


Perspectives

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Integrating Human-Centered Design in Tertiary Care Hospitals to Design Sustainable Solutions and Reduce Missed Opportunities for Vaccination : Uplifting Voices for Sustainable Solutions

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Authors' contributions

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the [Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors](#). Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

THE NEED FOR HUMAN-CENTERED DESIGN

For decades, public health officials have worked tirelessly to reduce deaths and illnesses associated with vaccine-preventable diseases, provide access to clean water to reduce disease transmission, and strengthen the health of communities worldwide. However, the COVID-19 pandemic, which has dominated the public health landscape in recent years, has led to a significant regression in gains previously made in various areas of public health. Within the last two years, children experienced the largest sustained decline in childhood vaccinations recorded over the past 30 years. Low-and-middle-income countries, including Nigeria and India, recorded the highest numbers of children missing routine immunization [1,2].

Previous studies indicate that a large proportion of children who miss out on vaccination services may already be accessing treatment and healthcare services in health facilities [3,4]. These missed opportunities may be due to failure to execute established vaccination policies and procedures. Specifically, these may include the inability of healthcare providers to screen patients for vaccine eligibility due to priority given to treatment for the acute condition for which care is sought, vaccine shortages and vaccination clinic inaccessibility for inpatients, perceived contraindications to vaccination on the part of healthcare providers and caregivers of children, and lack of health education. These challenges can be addressed by engaging local stakeholders, such as health facility staff, immunization officers, and caregivers of patients accessing care [5]. Designing interventions by integrating multiple stakeholder perspectives, building upon their innovative ideas, and creating solutions targeted to the environment within health facilities can substantially improve vaccination coverage without causing undue strain on available resources or requiring additional resources.

Human-centered design (HCD) is one such strategy that can help manage public health challenges such as missed opportunities for vaccination. The HCD approach is highly iterative, incorporates human factors into problem-solving, and puts people at the center of intervention design and execution. It seeks to design interventions and solutions that are desired by, used by, and responsive to stakeholders' needs [6]. The three primary phases involved in HCD are as follows: (1) inspiration, (2) ideation, and (3) implementation [6]. During the inspiration phase, researchers learn from the stakeholders and take time to discover their specific needs in the context of what is being studied. In the ideation phase, the researchers use the information from the inspiration phase to brainstorm ideas for potential solutions and create a prototype of solutions that stakeholders can pilot in their setting. In the final implementation stage, the ideated solution to the specific public health problem is implemented while being continuously refined.

HUMAN-CENTERED DESIGN IN HEALTHCARE AND HOSPITAL SETTINGS

HCD has been integral in addressing complex healthcare challenges and issues [7,8]. Although using HCD in healthcare settings can help stakeholders identify gaps in the healthcare system that can be filled to align with patient needs, more details are needed on what the approach specifically entails in healthcare-based settings [9]. Broadly, the three key characteristics of using HCD center around understanding and identifying which people are best suited to solve a problem, facilitating early and continuous stakeholder engagement, and developing a systems approach that ensures that changes implemented at the microlevel will also influence the macrosystem [9]. As healthcare and hospital settings involve a diverse range of teams with unique roles and responsibilities, HCD is a critical tool for developing innovative solutions that take into consideration the needs of all stakeholders.

IMPLEMENTING HUMAN-CENTERED DESIGN WORKSHOPS IN HOSPITALS IN INDIA AND NIGERIA

Our team used an HCD approach to motivate catch-up routine immunizations for children who were hospitalized in tertiary care facilities. Globally, between 27% and 84% of hospitalized children are reported to be incompletely immunized upon admission [10-12]. With limited primary care options, individuals in low-and-middle-income countries often use tertiary care centers as their first point of contact with the health system when needing acute care. Therefore, it is essential to ensure that these contacts with health services address gaps in preventative care, particularly with immunization. Tertiary care settings are likely to have on-site or nearby vaccination facilities, thus ensuring the feasibility of repurposing these resources to address undervaccination. Vaccination during hospitalization is critical, particularly because undervaccinated children have multiple vulnerabilities and more frequent hospital admissions [13, 14]. Although there have been previous efforts to address catch-up immunization during hospitalization, this issue persists, with less than 20% of hospitalized children receiving all age-eligible vaccines upon discharge [15-17].

We aimed to identify solutions to address this persistent gap in undervaccinated hospitalized children by implementing two HCD workshops in tertiary hospitals in Kano State, Nigeria, and Chandigarh, India, in November 2020. As travel and in-person meetings were not possible during the height of the pandemic, these HCD workshops were conducted virtually. These workshops aimed to design a targeted intervention to facilitate catch-up vaccinations for hospitalized children. We brought together diverse stakeholders, including traditional stakeholders like physicians, nurses, and immunization workers, and less conventional voices such as the hospital administration team, medical and nursing students, and community health advocates. They were representative of decision-makers and implementers of immunization in this setting and were diverse across age and sex. Stakeholders were selected by the local principal investigators in India and Nigeria and their team members based on their knowledge of the hospital patients and staff and their perception of who would provide essential information to design an intervention. By bringing together this well-rounded group, we sought to develop an intervention that addressed hospital vaccination barriers from multiple perspectives. Through these workshops, we reviewed primary data from both hospitals, highlighting the high proportions of undervaccinated children in hospital wards and caregiver and healthcare workers' perceptions of barriers to vaccination in the hospital setting. We further leveraged virtual conferencing breakout rooms to facilitate small group discussions to co-design the specific aspects of an intervention to overcome these barriers. In these breakout rooms, participants discussed the specifics of what content an intervention should highlight, how to implement the intervention, where to implement it within the hospital setting, who would be responsible for any additional tasks, and how to ensure the sustainability of any potential intervention. After completing these breakout sessions, participants completed a ranking exercise on a 'priority matrix' to assess the impact and feasibility of the intervention aspects of each proposed intervention.

By mapping the interventions to one of the four quadrants of low-to-high impact and feasibility, we were able to develop a prototype of a bundled intervention at the end of the workshop. The interventions discussed and ultimately selected were specific, realistic, and practical solutions that were simple to implement and evaluate.

WEB-BASED WORKSHOPS TO STRENGTHEN EQUITY IN MEETINGS

Traditionally, in-person meetings and conferences have led to exclusionary practices regarding gender, career stages, racial, and geographical backgrounds and have not promoted diversity, equity, and inclusion, particularly in science and engineering fields [18, 19]. Web-based meetings promote participant attendance and engagement by minimizing barriers to attendance and contribute toward decolonizing research in global health [20]. By

conducting our HCD workshops online, we found that we were able to bring together stakeholders of different ages and genders and, more importantly, break geographic and systemic barriers that may have prevented many of these individuals from attending or speaking up in an in-person setting. We recorded high attendance, eliminated travel costs, and minimized working-hour losses. During our HCD workshops, we found that younger participants, those who were not as senior in their positions, and women were actively engaged in discussions and willing to share their perspectives. More importantly, we discovered that organizing our HCD workshop online allowed us the financial flexibility to include a broader range of stakeholders to capture more unique perspectives that may have been missed in in-person meetings.

IMPLEMENTING SOLUTIONS

After co-creating tailored interventions, we designed and implemented them in both tertiary care facilities in India and Nigeria. These interventions aimed to address a range of barriers to vaccination in health facilities, focusing on the four Ds: (1) Dissemination of Information to increase awareness through informational posters targeted towards caregivers and vaccination education sessions targeted towards healthcare workers; (2) Documentation of Vaccination Status where healthcare workers (interns, resident physicians, and nurses) during their medical intake procedures of hospitalized children, ensured collection of their vaccination data and tracked their vaccination status so that immunization workers could quickly identify vaccine-eligible children and catch them up on missed vaccines; (3) Deployment of Vaccines with strengthened links between immunization workers, physicians, and caregivers to improve vaccination delivery; and (4) Discharge Advice where healthcare workers and hospital staff provided information and referrals to vaccination clinics near patients' homes upon discharge. Specific and tailored customizations are illustrated in Figure 1.

Figure 1: Customized solutions co-created and implemented in hospital settings in India and Nigeria to reduce missed opportunities in vaccination.

| MOV interventions | Nigeria customization | India customization |
|--|---|--|
| Dissemination of Information | Display posters on the value of vaccinations and relevant information (for healthcare workers and caregivers). Conduct teaching sessions for residents and healthcare workers, with emphasis on national immunization recommendations and catch-up vaccinations. | Display posters on the value of vaccinations and relevant information (for healthcare workers and caregivers). Information on interventions for missed vaccinations (regular and catch-up schedules) disseminated to all pediatric faculty, residents, and other health workers in the form of emails and FAQs. |
| Documentation of Vaccination Status | Determine the child's vaccination status (by focusing on accurate history and correlation with the vaccination card). Document child's vaccination status in book in ward and at bedside. | Determine child's vaccination status (by focusing on accurate history and correlation with the vaccination card) Document child's vaccination status in a vaccination chart in the medical file Use colored stickers on medical chart indicating vaccination status. |
| Deployment of Vaccines | Strengthen links to immunization services for children admitted in pediatrics by enabling vaccination clinic visits prior to discharge. Enable regular inpatient rounds conducted by immunization clinic nurses to identify and immunize admitted children with missed and due vaccines. | Strengthen links to immunization services for children admitted in pediatrics by enabling vaccination clinic visits prior to discharge. Enable visits to the immunization center in the hospital while the child is an inpatient. |
| Discharge Advice | Provide vaccination advice at discharge by instructing caregivers about their child's missed and due vaccines. Referrals to vaccination services in the community. | Add a colored sticker in the discharge booklet indicating vaccination status (complete or incomplete). Provide vaccination pamphlets to parents of children, indicating what vaccines are due (if any) and where they can go to get these vaccines. |

Broadly, these solutions were aimed to achieve the same goals in both Nigeria and India. Concurrently, the approaches were customized and tailored by the stakeholders in the HCD

workshops to meet the specific local contextual needs of each setting and local stakeholders. Each of the four Ds was tailored to the particular barriers, misconceptions, and hesitations most commonly seen in each hospital. Furthermore, the language, visualizations in the posters, layout in the medical record form for vaccination data collection, and prescriptions at discharge were all customized according to local context and integrated into existing procedures for sustainability. By involving stakeholders intimately throughout the process we designed bespoke interventions to reduce missed vaccination opportunities, which could be sustained for an extended period.

CONCLUSION

Using the HCD approach to understand the needs of patients and stakeholders in hospital settings provides a unique opportunity to develop meaningful innovations to enhance interventions in hospital settings without additional strain on resources. Designing these strategies via an online forum may be particularly beneficial, as it allows for extended and equitable opportunities for involvement and sharing perspectives. By understanding who the stakeholders are, engaging them throughout the HCD process and ensuring that solutions can lead to long-term change, HCD can be a valuable tool to uplift all voices and create a sustainable intervention to strengthen healthcare delivery and improve public health practice.

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AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the [Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors](#). Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests with this case.

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DECLARATIONS

Availability of Data and Materials

Meeting materials from HCD workshops are available from the corresponding author upon reasonable request. No data were collected and no datasets were included in the analysis manuscript.

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