

# Using Human Centered Design to Identify Opportunities for Reducing Inequities in Perinatal Care

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## Research Article

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1 **Abstract**

2 Background: Extreme disparities in access, experience, and outcomes highlight the need to  
3 transform how pregnancy care is designed and delivered in the United States, especially for low-  
4 income individuals and people of color.

5

6 Methods: We used human-centered design (HCD) to understand the challenges facing Medicaid-  
7 insured pregnant people and design interventions to address these challenges. The HCD method  
8 has three phases: Inspiration, Ideation, and Implementation. This study focused on the first and  
9 second. In the Inspiration phase we conducted semi-structured interviews with a purposeful  
10 sample of stakeholders who had either received or participated in the care of Medicaid-insured  
11 pregnant people within our community. Using a general inductive approach to thematic analysis,  
12 we identified themes, which were then framed into design opportunities. In the Ideation phase,  
13 we conducted structured brainstorming sessions to generate potential prototypes of solutions,  
14 which were tested and iterated upon through a series of community events.

15

16 Results: We engaged a total of 171 stakeholders across both phases of the HCD methodology. In  
17 the Inspiration phase, interviews with 23 community members and an eight-person focus group  
18 revealed seven insights centered around two main themes: (1) racism and discrimination create  
19 major barriers to access, experience, and the ability to deliver high-value pregnancy care; (2)  
20 pregnancy care is overmedicalized and does not treat the pregnant person as an equal and  
21 informed partner. In the Ideation phase, 162 ideas were produced and translated into eight  
22 solution prototypes. Community scoring and feedback events with 140 stakeholders led to the  
23 progressive refinement and selection of three final prototypes: (1) implementing telemedicine

1 (video visits) within the safety-net system, (2) integrating community-based peer support  
2 workers into healthcare teams, and (3) delivering co-located pregnancy-related care and services  
3 into high-need neighborhoods as a one-stop shop.

4  
5 Conclusions: Using HCD methodology and a collaborative community-health system approach,  
6 we identified gaps, opportunities and solutions to address perinatal care inequities within our  
7 urban community. Given the urgent need for implementable and effective solutions, the design  
8 process was particularly well-suited because it focuses on understanding the needs and values of  
9 stakeholders, is multi-disciplinary through all phases, and results in prototyping and iteration of  
10 real-world solutions.

11

12 **Keywords:** human-centered design, perinatal care

1 **Background**

2 Poor pregnancy outcomes and disparities in the United States are a sign of low-value and  
3 ineffective care. The structure and content of outpatient prenatal and postpartum care largely  
4 emerged from medical opinion and tradition, rather than evidence tying it to better outcomes.(1)  
5 In addition, there is abundant evidence that structural, institutional, and interpersonal racism is  
6 deeply embedded into U.S. medical care, especially within obstetrics and gynecology.(2–4)  
7 These issues highlight the need to transform how pregnancy care is designed and delivered,  
8 especially for low-income individuals and people of color who face the worst inequities in  
9 pregnancy care access, experience and outcomes.

10

11 Barriers to ineffective pregnancy care for low-income people are well-documented. Inadequate  
12 transportation, limited clinic hours that require time off from work, job insecurity, and short  
13 grace periods before being considered a “no-show” make it challenging to consistently attend  
14 prenatal care appointments.(5,6) Standard prenatal visits, often 10-15 minutes in duration,  
15 usually focus on a pre-determined list of screening tests and questions, rather than prioritizing  
16 patients’ concerns and questions.(7) Psychosocial, educational, and resource support are often  
17 delivered through separate providers and programs-- requiring more of the patient’s time,  
18 additional screening and intake processes, and a more fragmented care experience.(8) People of  
19 color experience widespread racism and discrimination during pregnancy care encounters,  
20 eroding the ability to trust and value the care being provided.(2,9) While models such as  
21 Centering Pregnancy® and home visiting programs have been developed to overcome some of  
22 these barriers, disparities in care access, experience, and outcomes persist, even in communities  
23 where these novel programs have been implemented.(10,11) To address these disparities, it is

1 important to focus on the care experience of those facing the worst outcomes, and to design  
2 solutions accordingly.

3  
4 In this study, we describe our community’s use of human-centered design (HCD) methodology  
5 to identify opportunities for redesigning pregnancy care, with the goal of reducing racial and  
6 socioeconomic disparities faced by Medicaid-insured individuals. Through a community-health  
7 system partnered process, we sought to identify important insights and opportunities to guide  
8 redesign efforts and to develop concrete and desirable prototypes for implementation.

## 9 **Methods**

### 10 Study Design and Setting

11 We conducted a prospective observational study using HCD methodology to identify and  
12 develop solutions to address the needs of Medicaid-insured pregnant people in San Francisco,  
13 California. This work was a collaboration between the San Francisco Respect Initiative, housed  
14 within the Department of Obstetrics, Gynecology and Reproductive Sciences at the University of  
15 California, San Francisco (UCSF) and Zuckerberg San Francisco General Hospital (ZSFG), and  
16 The Better Lab, a mixed-methods research center at ZFSG. The study protocol was approved by  
17 the Institutional Review Board of UCSF. Informed consent was obtained from all participants  
18 who took part in an in-depth interview or focus group discussion.

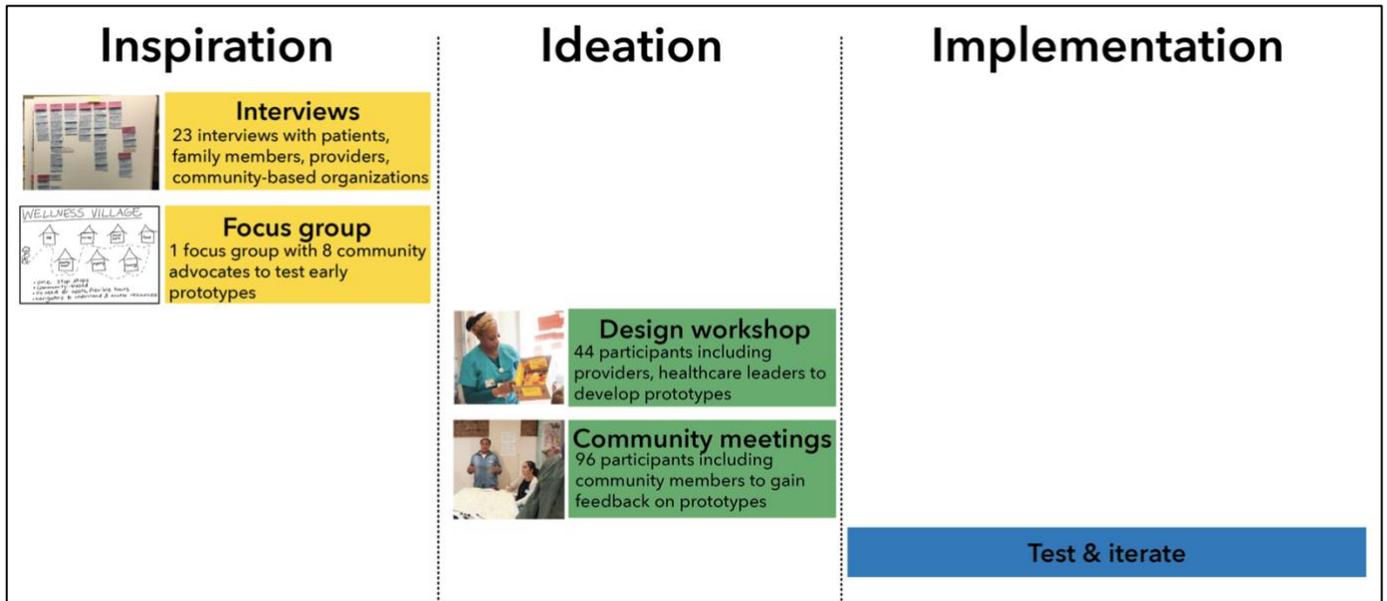
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### 20 Human-Centered Design in Healthcare

21 HCD uses ethnographic research to understand the values and needs of stakeholders, and a  
22 structured and iterative process to develop innovative solutions that prioritize diverse  
23 stakeholders’ needs and preferences. The use of HCD methodology in healthcare has been

1 growing over the past decade, with evidence of improved healthcare access and outcomes.(12–  
 2 14) Here, we describe the first and second phases of the HCD methodology: ‘Inspiration’ and  
 3 ‘Ideation’ (Figure 1). The ‘Inspiration’ phase included qualitative research through individual  
 4 semi-structured interviews and a focus group with key stakeholders. Qualitative data from these  
 5 interviews were synthesized to identify themes and inform the creation of insight statements and  
 6 opportunities. The ‘Ideation’ phase included brainstorming and prototyping solutions, with  
 7 feedback from users and relevant stakeholders. The third phase, ‘Implementation’, is outlined but  
 8 will be further described and evaluated in future studies.

9 **Figure 1:** Activities that comprise the Preparation, Inspiration, Ideation and Implementation  
 10 phases of the Human-Centered Design process. During the Inspiration and Ideation phases  
 11 described in this study, insights and themes from target users are made into actionable  
 12 opportunities, as depicted in Figure 2.  
 13



14  
 15  
 16

1 The San Francisco Respect Initiative

2 Before our study began, the San Francisco Respect Initiative assembled a multidisciplinary

3 advisory group of 14 individuals to ensure community participation across all aspects of the

4 HCD process, and the prioritization of prototypes for future implementation (Table 1). Half

5 (7/14) of this advisory group identified as Black, 21% (3/14) as Latinx, 14% (2/14) as White, and

6 14% (2/14) as Asian; all group members identified as women. The advisory group met monthly

7 and was co-led by the project leader and one of the community members. The core research team

8 met weekly and included the project leader (MN), the community member co-lead (SW), and

9 design researchers from The Better Lab (AS, LC, DP, JL).

10

11 **Table 1:** Multidisciplinary Advisory Group Members

12

<b>Community Members (4)</b>
Four Black and Latinx identifying SF residents
<b>Health system workers (4)</b>
Midwife - ZSFG Midwife researcher Women’s Health Clinic medical assistant OBGYN resident physician
<b>System Leaders (4) from SF Department of Public Health or UCSF</b>
UCSF Center of Excellence in Women’s Health UCSF Child Health Equity Initiative SFDPH – Perinatal Service Coordinator SFDPH – Black Infant Health Program
<b>Project Leader</b>
Obstetrician Gynecologist – ZSFG and UCSF
<b>Facilitator</b>
Community Engagement and Equity Driven Initiatives Expert (UCSF)

13

14 Abbreviations: ZSFG – Zuckerberg San Francisco General Hospital; SFDPH – San Francisco

15 Department of Public Health; UCSF - University of California San Francisco

16

1 Inspiration Phase: Qualitative Data Collection & Analysis

2 *Interviews and focus group*

3 Purposeful sampling was used to recruit stakeholders that represent a broad demographic cohort  
4 with diverse pregnancy experiences.(15) Eligibility criteria for patients who were interviewed  
5 included the following: 18 years old or older; experience of being Medicaid-insured; living in  
6 San Francisco; preparing to become pregnant, currently pregnant, or recently pregnant. Patients  
7 were recruited through provider and staff referrals at the ZSFG women’s health clinic and at  
8 local community organizations that support pregnant women, primarily through referrals and  
9 flyers posted at these sites. Health professionals, providers, community health workers, and  
10 community members, and activists chosen for interviews were recruited through referrals from  
11 our advisory group and word of mouth. All interviews were one hour long and performed in a  
12 location of the interview subjects’ choice, including but not limited to, community health centers,  
13 places of work, and at The Better Lab offices. Participation was voluntary and patients were  
14 compensated \$50 for their time.

15  
16 Interviews were semi-structured and included open ended questions about the experience of  
17 being pregnant and receiving pregnancy care in San Francisco (Appendix 1). Interviews were  
18 conducted by 2-4 members from the core research team. Each interview was led by one design  
19 researcher, while the rest of the team recorded notes and asked follow-up questions. To maintain  
20 participant confidentiality all interviews were anonymous and were not audio-recorded. One  
21 focus group was conducted with a group of 8 community advocates who were part of an existing  
22 group assembled by UCSF’s California Preterm Birth Initiative to work with UCSF researchers  
23 on developing and implementing interventions aimed at preventing preterm birth. The focus



1 *Themes*

2 Qualitative data were analyzed using a general inductive thematic analysis  
3 approach.(17,18) Each interview was reviewed by two design researchers to  
4 independently extract quotes or ideas that represent discrete themes. These researchers  
5 then collaboratively discussed the themes until consensus was reached on each interview.  
6 The core research team then met to discuss all interviews and to agree on common  
7 themes until no new themes emerged. Quotes were then extracted to represent each  
8 theme. Themes were finally reviewed by the Advisory Group to ensure the completeness  
9 and accuracy of the data from the community perspective.

10

11 *Insight Statements*

12 The core research team reviewed the themes and developed insight statements. An insight  
13 statement is a short sentence that represents user perspectives, motivations, and tensions  
14 from the thematic data to define a human need.(19) The goal of developing insight  
15 statements is to ascribe meaning to thematic data.(20) The insight statements were  
16 reviewed by all members of the core research team and advisory group, discussed and  
17 refined until consensus was reached.

18

19 *Design Opportunities*

20 Insight statements were then translated into design opportunities. Design opportunities  
21 propose actionable ways to address the challenges described in the insight statement and  
22 inform the development of low-fidelity prototypes that can be tested with users in  
23 subsequent phases of design research.(20) As with insight statements, a list of design

1 opportunities was initially developed by the core research team and then refined through  
2 discussion with the Advisory Group.

#### 3 4 Ideation Phase: Brainstorming, Prototype Development and Testing

##### 5 *Brainstorming: Design Workshop*

6 To start the ideation phase, a diverse group of healthcare stakeholders were assembled for a four-  
7 hour design workshop. A list of potential stakeholders was created by members of the advisory  
8 group to ensure representation from different roles involved with perinatal care of Medicaid-  
9 insured SF residents, including clinicians with different roles, licensure, and sites of practice  
10 (ZSFG and UCSF); decision-makers from the major healthcare delivery systems and the  
11 Department of Public Health; payers; researchers; leaders from community-based organizations  
12 (CBOs); and community members. Stakeholders were invited to attend via direct email from  
13 advisory group members.

14  
15 Insights, supporting themes and quotes were presented to workshop attendees in a structured  
16 format using Microsoft PowerPoint slides (Microsoft Corporation, Redmond, USA). After  
17 insights were presented, participants were given the opportunity to vote on 6 insights: 3 insights  
18 for challenges that they would like to address soon, and 3 insights for challenges to address in the  
19 future. After a group discussion, participants were organized into four groups. Each group chose  
20 a brainstorming prompt and its associated insight statement. These brainstorming prompts are  
21 known as a ‘How Might We’ (HMW) questions that are written to enable stakeholders to  
22 generate solutions to the insight they chose to address. Once the brainstorming was complete, the

1 discrete ideas were organized into categories and stakeholders developed early prototypes to  
2 represent these categories.

3

4 The core research team and advisory group met several times after the design workshop to  
5 review all insights generated from the interviews and focus group, and all opportunities, discrete  
6 ideas, and early prototypes generated from the workshop. Discussion within this group resulted  
7 in identification and description of a set of prototypes to be presented for community feedback  
8 and scoring.

9

#### 10 *Prototyping: Community Meetings*

11 Stakeholder feedback and refinement of prototypes occurred through a series of community  
12 meetings, focused on obtaining feedback from residents living on low-income in San Francisco.  
13 These meetings included a “community design fair,” followed by 3 additional community  
14 gatherings held at partnering organizations. The community design fair was organized by the  
15 core research team and held at a community center, with advertising done through flyers  
16 distributed at clinics, community organizations, and direct outreach. The subsequent community  
17 gatherings were existing events or meetings (i.e., annual health fair and support group) at  
18 community organizations that serve either the Black community or pregnant people in SF.  
19 Members of the advisory group approached the organizational leaders to request 30-45 minutes  
20 of time during these events to obtain feedback on prototypes from attendees. Advertising and  
21 outreach was done by the host organization.

22

1 At each of the four events, prototypes were presented and then feedback was elicited from  
2 attendees. For each prototype, a team member gave a 30 – 60 second verbal description and  
3 some prompt questions (Appendix 2). Participants were then given up to 5 minutes to provide  
4 feedback on a questionnaire (Appendix 3), including a rating of each prototype on a 5-point scale  
5 based on “how much (they) like(d) the idea,” responses to specific questions, and any other  
6 feedback. The initial questionnaire contained 22 structured items and was modified 13-items as  
7 the prototypes were further iterated and prioritized.

8

9 During the design fair and one other community meeting, written feedback was followed by a 2-  
10 minute brainstorming session led by a team member in groups of 8-10 participants. Ideas that  
11 emerged from these sessions were captured by a team member on post-it notes, which were then  
12 grouped according to common themes and photographed for record-taking.

13

14 The advisory group and core research team used rating data, as well as open-ended comments  
15 from the community meetings, to identify the prototype features that were liked most and to  
16 iterate each design to incorporate important features. The advisory group finalized prototypes for  
17 implementation based on scoring and feedback from community meetings, discussion about  
18 levels of effort and impact, and a commitment to including those considered to be “low” effort  
19 and known to be feasible, as well as those considered “high” effort with less certain feasibility,  
20 but potential to create the most transformative impact.

## 21 **Results**

### 22 Design process participants

1 Table 2 summarizes the participants involved in each phase and activity. A total of 31  
 2 participants engaged in the ‘Inspiration’ phase, including 23 individual interviews with  
 3 stakeholders and one focus group with 8 participants. In total 19/31 (61%) participants were  
 4 community affiliated and 39% were working within the public health or healthcare delivery  
 5 institutions. Of these participants 39% identified as Black, 13% as Latinx, 19% as Asian, and  
 6 29% as White.

7 **Table 2** : Design phases, activities, outcomes participants and outcomes  
 8

<b>Phase:</b>	<b>INSPIRATION</b>	<b>IDEATION – Brainstorming &amp; early prototyping</b>	<b>IDEATION- Prototype refinement</b>
<b>Activity:</b>	<ul style="list-style-type: none"> <li>• Interviews</li> <li>• Focus Groups</li> </ul>	<ul style="list-style-type: none"> <li>• Design Workshop</li> </ul>	<ul style="list-style-type: none"> <li>• Community Design Fair (dedicated to feedback)</li> <li>• Presentations at 3 groups assembled by local CBOs</li> <li>• Advisory group discussions</li> </ul>
<b>Participants:</b>	<ul style="list-style-type: none"> <li>• 31 participants</li> </ul>	<ul style="list-style-type: none"> <li>• 44 participants</li> </ul>	<ul style="list-style-type: none"> <li>• 96 participants</li> <li>• Advisory group members</li> </ul>
<b>Participant characteristics</b>	<ul style="list-style-type: none"> <li>• Patients/partners (n=8)</li> <li>• Community representatives (n=11*)</li> <li>• Clinical providers/ researchers (n=12)</li> </ul>	<ul style="list-style-type: none"> <li>• Care delivery clinicians/ providers/leaders (n=22)</li> <li>• City program staff (DPH/HSA)/leaders (n=4)</li> <li>• Medicaid health plan staff/leaders (n=3)</li> <li>• CBO partners and Community members (n=6)</li> <li>• Researchers (n=5)</li> <li>• Designers (n=4)</li> </ul>	<ul style="list-style-type: none"> <li>• Community and other stakeholder participants at gatherings held at CBO community events and meetings (n=96):</li> <li>• 88% female</li> <li>• 68% reproductive age (&lt;45 years old),</li> <li>• 86% non-white</li> <li>• 78% ever pregnant</li> <li>• 64% receiving/received care on Medicaid</li> </ul>
<b>Outcomes:</b>	<ul style="list-style-type: none"> <li>• 7 insights</li> <li>• 7 opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• 162 discrete ideas</li> <li>• 8 prototypes</li> </ul>	<ul style="list-style-type: none"> <li>• 3 overarching perinatal redesign opportunities</li> <li>• 4 prototypes for implementation</li> </ul>

9  
 10 \* 8 community advocates participated in group discussion rather than one-on-one interviews  
 11 CBO- Community Based Organization; DPH- Department of Public Health; HAS – Human  
 12 Services Agency

1 A total of 140 participants were involved in the ‘Ideation’ phase (brainstorming and  
2 prototyping), including 44 participants in the design workshop and 96 participants at the  
3 community design fair and subsequent community meetings. The design workshop focused on a  
4 broad range of healthcare stakeholders, whereas the community design fair and subsequent  
5 community meetings were more focused on community members (Table 2).

6

7 Inspiration: Results of Qualitative Data Collection & Analysis

8 Analysis of interviews and the focus group revealed seven insights that represented unique  
9 challenges, tensions, and perspectives of perinatal patients and their providers. Table 3 describes  
10 each insight, supporting quotations and associated design opportunities.

**Table 3:** Key insights, supporting quotes and opportunities from the Inspiration Phase

Insight	Themes & Supporting Quotes	Design Opportunities
<p>1. Marginalized people are not welcomed as equal, trusted partners in their care</p>	<p><b>Unequal power dynamics breed lack of trust</b>            “My care was ‘sporadically informative’. They fed me information only when they wanted. I got only information when I pressed for it... I always felt they knew something that I didn’t.” - Patient</p> <p><b>Providers make (often incorrect) assumptions about what patients want to know</b>            “I just tell the mom that the baby is perfect. Because the value of reassurance to the woman is so much greater...”– Obstetrician</p> <p><b>Experience with racist stereotypes can make patients scared to advocate for themselves</b>            “[Patients] often times are just seen as the angry black women who are vocal and argumentative...they learn to be quiet.” – Midwife</p>	<ul style="list-style-type: none"> <li>• (Identify ways to) proactively shift power dynamics between patients and their providers to foster trust and partnership</li> <li>• Help healthcare team members to recognize and undo their own biases</li> </ul>
<p>2. Every touchpoint is essential, and one bad interaction can change the course of care</p>	<p><b>Disrespect is communicated in many different ways, and adds up</b>            “Clinic is busy, but does that mean you can’t give eye contact? Does that mean you leave [the patient] in the hallway?” - Patient</p> <p>“Something like being scheduled for the wrong time in your clinic appointment, little things that nobody likes. However, in the context of someone who’s lived a life where they’ve been a victim of the spectrum of racism, those things add up in a big way.” – Community Activist</p> <p><b>If patients can’t trust that they’ll be treated well, they’re less likely to engage</b>            “If I feel as though I’m not worth your time, I’m not gonna come back.” - Patient</p> <p><b>Lack of trust is dangerous</b>            “There was a patient from Haiti and this was her 2nd baby. She had a routine c-section. An hour after surgery, she arrested, &amp; they couldn’t bring her back. Later</p>	<ul style="list-style-type: none"> <li>• Approach every interaction as an opportunity to earn trust</li> </ul>

	found out that someone had told her not to get pregnant again. She intentionally didn't tell anyone about that. To me, there wasn't trust there somehow for her to disclose that." –Family Medicine provider	
3. The system stigmatizes lived experiences, and then requires people to re-tell their stories multiple times	<p><b>History stigmatizes one's care</b>  "People see mental health problems and they just stiff arm them." - Patient</p> <p><b>Repeating a traumatic history breeds shame.</b>  "A lot of people feel that they were being judged for their story. The more they told their story, the more chances they have of being judged."– Midwife</p>	<ul style="list-style-type: none"> <li>• Create less burdensome mechanisms for patients to communicate their stories across care transitions</li> </ul>
4. Racism affects how people show up, and then negatively impacts their care	<p><b>The burden of structural and interpersonal racism impacts how people show up</b>  "It is the hardest thing for me when a woman comes in and so much has already happened to them that the option to rapport build is just not there at all" – Midwife</p> <p>"Women who are vulnerable don't feel like they can speak." –Midwife</p> <p><b>The system punishes patients who are impacted by care barriers caused by systemic racism</b>  "At [care institution], I was turned away if I was late." –Community advocate</p>	<ul style="list-style-type: none"> <li>• Structure each visit around what the individual says they need that day, and create mechanisms for them to easily communicate this with providers</li> </ul>
5. Barriers to care are significant	<p><b>Being "compliant" with care isn't as easy as it sounds</b>  "For someone who's at risk for hypertension and pre-eclampsia who needs to have her blood pressure checked, no one thinks to ask what that involves – childcare for three kids, buses, time off work. We [providers] just say cavalierly that they need to get their blood pressure checked and not think about maybe teaching them about how to take their blood pressure, the implications this may have on their lives and what it means for their lives." -Midwife</p> <p><b>It's hard to focus on pregnancy when you're focusing on survival.</b></p>	<ul style="list-style-type: none"> <li>• Make care and services more valuable and easier to access, especially for those who face the worst outcomes and the most barriers to care</li> </ul>

	<p>“I didn’t know the due date, but I knew I’d get three days with a hot shower.”– Homeless Patient</p> <p><b>Those who need the most resources have the least around them</b> In Noe Valley there is all kinds of stuff; I don’t want to have to take a bus just because I don’t have that in my community. -- Patient living in Public Housing (Potrero Hill)</p>	
<p>6. Lived experience (social, medical, or cultural) makes patients “experienced” and in a position to help others</p>	<p><b>History makes the expert with lessons to share.</b> “[Women with lived experience:] They’re experts, consultants, partners.” – CHW</p> <p><b>Pregnancy is a vulnerable time, and having support is essential</b> “To have other camaraderie with women who are in the same situations as you are, to see a light at the end of the tunnel. It’s hopeful, inspiring...nice.” - Patient</p> <p>“I feel like coming into motherhood I’m not equipped, not adequate. I’m going to mess her up.” -Patient</p>	<ul style="list-style-type: none"> <li>• Incorporate people with lived experience as valued members of the healthcare team who can help others</li> </ul>
<p>7. Pregnancy is treated like a disease, rather than a life-changing event for pregnant people and their families</p>	<p><b>Over-focus on the pregnancy and not the pregnant person is de-humanizing.</b> “In the process I got weak. I got lost. Because no one cared for <i>me</i>.” --Patient</p> <p><b>Pregnant people want the celebration, the proverbial baby shower.</b> “You want everyone more excited than you are....It’s supposed to be the best time of your life –I didn’t have that opportunity.” – Homeless Patient</p> <p><b>Community is as important as medical care for healthy outcomes</b> “Ultimately for me, it’s support and community. We can get a lot of things from doctors, we can get information up the wazoo. But it is supporting what we believe and what we want for the future of our child that is important to me.”</p>	<ul style="list-style-type: none"> <li>• Use resources to provide more community support, rather than more medical care, during pregnancy</li> </ul>

1 Insights broadly fell into two categories. The first category described the role that racism and  
2 discrimination—on interpersonal, institutional and systemic levels—plays in creating major  
3 barriers to the access, experience and value of pregnancy care interactions. Participant  
4 experiences highlighted that care is fraught with unequal and uncomfortable power dynamics  
5 (Insight 1), often feels disrespectful and judgmental (Insights 2, 3) and does not acknowledge the  
6 significant systemic barriers that impact one’s ability to access and comply with care (Insight 4,  
7 5). These insights highlighted the need to pursue opportunities that would improve access to  
8 care, make care interactions with clinic providers and staff more positive, and allow the  
9 healthcare system to earn back the trust of communities that have been historically marginalized  
10 and harmed by medical care.

11  
12 The second category comprised of the over-medicalization and non-inclusive nature of  
13 pregnancy care. Insights demonstrated that pregnant people want to feel celebrated, rather than  
14 pathologized, during this life transition (Insight 7), value the support and wisdom of their peers  
15 (Insight 6) and want to be informed and equal partners in care decisions (Insight 1). These  
16 insights highlighted the importance findings opportunities to shift the care experience away from  
17 one where pregnancy is approached as a medical problem, and towards one where pregnancy is  
18 approached as a life transition that requires as much focus on the social, emotional, and practical  
19 aspects as on the medical and clinical aspects.

20

#### 21 Ideation: Results of brainstorming, prototyping and refinement

22 Brainstorming at the design workshop, in response to the insights and opportunities presented,  
23 generated a total of 39 HMW statements and 162 discrete ideas. As an example, one HMW

1 question that emerged from the opportunity “Approach every interaction as an opportunity to  
 2 earn trust” was “How might we embed empathy into every aspect of care?” This subsequently  
 3 led to 51 discrete ideas including “Let women say what they need, then provide that!”, “Build a  
 4 village model of care,” and “Bring the resource to them.” Table 4 lists selected other examples of  
 5 HMW statements and ideas generated from them.

6 **Table 4:** Selection of “How Might We...?” (HMW) questions and associated ideas from the  
 7 design workshop  
 8

Question	Selected Ideas
HMW acknowledge and address interpersonal and systemic racism in our system of care and support?	<ul style="list-style-type: none"> <li>• Peer advocates to help empower women</li> <li>• More diversity in hiring and teaching</li> <li>• Listen to me with empathy</li> </ul>
HMW help women be the experts in telling their own story?	<ul style="list-style-type: none"> <li>• Patients interview their provider</li> <li>• The MD is the consultant</li> </ul>
HMW help providers and patients have transformative experiences?	<ul style="list-style-type: none"> <li>• Recognize women’s expertise [by asking]: “tell me your story”</li> <li>• Patient decides next visit agenda</li> </ul>
HMW we ensure our patients’ priorities are our priorities?	<ul style="list-style-type: none"> <li>• Meet them where they are → mobile</li> <li>• One stop shop → wellness village</li> </ul>

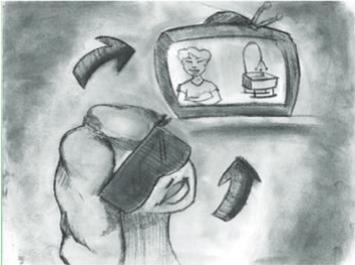
9  
 10 Table 5 describes the 8 initial prototypes that were presented at the community design fair and  
 11 were iterated on in response to scoring and feedback throughout the subsequent community  
 12 meetings. Overall scores from all quantitative feedback are listed, along with a summary of  
 13 feedback and discussion that led to the listed conclusion about implementation.

1 **Table 5:** Initial Prototypes, participant scoring and feedback, and conclusions  
 2

Prototype	Brief Description	OVERALL SCORE	CONCLUSION	Summary of participant feedback and Advisory Group conclusions
<p>SUPPORT SISTER</p> 	<p>Person on your care team who has gone through this experience, and is there to guide, support and get you what you need throughout your pregnancy and after.</p>	<p>4.6 (out of 5)</p>	<p>Adopted for implementation</p>	<p><u>Summary:</u> Many comments revealing high enthusiasm for this concept  <u>Refinement:</u> Questions emerged around if Support Sisters should be hired within health systems or be community based, recognizing that within health system allows for important integration with health system, but may compromise ability of support sister to effectively advocate for client if in conflict with health system staff.  <u>Rationale and final prototype details:</u></p> <ul style="list-style-type: none"> <li>• High impact for providing support, helping navigate resources, and identifying/mitigating interpersonal racism</li> <li>• Prototype to specifically focus on how community-based Support Sisters can be sustainably integrated into healthcare teams to allow for care that is more comprehensive (provides practical, emotional, and social support), is well-coordinated (insight and outside of healthcare system), and provides cultural sensitivity and lived experience.</li> </ul>
<p>COMMUNITY CENTER FOR PREGNANCY AND YOUNG FAMILIES</p>	<p>A community center as a “one-stop-shop” that provides clinical and non-</p>	<p>4.6 (out of 5)</p>	<p>Adopted for implementation with refinement</p>	<p><u>Summary:</u> Many comments revealing high enthusiasm for this concept  <u>Refinement:</u> Comments revealed that people thought this would be most helpful if within</p>

	<p>clinical services, and support for pregnant people and young families</p>			<p>one’s own neighborhood. Broad array of services and goods desired.</p> <p><u>Rationale and final prototype details:</u></p> <ul style="list-style-type: none"> <li>• High impact for reducing barriers to care, tackling systemic and institutional racism, shifting power dynamics, and investing in community support.</li> <li>• Recognizing that this could not exist in every neighborhood, this prototype was combined with “<i>Services that come to you</i>” and “<i>Build community with your care team</i>” prototypes (below) to create the “Pregnancy Village” prototype, as described in results section. Pregnancy Village brings services and goods into neighborhoods making them easier to access, while also providing an environment to foster community support, shift problematic power dynamics with providers, and develop more trusting partnerships with service providers.</li> </ul>
<p>SERVICES THAT COME TO YOU</p> 	<p>A mobile unit that travels to your neighborhood with helpful services and offerings.</p>	<p>4.6 (out of 5)</p>	<p>Adopted for implementation with refinement</p>	<p><u>Summary:</u> High enthusiasm for services being brought to one’s own neighborhood</p> <p><u>Refinement:</u> Concerns were around how to make this look and feel respectful—i.e. would people be lining up waiting for services? How would the mobile unit look and feel inside – “cold and clinical” versus “warm and comfortable”?</p> <p><u>Rationale and final prototype details:</u></p> <ul style="list-style-type: none"> <li>• Combined with <i>Community Center</i> prototype (see above) to create</li> </ul>

				<p>“Pregnancy Village” prototype, as described in the results section of manuscript.</p> <ul style="list-style-type: none"> <li>• Mobile unit a necessary part of Pregnancy Village prototype to deliver more private (clinical) services</li> </ul>
<p>PRENATAL CARE FROM HOME</p> 	<p>Video chat with your pregnancy care team from home, instead of coming into clinic.</p>	<p>4.1 (out of 5)</p>	<p>Adopted for implementation</p>	<p><u>Summary:</u> Feedback was mixed, with some participants enthusiastic about the convenience of this option and others not sure it would be personal enough.</p> <p><u>Refinement:</u> Must be implemented in an equitable way to ensure access and value for those with low resources and varying levels of digital access and literacy.</p> <p><u>Rationale and final prototype details:</u></p> <ul style="list-style-type: none"> <li>• Low-effort, high-impact intervention for patients who would want this option (and would not negatively impact those who wouldn’t).</li> <li>• Should be implemented as an option across the safety-net system so is an option, when clinically appropriate, for any patient who would like it</li> </ul>
<p>USEFUL TRANSPORTATION</p> 	<p>Provide transportation options that offer patient education and will check you in to clinic on the ride.</p>	<p>4.5 (out of 5)</p>	<p>Not adopted for implementation</p>	<p><u>Summary:</u> High average score but not many comments revealing enthusiasm.</p> <p><u>Rationale:</u> Given patients get care from multiple different clinics, this would be a high-effort intervention with unclear impact. Additionally, based on enthusiasm for bringing clinical services into neighborhoods, decided to prioritize “Pregnancy Village” model over this prototype.</p>

<p><b>BUILDING COMMUNITY WITH YOUR CARE TEAM</b></p> 	<p>Activities that allow you to get to know your doctors and midwives in a setting outside the clinic, to build trust and relationships.</p>	<p>4.1 (out of 5)</p>	<p>Not adopted for implementation</p>	<p><u>Summary:</u> Some enthusiasm, but comments revealed that other mechanisms such as continuity of care and longer appointments were most important factors in building trust and relationships. <u>Rationale:</u> Included this prototype/concept into the “Pregnancy Village” prototype as described in the results section.</p>
<p><b>CHOOSE FEWER VISITS</b></p> 	<p>Reduce minimum number of doctor or midwife visits to five and have other visits with whoever you choose from care team (for example, support sister or a healthcare educator)</p>	<p>3.83 (out of 5)</p>	<p>Not adopted for implementation</p>	<p><u>Summary:</u> Poor enthusiasm for this concept, with many people concerned about the safety of having so few visits with providers, and wondering how they would know when they need to see a provider <u>Rationale:</u> While studies show five clinical visits safe for low-risk pregnant people, patients are not comfortable with this approach.</p>
<p><b>LEARN THROUGH EXPERIENCE</b></p> 	<p>Learn about pregnancy-related topics through the eyes of a peer who has experienced it using virtual reality technology.</p>	<p>3.3 (out of 5)</p>	<p>Not adopted for implementation</p>	<p><u>Summary:</u> Poor enthusiasm for this concept, though did think might be a helpful adjunct to different classes/ education that are already available (lactation, labor &amp; delivery, birthing) <u>Rationale:</u> Low impact</p>

Three finalized prototypes were selected by the advisory group to move forward for the final phase of the HCD process: implementation.

**1. Universal access to a “Support Sister” (community doula or perinatal health worker) for all Medicaid-insured pregnant people**

Several key features emerged around how to make the Support Sister most impactful: establishment of the relationship early in pregnancy and ensuring its continued support beyond the traditional postpartum period, someone who is easily accessible, and someone who is available to help navigate the system and the pregnant person’s needs. The need to be well-connected to the healthcare system was an important feature, so the Support Sister could help overcome barriers within the health system, like helping get an appointment and helping advocate if there is difficult communication with staff and/or providers. Other desired characteristics of this peer support included being from one’s own community; helping to navigate services outside of the clinic; being reliable, empathetic, familial, and able to speak from experience; using media to help address basic concerns and share knowledge; and being readily available.

**2. Telemedicine (video visits) as an alternative option to in-person visits**

While many people felt that they would prefer to see their provider in person, others appreciated the option for video visits because of their ease of attendance. Participants felt this would be particularly helpful for certain types of appointments such as receiving test results and one-time consultations for counseling. While this prototype had an overall lower score than some others, comments from feedback suggested that having a remote option for care could provide considerable benefit to those whose care access is limited

because of significant practical barriers care. Given that telemedicine implementation was considered “low-effort,” the advisory group determined that this was an important prototype to pursue to reduce disparities in care access.

### **3. The “Pregnancy Village” model to deliver care and services into neighborhoods through a one-stop-shop**

The importance of delivering care and services in a way that is less burdensome, and that better responds to the needs of communities, was clear. The Pregnancy Village prototype was designed to achieve this goal - delivering multiple pregnancy-related services, such as clinical care, public entitlements (e.g. Women, Infant and Children’s program benefits, Medicaid enrollment), and wraparound services (e.g. breastfeeding support, community-based services) into high-need neighborhoods, at one place and time, on a recurring basis. The prototype design also recognizes the value of creating a new *environment* for care delivery: one that is be free from the historical trauma and harm that have been experienced by communities of color in healthcare institutions, would shift away from the power dynamics that people feel when interacting with providers inside of institutions, and would provide a safe, healing, and positive space focusing on community wellness.

## **Discussion**

Socioeconomic and racial inequities in perinatal care access, experience, and outcomes exist across the United States.(21,22) The approach to tackling these inequities in any given community will depend on the local context of care delivery, resource availability, and other social and community inequities. Our work describes the process of using HCD methodology to first understand pregnancy care experiences from different stakeholders’ perspectives, and to

then use this understanding to design promising interventions. Our HCD process revealed both short-term opportunities (use of technology and community-based care delivery models) and long-term investments (earning the trust of marginalized communities) to improve perinatal care access, experience and outcomes of Medicaid-insured pregnant people in our urban community.

Findings from our ‘Inspiration’ phase are consistent with existing literature that demonstrates why the traditional U.S. system of pregnancy care delivery results in poor access, experience, and outcomes among low-income people, and especially low-income people of color. The barriers to care access place significant and disproportionate burden on those who must take unpaid leave to attend appointments, have unreliable transportation, and face other practical constraints.<sup>(6)</sup> Discriminatory and racist practice patterns are commonplace, making it extremely challenging to feel safe and trust the care provided.<sup>(23)</sup> Additionally, pregnancy care is overmedicalized with not enough investment and focus on the non-medical support needed for people to thrive.<sup>(24)</sup> Our work contributes further by describing the use of HCD methodology to translate these insights into concrete solutions that could be prototyped for local community ratings and feedback.

The use of HCD methodology in healthcare is becoming more common, with a focus on centering the user experience when designing new interventions and care models. Traditional qualitative research is able to describe the barriers and facilitators to high-quality care and to test interventions, but often misses the step of co-creating solutions that are relevant and preferred by the local community of interest. In perinatal care, HCD has been used to develop specific healthcare interventions or programs for defined populations within a care delivery system, such

as adolescents, people living with substance-use disorder, and low risk people who may need less in-person care than the traditional model dictates.(25–27) We sought to better understand the entire pregnancy journey of Medicaid-insured individuals within our community, inside and outside of the care provided within clinical care sites. The most promising, novel perinatal care models such as group prenatal care, home visiting programs (Nurse Family Partnership®) and free doula care are already available to residents of color living on low incomes in San Francisco.(10,11,28) Nevertheless, our city still demonstrates significant inequities in perinatal care and outcomes.(29) As such, we intentionally took a broad approach to investigating the experience of care and support during pregnancy, so that solutions would not be confined to a specific part of the system (e.g. within one clinic, hospital, city/public health agencies, or CBO), and could include those that exist *between* parts of the system (e.g. opportunities for better care coordination).

We focused heavily on engaging leaders from across organizations and sectors starting from early in our HCD process. Successful implementation of the prototypes we developed would ultimately depend on buy-in from organizational leaders, and it was critical that they gain understanding of the problem before being asked to implement solutions.(30) We used various approaches to engage with organizational leaders. The project leader spent significant time meeting with them one-on-one to introduce the background and plans for the HCD process. Organizational leaders were asked to appoint a representative to our advisory group, adding to the group’s collective sphere of influence. Finally, we invited multi-sector leaders to the design workshop in which insights were shared and early prototypes were built. These leaders included decision-makers from the safety-net care system, public health department, human service

agency, and health plans, among others. This process required a significant amount of time over the course of one year, but was considered essential to ensure willingness to implement solutions later.

While the HCD ‘Implementation’ phase plans are broadly summarized in this study, rollout and subsequent evaluation of each prototype is ongoing and continues to be iterated in response to user feedback. For our work to make “Support Sisters” universally accessible to Medicaid-insured pregnant people, we are working closely with two perinatally-focused CBOs in our community to better integrate their doulas and perinatal health workers into the broader care team, and to create sustainable models for revenue generation. Implementation of video visits within our safety-net system started in our Maternal-Fetal-Medicine clinics, with iteration of workflows and user-friendly tools ongoing in response to patient and provider feedback. Finally, the *Pregnancy Village* prototype will be launched in Spring 2021 in San Francisco’s Bayview neighborhood, using a community-partnered process which will incorporate real-time feedback and iteration throughout the launch.

Limitations of our study include the local focus of HCD work, which may make the themes and opportunities less generalizable to other communities. While the outcomes of the HCD process are most valuable when tailored to a local context, the use of purposeful sampling and consistency of our themes with those in the national literature suggest that the opportunities we identified may apply other communities. Another limitation is that our ‘Inspiration’ phase had a modest sample size for qualitative inquiry and our ‘Ideation’ phase included only a few perinatally focused community-based organizations – given the limited number that exist in our

city. However, combining their feedback across multiple HCD phases with both open-ended interviews and brainstorming and closed-ended scoring likely reinforced the primary HCD findings in this study.

## **Conclusion**

Our work supports the strong push for a major overhaul of pregnancy care in the United States. Evidence of low value perinatal care is clear and widespread, with stark and unjustified racial disparities in outcomes and those most vulnerable to these outcomes facing extreme burdens while both accessing and experiencing pregnancy care. The insights, opportunities, and prototypes that emerged from our work may be of use to similar communities seeking to tackle these disparities by changing models of care delivery. For communities eager to take a community-engaged approach to understanding and addressing the specific challenges in their own setting, the description of our HCD work may offer a valuable approach. Given the maternity care crisis in communities across the U.S., intentional and urgent change efforts are critical.

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## Declarations

- **Ethics approval and consent to participate:**

The University of California, San Francisco institutional review board approved this study (#17-23862). All methods were carried out in accordance with relevant guidelines and regulations. Informed consent was obtained from all subjects who shared information cited in this manuscript.

- **Consent for publication**

N/A

- **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

- **Competing interests**

AS, LC and DP are human-centered design consultants for The Empathy Studio, LLC.

All other authors declare that they have no competing interests.

- **Funding**

There were no external sources of funding for this study.

- **Authors' contributions**

MN, SW and AS were involved with conception and design of the work; MN, SW, DP, JL, LC, SW, AS were involved with acquisition and interpretation of data; MN, CL, DP and AS were major contributors in writing the manuscript. All authors read and approved the final manuscript.

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# Figures

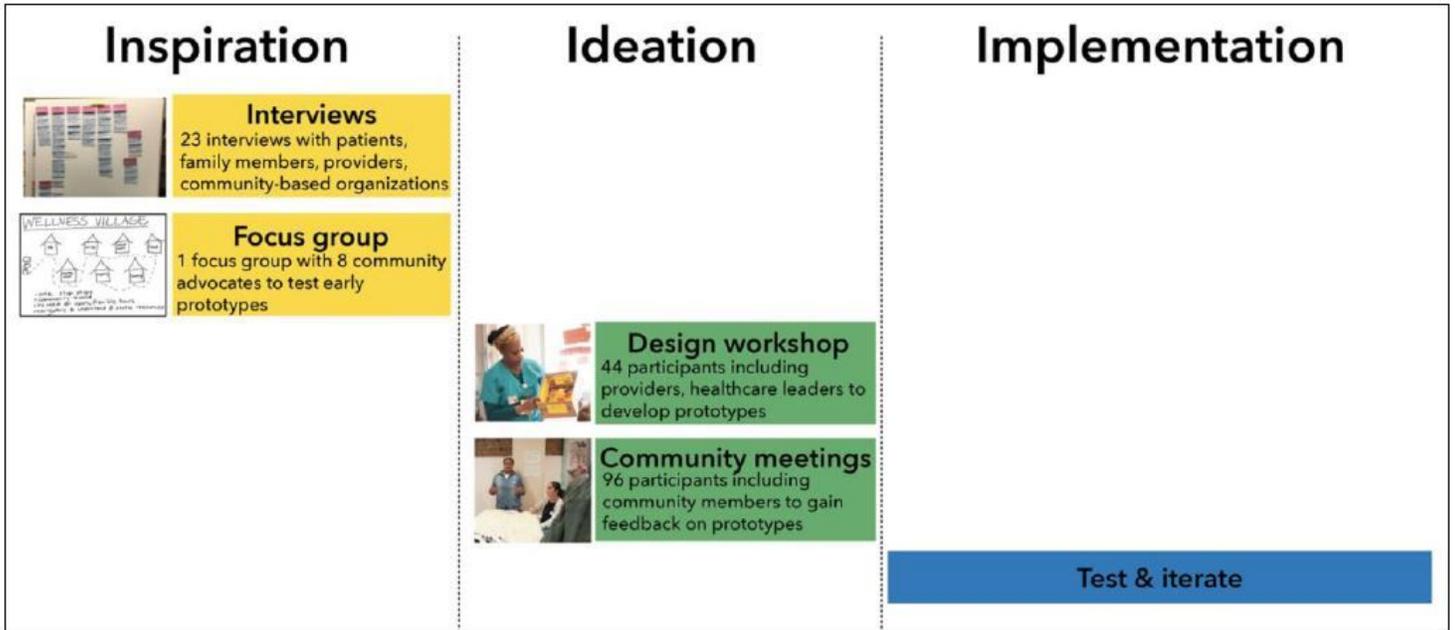


Figure 1

Activities that comprise the Preparation, Inspiration, Ideation and Implementation phases of the Human-Centered Design process. During the Inspiration and Ideation phases described in this study, insights and themes from target users are made into actionable opportunities, as depicted in Figure 2.

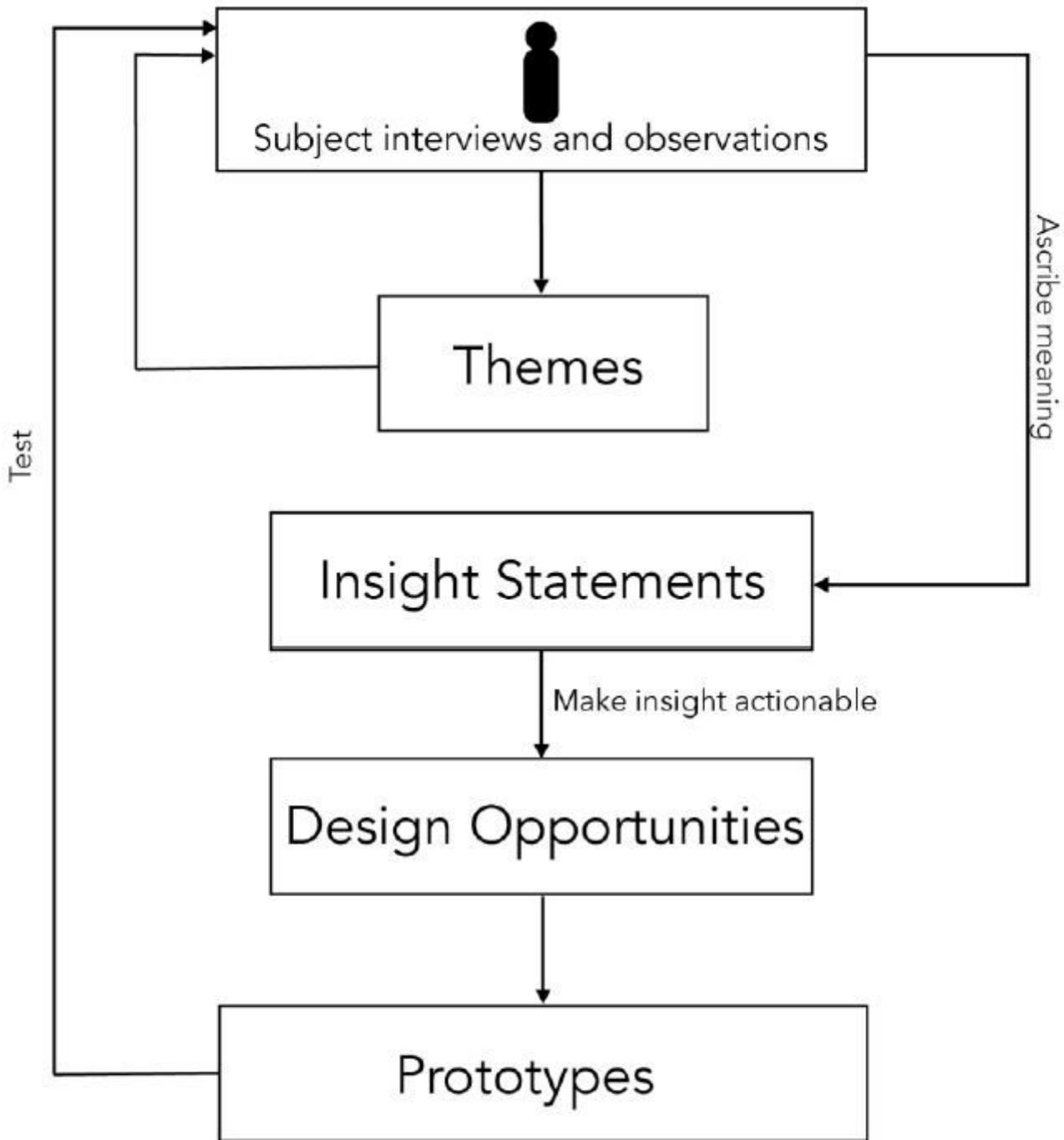


Figure 2

The inductive analysis process starts with qualitative data from users, which is then distilled into themes, contextualized to form insights, and translated into actionable opportunities. These design opportunities are then translated in prototypes that can be implemented tested in a real-world context.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [HCDPerinatalimprovementAppendicesBMCHSR.pdf](#)