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Empathetic Iteration of a SnuggleTime Garment System for Kangaroo Care of Mothers and Babies in the Neonatal Intensive Care Unit

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ABSTRACT

Kangaroo care (KC), involves skin-to-skin contact where an infant lays chest-to-chest on an adult caregiver. Feldmen and Eidelman (2003) suggest KC is a low-cost option with known health benefits for preterm infants. Babies in a neonatal intensive care unit (NICU) often cannot be held due to their own health or concerns about the health of their mothers. NICUs lack privacy and the presence of medical equipment makes kangaroo care more difficult than other public or private settings (e.g. in the home). Moreover, clothing is a physical barrier to exposing the skin for kangaroo care, which creates a design opportunity (Sather-Clarke, 2018).

Keywords: wearable therapy, kangaroo care, creative process, functional design

Introduction

Relevance to Design Practice

This illustrative case study merges academic writing with creative visual processes, thereby demonstrating an approach to design research and illuminating the process of discovery of a functional garment system. Creative process is rarely the focus within academic writing. While the stages of the design process are clearly defined, the exploratory and discovery process (while highly iterative and visual) are rarely represented. Empathy and creativity are interrelated and act as a conduit connecting diverse stakeholders within the process of design (Raijmakers, 2009; Visser, et. al, 2005; Brown, 2019). Empathic design builds emotional connections between user and product at an early stage of development, seeking to understand users' experiences and discover their undiscovered needs. This approach enables designers to innovate new solutions, often for problems that users had not considered or identified (Fairburn, Steed, & Coulter, 2016).

LaBat and Sokolowski (1999) conceived a design process based on research within kindred design fields to clothing and apparel. Their research yielded an approach that emphasizes three-dimensional structures and spaces. The present study employs this

process for design development through the phases of Problem Definition and Research, Creative Exploration, and Implementation. One approach for studying and incorporating user feedback into design is interviews with end users. This approach engages users on the front end of design to ultimately improve the quality and functionality of a design. The cyclic process of prototyping, testing, analyzing, and refinement complements the participatory approaches to design development. The authors of this study adopted a participatory approach to collect preliminary contextual data, which informed the initial design iteration. Assessment (via focus group) then guided design refinement.

Problem Statement and Research

This study seeks to: (a) better understand clothing limitations for beneficial early caregiver behaviors in hospital, public, and private spaces; (b) explore market needs; (c) apply insight gained toward the concept development of a wearable therapy functional for kangaroo care. The SnuggleTime research project is focused on removing barriers to KC (skin to skin contact), breastfeeding, and expressing milk to improve NICU infants' health outcomes. KC, defined as bare skin-to-skin contact between an infant and an adult caregiver, is usually done chest-to-chest. This exploratory design, ideation and development of a prototype caregiver wearable in the NICU aims to increase the duration an infant spends in KC, as well as foster breastfeeding and the volume of milk expressed by the mother.

This exploratory iteration represents one facet of a broader interdisciplinary initiative seeking to develop solutions (garments, devices, and policy recommendations) that facilitate kangaroo care, breastfeeding, and pumping breastmilk in the NICU by overcoming identified barriers and increasing identified support for mothers. The research team is comprised of experts in the areas of physical rehabilitation, apparel and textile design, engineering, human geography and sustainable food systems/food security. As designer and lead author, it is my intention to frame empathy and creative process as kindred attributes, beneficial to design, specifically multi-disciplinary design.

User context (regarding kangaroo care, mothers and babies and wearable therapies)

Hospitals are unique environments where barriers to kangaroo care may be different than other settings. Clothing is a physical barrier to exposing skin needed for KC. Kangaroo care, breastfeeding, and consuming human milk are known to improve immediate and long term outcomes for NICU infants, especially those born prematurely. Removing barriers to these activities is at the cutting edge of medical research, combining family-centered care to improve patient outcomes by overcoming the NICU contextual (lack of privacy) and behavior barriers (social acceptance of nudity) for all caregivers involved in NICU infant care.

Kangaroo Care

Kangaroo care (KC), defined as bare skin-to-skin contact between an infant and an adult caregiver usually chest-to-chest, is a low cost option with known benefits. Skin-to-skin contact (kangaroo care) are early caregiver-infant behaviors that improve infant motor, cognitive, and social-emotional development including for infants at risk. Kangaroo care improves emotional regulation, alertness, and neurodevelopmental outcomes (Feldman & Eidelman, 2003). KC best practices include being held skin-to-skin by mothers within the first hour after birth, also known as the golden hour. Mothers of babies in the NICU, due to concerns about their own health or that of their babies, may not be able to follow best practices.

Wearable Therapies

This study focuses on the conceptual development of a wearable therapy. It will result in improved caregiver wearables, an innovative collection of soft, comfortable, safe, functional, smart garments that will move quickly from prototype to testing. Caregiver wearables will help infants at risk

for future delays due to a variety of diagnoses, be inexpensive for widespread clinical use, and will have low- and high-tech future applications.

Design Processes Related to Empathy and Creativity

Co-design

Co-Creative methods (also known as co-design) offer a format to directly engage the user throughout the design process. The premise of co-design is that those who use a product are entitled to have a say in determining how it is designed. The other premise is that when stakeholders and their interests shape and contribute to the design process, the quality of the design increases. (Fletcher, 2014).

Empathetic design

To empathize is to understand another person's situation, experience, or perspective as it were ones' own. (Sanders, 2012). The definition and origin of the word "empathy" is very well detailed in the literature about empathetic design. Empathic design builds emotional connections between user and product at an early stage of the development process and seeks to understand users' experiences in an effort to discover their undiscovered needs. Sanders (2012) developed a design approach stressing the importance that the designer achieve empathetic understanding of the intended users of a product or service. This approach enables designers to innovate new solutions, often for problems that users had not considered or identified.

Designers need knowledge about and have to develop empathy with the people they are going to design for. Traditionally, users were only involved in the later stages of the design process during the testing and evaluation of products. However, in the early stages of a design project, where the context is explored, requirements are defined, and ideas for solutions are developed, everything is still open and hardly any choices have been made yet. (Klawijk, 2014). Designers can include the user perspective in the early stages of the design process. They seek understanding and empathy through empathy mapping, user stories. and experiences of layman within joint design projects or contextual user research.

Participatory design

The premise of participatory design is that those who have a key use for a product must play a critical role in its development. The process ensures that the final design of an intervention is as relevant and beneficial to the user as possible, and considers the specific needs of a particular population. McDonagh (2004) states that empathy in design requires designers to be sensitive to users, able to understand them, their situation, and feelings, and thus design methods that allow for empathetic transfer are essential. A process of call and response through user feedback and conceptual design iteration ensures that the final design of an intervention is as relevant and beneficial to the user as possible, and considers the specific needs of a particular population (Schuler & Namioka, 1993).

Case Study: Development and Evaluation of a Functional "SnuggleTime" Garment System

In 2017, through funding from an NSF UD I-Corps Sites Program grant [3] of $3,000, the team conducted user research that would inform the design and development of a soft, functional device aimed at aiding breastfeeding and skin-to- skin contact for preterm infants in neonatal intensive care units (NICUs).

Methods

A participatory design framework was adopted as the design approach for this project. The premise is that those who have a key use for a product must play a critical role in its development. Central to the framework is the notion of empathetic iteration. Upon IRB approval, data was collected through individual interviews with mothers. User requirements were determined. Desktop research was conducted to better understand

existing market products and devices. Based on this data an initial wearable concept (A) was developed through creative iteration. This initial prototype A was evaluated during a focus group. Based on feedback, a second prototype, B, was developed. Empathetic Iteration guided the concept development of a wearable therapy functioning to encourage kangaroo care.

Analysis of existing devices

In order to establish requirements and specifications for the SnuggleTime garment system, researchers conducted an analysis of existing products. The product analysis evaluated material selection, construction, design details, marketing, cost, and user reviews. Actual breastfeeding garments as well as kangaroo care clothing advertised online were evaluated. User responses to existing products revealed that currently available clothing products could function better to meet market needs, especially for use in a medical setting. Existing KC assists, such as garments for mothers (e.g. NuRoo, Hudlo baby, milk & baby, Precious Image) and preterm baby carriers available commercially, (e.g. K'tan, Uchi) do not work well for use in the NICU. Commercially available garments do not easily allow the infant to enter KC due to the tubes that connect the infant to medical devices. Discreet skin exposure for KC, breastfeeding and pumping breastmilk is difficult for mothers using commercially available garments, including easy garment donning and doffing in a confined space. (Sather-Clarke, 2018).

Individual interviews

User input was gathered to determine if and how clothing was a barrier as well as opportunities for design solutions to encourage kangaroo care. Thirteen mothers from the U.S. East Coast were interviewed by six different interviewers, either in person (n=12) or via Skype, (n=1) between March and August 2017 about their experiences with KC, breastfeeding, and pumping breastmilk in the NICU or hospital. Ten of the thirteen mothers interviewed had cared for their children in the NICU. Their children ranged from 24 weeks to full term (defined as 36 weeks 6 days) gestational age. Seven mothers specified where their children were hospitalized, representing five different hospitals' NICUs and six different hospitals.

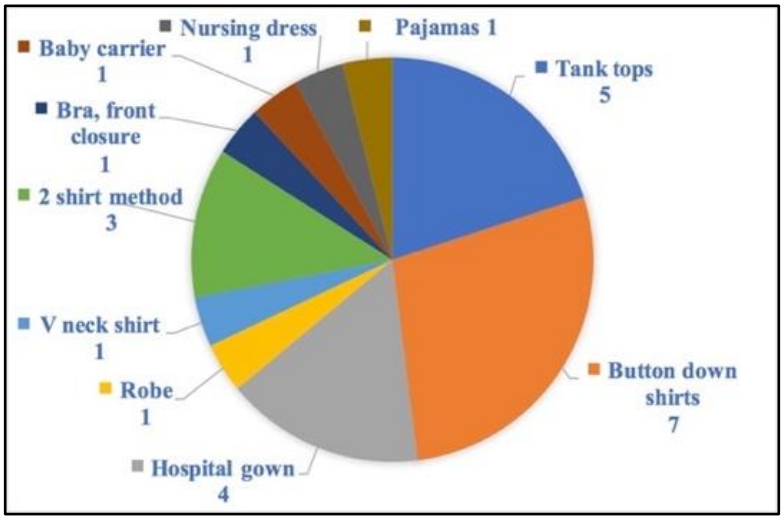

Figure 1. Clothing used for KC in hospital

The mothers interviewed were split on their opinion of whether clothing had an impact on their ability to do KC. However all but two mothers mentioned choosing specific types of clothing to wear to make KC possible in the hospital, as visualized in Figure 1. Also, the majority of mothers described planning what clothing to wear in advance of going to the hospital in order to facilitate KC. The mothers' described actions demonstrate that clothing impacted their ability to do KC. Four mothers described simply taking off their clothes in the NICU in order to be able to do KC.

User interviews offered insight into problems with clothing as well as potential practical solutions based on analysis of existing devices and individual interviews design requirements of Don/Doff, coverage (articulated visually thorough comfort mapping) modesty, ease of use (for mother and nurse) fit, comfort, fabric (touch/feel, support/structure and temp regulation), expression and aesthetics, ease of use, coverage and temperature regulation.

Design Process

Figure 2. Biomimicry thematic exploration

Creative Exploration and Early Ideation

Inspired by the early ideation strategies of Gordon and Guttmann (2013), the design team adopted biomimicry thematic exploration as visualized in figure 2, inspired by kangaroo pouches, floral petals and animals embracing their young. Creative exploration through sketch and material studies led to the concept of a type of "hugging or snuggling" garment to encourage kangaroo care.

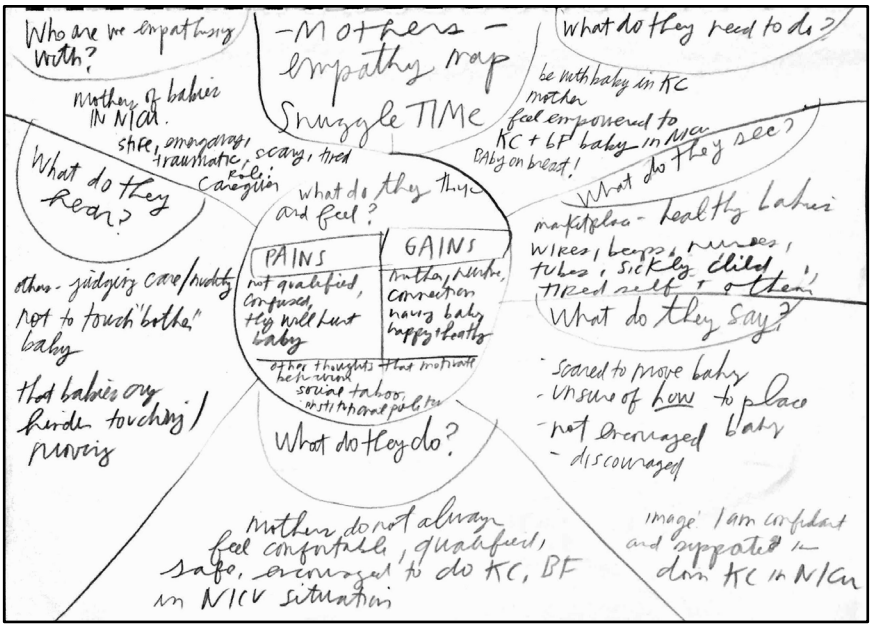

Figure 3. Empathy mapping strategy

Empathetic Ideation strategy

An empathy map, a collaborative tool primarily used in UX design, is here applied to the exploration phase of design of apparel. Teams can use it to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. Empathy maps were generated for mothers and caregivers and nurses. Figure 3. offers an example of the mother empathy map. Another ideation strategy employed the development of an interaction narrative. Interaction narratives assist in working through the development of detail in a design concept (Watkins & Dunne, 2015). Short storytelling exercises that enable the designer to "walk in the users shoes" from point A to Z of the user experience.

Figure 4. Low fidelity prototype-primary iteration

Design development and primary iteration

A low fidelity prototype (Watkins & Dunne, 2015) was developed synthesizing preliminary data and creative exploration. This first iteration prototype (see Fig. 4) enabled the designer to communicate concept in physical form to users and other stakeholders. Given the unique situational parameters, it was determined that users would benefit from a "system" rather than one garment, layered or worn separately. A bandeau top was developed from compression fabric and paired with an organic jersey kimono style robe. Pattern making reflects generous front bodice that can easily transform (fold, wrap, tie back) as required by the user. The core requirements of coverage, ease of use, fit, comfort and fabric preference were synthesized into the design concept. The layering system accommodates regulation of temperature as the wearer can adjust how much coverage is sufficient, a critical indicator of whether an infant can continue tolerating kangaroo care. Considerations that the garment must co-exist with actively working IV lines and sensors gathering medical vital signs of the infant were incorporated as well.

Assessment of primary iteration

Human subject research protocol entitled "Participatory Design for Kangaroo Care Garment Study" #1095378-2 from 7/21/2017 to 7/05/2018 was accepted at the University of Delaware for the author to do initial fit testing and feedback about garment prototypes with mothers of NICU babies via focus group. The Participatory Design of the Kangaroo Care Garment was conducted in an academic simulation hospital learning facility. Mothers and organizations of mothering support groups and breastfeeding support groups were contacted and invited to participate. Facilitators introduced the research and handed out information with contact cards. Mothers had an opportunity to try the primary iteration and test its performance abilities. A brief discussion was held with a few open-ended questions proposed by the researchers on the structure and capability of the garment. The focus group enabled researchers to capture feedback to modify the primary iteration in order to develop a design more suitable to the user secondary iteration.

Focus group

A focus group was conducted to evaluate initial snuggle garment prototype. The focus group allowed users to directly interact with the concept prototype and respond while wearing the initial prototypes. Surveys completed prior to the focus-group sessions requested demographic information. The moderators guide for focus group discussion included fiber construction (knit, woven, non-woven) as well as composition (bamboo, cotton, linen) requirements relating to Don/Doff, coverage (articulated visually thorough comfort mapping) modesty, ease of use (for mother and nurse) fit, comfort, fabric, (touch/feel, support/structure and temp regulation) and expression and aesthetics. The Wong-Baker Faces ™ pain mapping tool was adopted to visually map wearer preferences.

Figure 5. Design refinement-second iteration

Design refinement and secondary iteration

Insight gained from focus group resulted in a second iteration design concept of Snuggle Garment as depicted in Fig. 5. While previous interviews did not register aesthetic considerations, being face-to-face with the fabric and design helped different concerns and requirements for the participants arise. One participant discussed the importance of color (i.e. mom # 2 discussing color from the newborn perspective "newborns, the way their vision is, you see a lot of high contrast colors {sic} because that's what they can focus on") as well, participants discussed the pleasure they derived from non-institutional color (i.e. blue scrubs) in the NICU. The second iteration design reflects user feedback with the application of a custom contrasting textile design. The "animal gathering" theme is varigated to mimic block printing. The base layer garment is a compression bandeau constructed out of digitally printed sport lycra. The outer garment, a kimono-style robe, is constructed of spandex lycra and digitally printed with a lavender and white contrasting print, finished in a reverse contrast twill tape.

Discussion

This study is significant and contributes to efforts to improve caregiver wearables, innovative systems of soft, comfortable, safe, functional, smart garments that will help infants at risk for future delays due to a variety of diagnoses, be inexpensive for widespread clinical use, and will have low- and high-tech future applications. Findings from this study will guide the refined iteration/final design of the of SnuggleTime garment system that will be tested in a medical setting..

Conclusion and Implications for Future Research

This design research explored clothing limitations for important caregiver practices that are limited in hospital, public, and private spaces. User input and participation informed and guided empathetic iteration to meet objectives for the garment system related to emotion, function, expression, and aesthetics, future studies will evaluate requirements within a hospital setting. While the robe is open for ease of use and flexibility, the researchers are seeking closure solutions for future iterations. The researchers would also like to explore seaming/seam-free and welded constructions to reduce potential

friction rubs and chafing. Participatory design methods can inform the development of garments and wearable medical devices to facilitate important early infant-caregiver behaviors, such as kangaroo care, overcoming barriers by mothers, by design.

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