A theory of change for cleaner cooking: building a health belief model for service design starting with the slums of Kathmandu

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2021 IEEE Global Humanitarian Technology Conference (GHTC) | 978-1-6654-3372-3/21/$31.00 ©2021 IEEE | DOI: 10.1109/GHTC53159.2021.9612489

***Abstract*— A new theory of change is needed for cleaner cooking. Indoor cooking on three stone fires is a practice that is harmful to both people and planet: causing an increasing number of fatalities and destroyed forests. Yet humanitarian, international, and national efforts to transition to cleaner fuels are so far unsuccessful. This short paper proposes a new and transdisciplinary approach; one that deeply seeks to understand the women end-user and community perspective and opportunity for change. We will start by investigating the link between quality of life indicators, health impact of indoor air pollutants and local strategies in the slums of Kathmandu. This data collection will contribute to the development of a Health Belief Model (HBM): a model that considers people own role in creating change. This combination of data collection and HBM can help us understand how women and communities can be approached to trigger the needed behavioral change. Describing the end user perspective in a more holistic manner will further contribute to create service blueprints showing how existing service systems can integrate stove introduction programs with existing public health programs. The model creation will be followed with stove introduction for clean and affordable fuel use.**

Keywords—service design, indoor cooking, SDGs, HRQL, design ethnography, health belief models

I. INTRODUCTION

Four million women and children die every year due to indoor cooking pollution mainly due to the use of a three stone fire using firewood[1, 2]. This tradition contributes to the deforestation of already environmentally vulnerable areas. Chronic disease, premature births and low birth weight are common among women and children who are exposed to smoke from indoor cooking[3-7]. Burning solid fuels for cooking, heating and lighting has been estimated to cause 4 million deaths per year globally. "*The world, however, is not simple when we study something as central to daily life as household energy*"; in other words, the issue of household cooking is one of the most cross-sectional and wicked challenges to approach as a research community[8]. Larger scale efforts and focus of technology transfers up until now has largely been centered on and targeted by stakeholders with environmental and engineering interests and agendas such as deforestation and fuel production. Comparatively less focus has been put on understanding the women end user's role and their understanding of the health effects of indoor cooking. Cleaner cooking is agender issue [9]. Women and children in developing countries, are disproportionately affected by exposure to indoor air pollution, and household cooking alternatives are hence both a gender issue and a public health concern. Typically, female household members spend large amounts of time collecting their daily fuel. This necessary activity prevents them from spending time on other activities such as income gathering. Moreover, issues such as affordability and the health of their children, mean more. In her PhD research, from 2015, Fladvad Nielsen found that refugee women that have lived in deforested areas are not concerned with the environmental issues connected to cooking with biomass. Instead, they are more concerned with urgent issues such as access to water, safety and in general the health and life prospects of their family members [10, 11]. As health issues for themselves and their children is a more pressing concern for women than environmental concerns, we hence support the statement made by Call et al: "*the success of clean cook stove campaigns might hinge on a greater integration of the public health community with a variety of other disciplines* [6] Further, service design is perhaps the most rapidly growing innovation discipline and will allow to bring learning from an individual and community level and up to systems, policy and decision-making level. Service design provides the opportunity to map the complex interactions, support systems of fuel supply, economics, trades of cleaner cooking and also the community health care service systems locally[12-14]. In this study, we present a new theory of change for cleaner cooking, one that enhances the impact of knowledge about health effects and information through service design and triggers change in a new way. The theory of change is described, and then followed by the description of a study aiming at communities of the slums of Kathmandu, Nepal. We present the expected results, before discussing how these insights can contribute to the proposal of new service design that integrates health care services and community health care programmes with technology transition programmes for new stoves and fuel alternatives. Lifting exploratory case studies of the entry through health services to tackle this issue, will directly impact three SDGs

goals: Goal 3 Good health and Well-Being;Goal 5- Gender equality, Goal 7- affordable and clean energy, and Goal 15 Life on land.

II. Developing a health belief model of indoor cooking (theory of change)

Sandvik calls for new theories of change in humanitarian innovation[15]; stating that "*Since the publication of the ALNAP study on innovation in international humanitarian action in 2009, innovation has emerged as a central vehicle for change in the humanitarian sector. As the field of humanitarian innovation expands and matures, there is an increasingly vocal expectation that "now is the time to deliver*." Sandvik also says "*exactly what do actors in the humanitarian sector expect innovation to deliver, how, and why does it matter*?". In humanitarian relief and development, including north-south collaborations between academic actors focusing on technology transfer and suitable change in a global south context, there is a multitude of actors involved. Yet, impact on core issues is yet failing to materialize. In the case of indoor cooking, tech transfer programs up until now have failed to deliver satisfactory impact, failed to eliminate deaths, premature births and deforestation. We therefore propose the build-up of a new theory. This theory of change will go through public health, design ethnography and community outreach, digging deep into people and community's relationship with indoor cooking, rather than staying on the engineering path. We propose a humanitarian design approach[16], that will be appropriate both for humanitarian markets and development markets. Humanitarian design focuses on design for dignity in vulnerable settings. The humanitarian design approach will combine two concepts previously unknown to each other: the development of a Health Belief Model (HBM) of indoor cooking, tailored through service design ensuring adaptation to communities of lower income regions in the global south. The theory of change is further based on the knowledge that in order to generate insights so that we can develop transitional programmes for the humanitarian and development sector, we need to move focus from product and technology level, and up to service design; acknowledgingthe complexity of health effects and indoor cooking. We need to better understand end-users *interest* in the change from harmful to cleaner cooking. On the cooking side, we need to describe the entire service blueprint including fuel production, markets, access, household economics and affordability, cooking practices and end-user options. On the health side, we need to develop models to explain how community health care can create a dialogue with communities on the benefits of cleaner cooking. On policy level, this oversight and new proposals for change, can give capacity to decision-makers to target the challenges of indoor cooking on a completely new level.

Moreover, we need a model that explains how practitioners can impact households' awareness and attitude towards change. It has been evident in interviews, that health is a more pressing concern to women and families, and that environmental concerns or technology are far from communities first interest[10]. Since the early 1950s, the Health Belief Model (HBM) has been one of the most widely used conceptual frameworks in health behavior research, both to explain change and maintenance of health-related behaviors and as a guiding framework for health behaviour interventions[17]. *"If individuals regard themselves as susceptible to a condition, believe that condition would have potentially serious consequences, believe that a course of action available to them would be beneficial in reducing either their susceptibility to or sever-ity of the condition, and believe the anticipated benefits of taking action outweigh the barriers to (or costs of) action, they are likely to take action that they believe will reduce their risks".* The HBM is also developed within an individually oriented society, in which customers to a certain extent may decide on an individual basis what is best for them. Cooking on the other hand is a community practice, and often the countries were these practices are widespread hold a more collective approach that can also influence how we build a new HBM for indoor cooking[1].

Finally, a person also must have the *real option* to make choices. In the context of indoor cooking, we know that there might be a conflict of interest. This can be other interest such as fuel and stove affordability, fuel accessibility and affordability, household economics and decision power over purchase, time consumption, power relationships, daily practices and food traditions.

We believe that all these issues can be proposed solved in combination through a service design approach, mapping contact points, actors, value interactions and experiences. This need is supported by Jürisoo, Lambe and Osborne who in their service design study conclude that "*key behavior change techniques could be applied, primarily by cookstove implementers, at different phases in the adoption journey to support users in the process of overcoming behavioral barriers to adopting a new technology. […]complex factors affect people's decision-making around the purchase and use of clean cookstoves, and highlight the need to carefully map user's experience to pinpoint where support is most needed in the process of change"[12].*

III. Research question and rationale

In order to create a foundation to understand how we can build a health belief model (HBM) of indoor cooking and enhance it through a service design approach, we need to first develop a baseline of knowledge about women's own understanding of the link between health and indoor cooking. To begin with, and as an example of how this can be done, we will investigate the link between indoor pollutants and health related quality of life, and the communities' own strategies towards the challenge. To do so, an initial study has been developed that will take place in the urban slums of Kathmandu, Nepal.

A. Indoor pollutants and cooking in Nepal

In the households of Nepal most common sources of indoor pollutants are cookstoves, secondhand smoke and wood smoke which produces gases like carbon monoxide, nitrogen dioxide, radon and indoor particulate matter which has a toxic effect in human health leading to various respiratory related diseases [18]. According to NDHS 2016, in Nepal more that 66% of the households still use solid fuel like wood as a main source of energy for cooking food which is mostly prevalent in rural areas (88%). A study shows that more than 80% of household in Nepal had one marker of indoor air pollution (IAP) i.e. they have either indoor smoking or use of unclean fuel or improper indoor coking practice[19].

B. Quality of Life Indicators

As per CDC "HRQOL is the individual's or group perceived physical and mental health over time." It covers domains related to physical, mental, emotional, social functioning and the social context which people live in. HRQOL measure the aspects of quality of life that affect the health of the people. HRQOL on the personal level covers physical and mental perceptions while on the community setting involves community level resources, policies and practices that control a population's health perceptions and functional status (8).A study in India showed that Health Related Quality of Life among woman exposed to indoor smoke while cooking (wood) was significantly lower than those of not exposed or those used Liquefied petroleum gas (LPG) [20].

C. Research question and methods

In the upcoming study, we will ask three central questions: *To which degree are women in the slum aware of the health-related hazards of indoor cooking?*

What is the relationship between quality of life and access to clean fuel?

How have local communities found coping mechanisms to handle challenges related to indoor cooking?

These questions will contribute to a foundation for building the health belief model and service design approach.

IV. PREPARATION OF STUDY

The study area will be the slums of Kathmandu of Nepal between September 2021 and June 2022. The study design will be of mixed methods. Quantitative data will be collected through a cross-sectional study and for assessing the qualitative data about strategies FGDs will be conducted. A Nepali version of the questionnaire will be used to collect data for the quantitative purpose and the respondents will be women of household age above 18. For acquiring both qualitative and quantitative data primary investigator will hire other data enumerators who have been trained extensively in data collection methods. The sample size for the study is calculated using SPSS Power Sample 3 software. For this study, the study will enroll 354 people. With this sample size, there is a 95% likelihood that the sample mean will fall within 0.13 points of the true mean. If we observe a mean of 2.49, we will be able to report that the true mean probably falls in the range of 2.49 plus/minus 0.13 points. There are 13 informal clusters of slum areas in Kathmandu (10), among which some of them were selected randomly for the data collection. From the selected cluster of slum various woman's group or mother's group organized there will be accessed from which possible list of women involved in the group will be generated and the participants will be selected randomly for data collection.

In the chosen communities, 5 focus group discussions will be held with selected participants from the survey study. In these focus group, we will discuss in groups of 5-10 women. The topic will be open ended to gather qualitative input about whether the women have strategies to reduce the harm of household cooking, and to discuss the topic of HRQL and indoor cooking smoke. For the quantitative data, SPSS analytical software will be used to analyze data. Univariate analysis of all the variables will be performed to know the descriptive statistics of all the variables. Multivariate analysis (Mann – Whitney U test) will be used to find the association between socioeconomic and demographic variables and subscales (physical, mental, emotional, social health) of women's HRQOL. Two linear regression model will be performed to find the relationship between cooking practice (use of clean or unclean fuel) and subscales of HRQOL. First one will include socioeconomic and demographic variables as independent variables while the second test will use cooking practice as an independent variable controlling socioeconomic and demographic variables. For the qualitative data the recorded discussion will be transcribed and analyzed following interpretive phenomenological approach model. The focus groups will be recorded, transcribed, and analyzed for the qualitative purpose.

V. VALIDITY AND FIELD WORK RISKS

Due to the COVID-19 situation, the progress of the study might be delayed or the direct data gathering hindered. As well, one must take into consideration that families in the slum might have been disproportionally affected by the pandemic, leaving the question to ask in the context of whom it is okay to gather data from without it being unethical; this can be mitigated by good local guides and gatekeepers to help evaluate the appropriateness of each step in the research plan. Also, gender issues regarding the gender and trust of the researchers and research assistants can impact the data collection and validity an need to be considered.

VI. EXPECTED FINDINGS AND RELEVANCE

Overall, we expect that the study will give the current scenario of indoor air pollution and its health effects in the women living in the urban slums of the Kathmandu. It will help us to broaden our knowledge and understanding of impact of unclean cooking practice on overall health and wellbeing of the women. The study will also provide us with an access to further studies and trust building in the selected

areas of the Kathmandu.The expected results will more specifically show the status of indoor air pollution and the information on types of fuel used for cooking practice (major source of indoor air pollution). We expect a significance association between indoor air pollution and the health-related quality of the life of the women in slums. And perhaps there will be a linear relationship between cooking practice and HQOL; in other words that the status of HRQOL of women in slums is decided by their amount exposure to indoor smoke. Through the qualitative analysis it will be are interested in identifying to which extent women are aware of the effects of indoor air pollution. We are also interested in seeing whether they are unable to change the way of cooking due to factors such as lack of proper knowledge, guidance, resources, household economy, daily practices, and access. The probable findings of the study will show the urgency of sifting the traditional cooking practices like use of firewood and traditional stove to the modern cooking practice or use of clean energy source (electricity) for improving overall health and quality of life of women in urban slums. For the change of the scenario the bodies and organizations involved in the welfare of the slums need to be involved in the further aware and provide knowledge and guidance on use of clean energy. Government should give priority and develop strategies on building infrastructure needed to provide uncut supply of clean energy and provide subsidies on the cost required to replace and install modern clean energy appliances.

VII. FURTHER WORK

Transitioning to new technologies and fuels to create an alternative to the three stone fire, requires technology acceptance, desirability, opportunity, and collaboration. Acceptance and desirability is based on ownership, which require the design of products, services and systems that meet the 'real needs' of the end-user. Further work will focus on the development of a Health Belief Model appropriate for three countries: Ethiopia, Nepal and Malawi. We will develop service design blueprints together with public health, local stakeholders and end-users. Service design plans and organizes people, infrastructure, communication and material components so that the end-user will have a good interaction with the service provided. Service design prototypes can also inform changes, redesign existing services and resources or create totally new services. Stove introduction programs is one service, spirometry for measuring lung health is one service, and communicating health effects through health belief models can be regarded as a third service. The research group 'Healthy Villages' at NTNU will work on combining these and redesigning a holistic end-user experience improving the technology transfer process. To do so, extensive end-user studies, design ethnography and co-design will be needed. We call other research and practitioner communities to contribute.

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