a lot with some of my mom friends, like the ladies from my [name] new moms group and some other friends who also happen to be... new moms."*

NP women did not share about help they received from friends. The data indicates that mothers, especially EP, depend on friends for instrumental, informational, and emotional support.

Support Needs and Sources

When we asked the NP women to select the most trusted sources for information about motherhood (A15), a majority selected their doctors and partners. EP and M women selected a variety of supporters, such as sisters, mothers-in-law, and friends. For information about infant health, pediatrician was the top choice. A majority of the participants indicated that they use social media for emotional support. Although study participants were at different stages of motherhood, their expectations, needs, and sources of support differed based on whether they had experienced motherhood before.

There was consensus among the groups about the types of support they needed after childbirth. As shown in Figure 3, a high percentage of women wanted to receive help with physical tasks, such as house cleaning and cooking that may require longer time and energy investments. Participants, especially in the M group, valued instrumental help so that they could focus on their baby's needs and their own recovery.

Support Expectations and Realities of New Mothers

In the Facebook group discussions, participants were optimistic about their support expectations, however when we asked the participants to discuss any difficulties they encountered when communicating about or receiving help, they expressed a different reality.

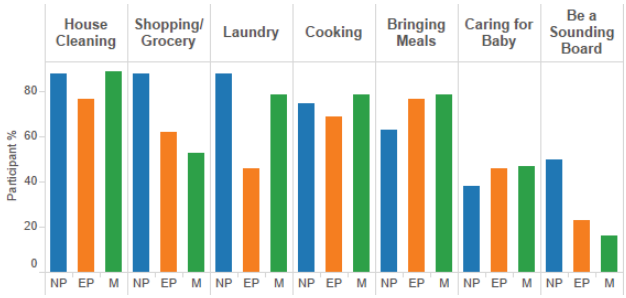

Figure 3: Support Needs: Data Collected Using a Survey Activity (A17)

Support Expectations

In terms of support expectations for NP, since we did not do a pre-, post- follow-up with them, we cannot authoritatively say if their expectations were realistic. The NP participants largely noted they would turn to their partners for emotional support and family for instrumental support. Their discussions also reflected practices one reads in baby books and hears from experienced mothers, such as NP-P5 (A12):

"Most babies sleep often the first few weeks, so as long as I can sleep while baby does I'm not too worried about that..."

One area that we found most concerning was some NP participants' views on postpartum depression - *"Even though some women experience 'Baby Blue or Postpartum Depression Syndrome', hopefully, I will not experience that. I would try to overcome that issue from now on by asking great supports from my care network."* (NP-P4 (A12). Indeed, some participants thought that PPD could be overcome on their own, which is potentially concerning.

Participants in the EP and M groups reflected on their past experiences to modulate their expectations from their support network. Based on these experiences and changes they were making, they felt more prepared than their first post-birth experience. Although they expected emotional support, they favored instrumental support:

EP-P2 (A10): *"Learning from previous experiences with my first baby, this time I am preparing myself a little bit better. I am preparing meals and freezing them. When people had offered to bring food after the baby arrives, I am saying that it will be really appreciated. Some people had offered to take my oldest child if I feel overwhelmed...it will also be appreciated."*

Some experienced mothers felt that their past experience prepared them enough so that they felt comfortable with their future birth:

EP-P8 (A8): *"I haven't done much research this time. Having been through it once, I am definitely not nearly as worried as I was about being a first-time mom."*

EP-P13 (A3): *"I seem to know what to expect this time so that's great. I have fewer questions and feel much more mentally prepared for things."*

Overall, there seems to be value in reflecting on one's own past birth experiences to prepare for the future.

Unexpected Difficulties

EP and M participants noted difficulties they encountered after childbirth that they were unaware of in their first childbirth, but were taking steps to be prepared for during their subsequent births.

EP-P8 (A14): *I never knew, and was so surprised after my first, how long I hurt. It hurt to walk, stand, sit, everything. Nobody ever talked about the pain of birth! I will need help with lots of stuff this time around and will gladly accept any help offered!"*

Many mothers faced unexpected recovery problems that affected their ability to care for their new babies.

M-P15 (A12):*"Then there was the bleeding and the engorged breast. It was something no one told me would happen. I did end up with an infection after birth and didn't know if it was 'normal' to feel so sick and have fevers. After that it was the taking care of baby when I had no sleep."*

EP-17 (A3): *"Aftercare...what it really is like for yourself after you deliver a baby. I was one of the first of my close friends to have a baby and no one was really open to discuss what you really feel like and go through for a bit after you deliver"*

Some mothers expressed how some commonly held beliefs and sayings about motherhood and support proved to be difficult to implement in practice.

M-P10 (A14): *"Definitely need help cleaning. It was very difficult when people were all like 'Clean llllaaaaterrr, sleep when the baby sleeps!' and I was like, 'If I don't take care of all of these things, who will?'"*

EP-P5 (A14): *"Cook me dinner and do my dishes!!! hahaha, also play with my toddler because I bet she will have some pent up energy since we won't be getting out as much!! It would be nice to have someone watch my toddler and baby so I can take a nice long shower! Also watch them while I take a nap where I can sleep until I wake up versus being woke up when someone needs me."*

Our findings show that mothers face unexpected physical difficulties after childbirth. They find it difficult to balance household responsibilities, infant care, and recovery. Their discussions also revealed that they sometimes did not receive realistic recovery information, nor the help they hoped for.

Support Reality

Some mothers described how their support network could not adequately support them. There was a gap in communication between M participants and their support network. Mothers often felt that they could not ask for help from their support networks because their supporters did not know what type of help the mothers really needed. This communication gap became a barrier for obtaining support and, as a result, the mothers found themselves overwhelmed and tired.

EP-P7 (A19): *"I usually won't ask for the help, but if someone does offer, I will usually say that I am interested. My parents ... have started to offer more help now that we are pregnant with our second, but most of the help offered was around caring for our daughter. When mostly the help I would most appreciate would be with taking care of things around the house, errands, etc."*

M-P1 (A19): *"With regards to the 'let me know if you need anything' I feel like people just say it to he [sic] nice or they want to help but are not sure how? I much preferred offers of specific help when friends &fam [sic] would say 'I'll come on (date) to help you with (task)' or 'what do you need from the store' 'I'm bringing food over (date/time)'."*

EP and M participants shared that they did not get the help they wished for, even from their partners, who they consider their primary supporters.

M-P1 (A6): *"My husband and I talk about baby but not in detail as he hasn't got a lot of experience with babies and is easily grossed out lol"* We note here that in the *Other Essential Supporters* section, some EP and M participants noted how helpful mothers were in taking care of these instrumental support tasks, however in this section we note different participants who did not have these expectations met, and often mentioned their partners with respect to this instrumental support.

Support Network Size and Wellness

Since we were interested in how social support impact a pregnant or new mother's mental health, we used the Edinburgh Postnatal Depression Scale [12] for A4 and A16 as a pre-post status survey. The instrument has 10 questions used by health professionals to assess postnatal depression. We scored the surveys based on the instrument instructions. If any participants scored as possibly depressed, we sent them an IRB-approved email encouraging them to contact a health professional with links to relevant resources.

Although 33% of participants scored in the depression risk category, we did not find any connection between postnatal depression and the size of a mother's social support network. From the responses to the Circle Diagram activity (A5) we calculated the total number of supporters (M=9, SD=4.1) in each participant's support circle . We also counted the number of support circles (M=5, SD=1.4) they had. While the descriptive statistical analysis indicates that the number of supporters and number of circles might have a negative association with depression status (Kendall Tau = -0.16 (supporter count), -0.182 (circle count)), there is no statistically significant evidence to suggest a negative association (p-values = 0.186 (supporter count), 0.094 (circle count)). We acknowledge however that we only have a sample size of 35 women who completed both EDPS and the circle diagram activities, thus we need more studies with larger sample sizes to confirm this finding.

Barriers to Asking and Receiving Help

EP and M participants discussed their experiences and attitude towards asking for help. While some felt comfortable asking, many were reluctant since they felt guilty about asking for help and feared judgement from others.

EP-18 (A19): *"I hate to impose on other people. My local friends all have families and stressers of their own, and I don't want to be the cause for another."*

Some participants questioned whether the offer to help was genuine:

M-P18 (A19): *"Everyone says 'lets us know if you need help!'. With some people I don't know that well and I'm not comfortable asking them. Others, I'm not sure if they were just saying that or if they really meant it."*

Some women wanted to ask for help, but really did not know how to ask for it or if offers were genuine.

M-P9 (A19): *"I've never been the type to ask for help...This is no different. So many times I want to call a friend and ask them to just hold her so I can sleep. But, then I feel guilty. I feel like most people say they want to help, and to call them, but then when push comes to shove, they can't."*

Even when helpers are available, the help they offered was not what the mothers really needed.

M-P10 (A19): *"I feel like this is something I hear a lot about in my mom groups...their own mothers or MILs either treating them as a burden or being on the flip side which is to overly insert themselves/not respect authority."*

Our study shows that there is a significant gap between the expectations of support and the actual support. There is also a gap between the expectations of life after delivery and the reality. Finally, some of these gaps may exist because participants are unsure how to ask for help and if the support will be what they need.

Mothers' Use of Technology

Previous studies on the technology use of mothers have shown that many mothers sought information and support from various internet sources, such as online forums and Facebook [19, 2, 31, 20]. We observed a similar trend in the three groups in this study. Each group specifically stated that they use online forums and websites, such as WebMD and BabyCenter, as informational resources. 94% of the participants used mobile phones for communicating with their support network and accessing information.

In addition, mothers used technology to communicate with their support network via texting, Facebook chats, and video chats, as NP-P4 described: *"With my mother (via text or voice conversation) - at least once a week, we talk much about the pregnancy, how to care for baby, required stuff, and everything that I want to know.* The type of technology women used evolved over the course of their pregnancies into motherhood. Pregnant women relied on social networks such as Facebook and Twitter to connect with friends and family and to share their excitement and pregnancy updates with friends and family. They watched YouTube videos to gain understanding of labor and delivery. On the other hand, mothers used on-line forums and Facebook groups to get answers to questions regarding infant care or recovery from childbirth. They noted that they used social media to get emotional and social support.

DISCUSSION

In this section, informed by our findings, we propose a design framework in a specific design space for mothers to encourage the Pervasive Health community to explore.

Evolving Ecology of Support

Analysis of our data reveals the transient nature of support needs, sources of support, and the type of socio-technical systems mothers depend on as they embark on the life changing journey of pregnancy and motherhood. From the responses of first time pregnant mothers, we find that they are excited about pregnancy, the prospect of motherhood, and expect support from a variety of people in their support network. They depend on health care providers for guidance through their medical journey and loved ones for emotional and physical support. Sometimes, they depend on peers in social media groups - strangers who are bound by common experience - for informational support and encouragement.

Adjusting to the realities of motherhood can be physically and emotionally taxing for mothers, especially for first-time mothers. As we discuss in our findings, first-time pregnant women did not discuss the challenges they may face following childbirth. Recovering from childbirth is a demanding period for mothers as they go through hormonal changes and physical recovery, in addition to the new responsibilities of infant care and possibly breastfeeding. During this period, mothers have different support needs and their sources of support change.

Our findings show that EP and M mothers need help with time consuming physical tasks such as laundry and cooking and they expect their partners and other supporters to share these responsibilities. Sometimes there is a gap between expected and received support. Mothers with multiple children have additional support needs to manage their own lives and their families. In short, the ecology of support evolves as mothers go through their first pregnancy to motherhood and possibly cycling back through this evolving ecology when they bring subsequent children into their families. The evolving nature of the support ecology presents challenges to designers who build support interventions to help women navigate this transitional phase.

Drawing from prior research, we present a design framework in a design space for mothers that the Pervasive Health community can utilize in developing socio-technical systems. Peyton et.al [38, 37] introduced the concept of "pregnancy ecology" as a paradigm for designing health and wellness management tools for lower income pregnant women. Their work encourages designers of mHealth solutions for pregnancy to use an ecological approach that includes informational triggers for holistic health, social and overall life support, along with medical guidelines for health [37]. We extent the concept of "pregnancy ecology" to a wider transitional arc in a woman's life: from pregnancy to stages of motherhood. Indeed, we also

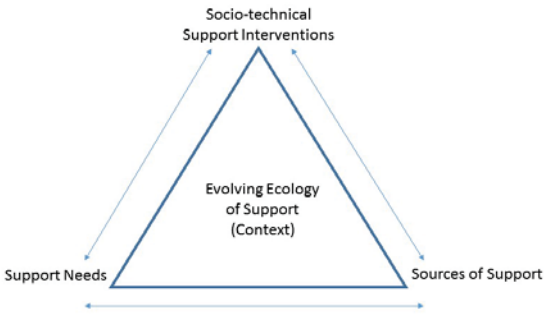

Figure 4: Evolving Ecology of Support (EES).

bolster and extend Peyton's notion of supporter network with respect to who is involved and for what purposes[37].

Another holistic health technology approach that informed our design framework is the "Cancer Journey Framework" proposed by Jacob et.al [24]. They presented a framework to support the development of health tools that consider a patient's cancer journey (diagnosis through post-treatment survivorship) more broadly to include health needs alongside the priorities of daily life. We believe, similar to a patient's cancer journey, a woman's journey from pregnancy to stages of motherhood faces numerous physical and emotional challenges that necessitate support from diverse sources depending on the stations of journey they are in. In addition, the need to consider one's personal health while also coordinating others' lives (e.g., younger child) and household responsibilities resonates with this framework. Informed by these two holistic, transitional frameworks, we present an evolving ecology framework for support interventions that evolve with a mother's journey through pregnancy, childbirth, recovery, and motherhood.

Here we introduce a design framework, *Evolving Ecology of Support* (EES) for maternal support interventions. In this support ecology, we identify three key elements, as shown in Figure 4, that continually evolve: support needs, support sources, and support interventions. We also present a conceptual design space, *pregnancy-motherhood continuum* for maternal support interventions where the EES framework can be integrated into. In this design space, needs, sources, and interventions adapt and evolve along the pregnancy-motherhood continuum. Current socio-technical support solutions do not take this pregnancy-motherhood continuum into consideration. For example, the text messaging service Text4Baby [18] fulfills the informational needs for a healthy pregnancy, infant safety, and infant wellness after delivery [2], however, it does not provide informational help on topics about a mothers' recovery from childbirth or her overall wellness. If one applies the framework we proposed, such helpful messaging services will cover the arc of pregnancy, childbirth, recovery, and stages of motherhood - for both baby *and mother*.

[2]https://text4baby.org/about/message-content

IMPLICATIONS FOR DESIGN

Here we propose some design guidelines for socio-technical systems following EES that evolve along the different stages in the pregnancy-motherhood continuum.

The platform is the most important consideration when designing a sociotechnical system for mothers to ensure it is versatile, accessible, and convenient. A nationwide 2014 survey commissioned by Kensington found that 88% of American moms have smart phones [25]. Indeed, 94% of mothers in our study relied on mobile phones to search information on the internet, participate in social media interactions, and keep in contact with partners, family, and friends. Research has also shown that first-time mothers often use computers when they are pregnant more than after they have children because their time commitments change [20]. Thus, we suggest building support interventions for mothers that can be easily accessed on mutiple platforms - from computers to mobile devices. If researchers aim to work with mothers after they give birth, mobile platforms are the best options.

Sources of Support were primarily identified as one's partner for emotional and physical support by mothers in our study. In addition, participants identified their mothers as important providers of physical support. When women had multiple children, they included friends for physical support. Since the support needs and sources evolve, design strategies to initiate, maintain, and terminate membership to this support system ecology needs to be investigated in detail. When is the ecology of support initiated? Who initiates it? Who are the members of her support ecology at various points in the continuum? More insights are needed into the initiation and evolution of this process.

Breaking Barriers to ask for help by mothers is important since the mothers expressed some reluctance to seek support. As a community, we must investigate how we can design systems to enable and empower women so that they do not feel guilty or judged when asking for help. How can a system make it easy for supporters to proactively seek *what* mothers need help with since mothers noted how sometimes the help offered was for something they did not need help with (e.g., volunteering to watch an older child when the mother wanted to spend time with the child, but needed help with laundry). A possible avenue of investigation is sharing economies [5] where people can post their needs in exchange for helping someone else at another time.

Messaging and Privacy are incredibly important for the Ecology of Support because mothers expressed the need to share, learn, and know about intimate life details - from dealing with childbirth pain to engorgement. We also know that mothers, upon reflecting on past events, prepared for their subsequent pregnancies differently in an attempt to improve their recovery experience. Thus, we need to design mechanisms for women to share their experiences and how they overcame these sometimes traumatic experiences with the ability to hide their identity in case they do not want their identity known. Likewise, with messaging, we want to provide mothers, especially first time mothers, with information about the postpartum experience so they are prepared, but without scaring them. For

example, not all mothers will get an infection and a fever as M-P15 reported, however if a mother does have a fever, she should know that this is not normal. We envision a modern system similar to HeartCare [9] that helped people recovering from coronary artery bypass graft surgery understand what is "normal" during recovery and what symptoms required a medical professional.

LIMITATIONS

The main limitation of our study was the need for participant to have an an Internet connection. In addition, only women who met our maternal status criteria who also had Facebook accounts could participate. They also needed to be familiar with navigating social media. These limitations may have excluded participants living in remote and low-resource locations. In our study, 88% of the participants who reported their family income were above the federal poverty income guideline [3]. Another limitation is that we did not ask the participants about their geographic proximity to supporters. In addition, we did not ask the participants about their sexual orientation. We encourage researchers to collect this additional information in future studies to better understand the support realities of new mothers in different sexual orientation relationships.

CONCLUSION

We discussed findings from a study we conducted with 48 pregnant and new mothers to understand their social support expectations and realities. Our findings show that mothers' support needs and expected sources of support evolve as they transition from pregnancy to motherhood. Socio-technical systems that aim to facilitate support for new mothers need to have a long-term perspective. To this end, we proposed a design framework, Evolving Ecology of Support (EES) and identified design space challenges for Pervasive Health Community. We challenge the Pervasive Healthcare community rethink support solutions for mothers in a holistic way, that supports infant care and *mother care* through the ever evolving, personalized, support solutions that promote mothers' wellness, especially during a major transition in her life.

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[3] https://aspe.hhs.gov/poverty-guidelines

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