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WOMEN AT THE FRONTLINE OF SURVIVAL: LESSONS LEARNED FROM DEPLOYMENT PORTABLE ULTRASOUND IN DISASTER-AFFECTED HIGHLAND COMMUNITIES IN BENER MERIAH, ACEH

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List of Abbreviations

COVID-19	: Coronavirus Disease 2019
EMT	: Emergency Medical Team
GBV	: Gender-Based Violence
KEMENDIKTISAINTEK	:Kementerian Pendidikan Tinggi, Sains, dan Teknologi Indonesia / Ministry of Higher Education, Science, and Technology of Indonesia
LMICs	: Low- and Middle-Income Countries
mHealth	: Mobile Health
POCUS	: Point-of-Care Ultrasound
SRH	: Sexual and Reproductive Health
UGM	: Universitas Gadjah Mada / Gadjah Mada University
UNICEF	: United Nations Children's Fund
UN WOMEN	:United Nations Entity for Gender Equality and the Empowerment of Women
USG	: Ultrasonography

ABSTRACT

Introduction: Disasters exacerbate gender-based vulnerabilities while underscoring women's critical role in sustaining community health systems. In Aceh, disaster-related damage to infrastructure disrupted access to essential maternal and reproductive health services.

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Objective: This study reports lessons learned from the deployment of portable ultrasound (USG) within a mobile disaster health response in Bener Meriah, Aceh, focusing on women's intersecting vulnerability and agency. **Methods:** A descriptive lessons-learned design was applied using service logs, field observations, team debriefings, and informal discussions with affected women and community midwives during a Universitas Gadjah Mada–led response. Portable USG was integrated into community-based midwifery networks to support point-of-care assessments in isolated areas. **Results:** Disrupted transportation and damaged health facilities significantly limited access to care. Mobile services using portable USG reduced geographic and mobility barriers, enabled timely assessments, and strengthened trust in health services. Community midwives played a central role in outreach, service delivery, and continuity of care. **Conclusion:** Disaster health responses are more effective when mobile health technologies are embedded within trusted community-based female health worker networks, reinforcing women's roles in equitable and resilient health systems.

Keywords: Women in Disaster; Gender Vulnerability; Portable Ultrasound; Disaster Health Management; Community Resilience

INTRODUCTION

Crises always unearth, and exacerbate, structural social disparities women and children bear the brunt of health, social and economic burdens (1, 2). A 2019 report by UN Women and UNICEF confirms that women, young children and adolescents belong to the population most at risk from hazards, conflicts or climate change and other shocks. The evidence is clear: in emergencies, women and children are 14 times more likely to die than men. In the 2004 Indian Ocean Tsunami, that left 230,000 dead, women constituted 70% of all people killed. These differences extend past biological differences of anatomy and can be deeply embedded in the social roles assigned to both genders, patterns of caregiving, unequal resource distribution and long-time standing norms within society, culture as well as law that are discriminatory. All of these factors greatly restrict women's access to essential services, including maternal and reproductive health care during and in the aftermath of large crises, thus reducing their capacity to respond effectively.

Pre-existing gender inequalities mean that disasters affect women differently than men in all aspects, from preparedness and evacuation to response, mortality, and recovery (5, 6). Women make up the majority of the poor, the most malnourished, the least educated, and

account for over 75 percent of displaced persons in disaster situations (7, 8). In low-income countries where gender and social inequalities are already significant, vulnerability to the negative effects of natural disasters is much higher. Disasters worsen existing gender inequalities by restricting mobility, increasing health risks, damaging livelihoods, and raising rates of gender-based violence (7, 9, 10). For example, women are more likely to experience post-traumatic stress disorder and other mental health problems after disasters (7).

At the same time, women often serve as primary caregivers, informal health providers, and community connectors, making them crucial agents of survival and recovery during disasters. Women take on vital yet frequently under-recognized roles, such as caregiving, transmitting early warnings, managing resources adaptively, and guiding their local communities (2, 11–13). The World Health Organization emphasizes that women form the backbone of the global healthcare system, representing 70 percent of health care workers worldwide (14, 15). This paradoxical position, being both highly vulnerable and essential to community resilience, is the main focus of this manuscript.

Aceh Province is in a seismically active region of Indonesia, and the area has been affected by numerous disasters that have disrupted health systems and community infrastructure. The heavy flooding and landslides hit in late November 2025, directly impacted Aceh, North Sumatra and West Sumatra province covering as many as 18 districts/cities of these provinces which includes as many as 226 sub-districts and 3,310 villages were affected. As of February 2026, these disasters have killed 1,204 people, with 562 deaths in Aceh alone. In addition to the immediate death and injury, such events result in prolonged disruption of access to essential health services. Many hospitals and community health centers were heavily damaged; some could not function at all, particularly in the early going as many health care workers also became victims of disaster. When roads, health facilities and referral systems are destroyed, routine service utilization is often difficult, time-consuming or impossible.

For women, such disruptions have multi-layered effects as a result of reproductive health concerns, care giving responsibilities and specific rules for movement in post-disaster situations (8, 13). In humanitarian emergencies resulting from conflict, climate change, natural disasters and public health crises, sexual and reproductive health needs are typically neglected with borderline catastrophic consequences (3). Approximately 60% of avoidable maternal deaths occur in conflict, displacement and natural disaster settings (3). In the absence of prenatal care,

safe delivery and obstetric emergency care, pregnant women are at increased risk of life-threatening complications (8). Pregnancy and childbirth in developing countries are always risky one woman dies every minute from pregnancy-related causes and when disaster strikes, these risks increase (3, 7). For example, not being able to access essential maternal and reproductive health services due to damaged infrastructure, lack of supplies, or unavailable health workers worsens outcomes for women in these situations (16, 17).

Bener Meriah District demonstrates how the impacts of disasters are not experienced equally by various sociodemographic groups, and women bear disproportionate burdens due to preexisting gender disparities (5, 8). Difficulty of access is exacerbated during emergencies by geographical isolation, rugged terrain, and underdeveloped infrastructure for transportation; the problem is particularly acute in resource-poor contexts where family care responsibilities rise post-disaster (13). Not only do women have to negotiate the ruined roads and house recovery, children and elderly or injured relatives can take them into child care and elderly care roles that can increase substantially when mobility is restricted and resources are lost yet (8, 13). This dual burden incurs health risks such as mental health issues, heightened risk of gender-based violence and consequently delayed or deferred care (7, 10). The physical stress of pregnancy, compounded by increased levels of psychological stress after disasters and through the post-disaster period, put women at further risk for negative health consequences including preterm birth and maternal mortality (18).

In Bener Meriah, the Universitas Gadjah Mada team used portable ultrasound as part of a general strategy of mobile health service to meet women's heightened vulnerability stemming from changes in disrupted infrastructure and referral systems during the disaster health response (3, 8, 17). Over 1,200 healthcare workers from the Ministry of Health and Aceh Health Office were dispersed through the province during the emergency response period emphasizing efforts to increase accessibility of health services among affected women who had higher risk of maternal mortality, preterm delivery, and gender-based violence as a result of existing disparities and additional caregiving responsibility (7, 13, 18). Portable USG has been particularly useful in disaster situations and under resourced settings where availability of sophisticated equipment and trained operators is scarce, and providing point-of-care support which becomes essential for pregnant or post-partum women who are challenged by geographical isolation and family responsibilities (5, 16). In disaster triage, portable ultrasound has been shown to influence clinical care in up to 70 percent of cases, reducing diagnostic time, alleviating prohibitive costs, travel barriers, or time constraints, and supporting continuity of

care through integration with community Midwives/Nurses (17). This highlights the usefulness of portable ultrasound technology in improving patient management and outcomes in challenging environments (19).

This intervention was carried out in close partnership with community-based midwives/Nurses who are already deeply integrated into the social fabric of the affected villages. Community Midwives/Nurse, a large component of the predominantly female health workforce, have essential roles in terms of preparedness and response to all emergencies (14, 15). They are embedded in communities and have deep knowledge about local practices, women's care-giving roles and the experiences of women and children (8, 13). This puts them in a strong position to identify what actions are required to maintain the availability of quality sexual, reproductive, maternal, newborn and adolescent health services despite challenges. Strangely, although midwives/Nurse-midwives are the ones closest to affected communities (usually women at the lower end of health hierarchies), they are quite regularly left out in emergency preparedness and response planning at local, national, and international levels (15). Such exclusion does not optimize gender-responsive disaster health management (10, 12). To do so would have infected and already vulnerable maternal and neonatal services, especially in contexts where maternal and newborn health outcomes are weak (20). Thus, inclusion of a community Midwives/Nurses component in disaster preparedness and response is essential to building health systems capacity to function during crises and continue the provision of core maternal and reproductive health services.

This manuscript shares lessons learned from this field experience, focusing on how women's vulnerability and agency coexist in disaster settings. Instead of focusing solely on antenatal clinical outcomes, it highlights broader gendered dynamics of access, trust, and continuity of care that are essential to disaster health management.

METHODS

Study Design

This study used a descriptive qualitative design with a lessons-learned framework. This method is used due to the need for rapid response, ethical limitations, and operational priorities that restrict the implementation of experimental or longitudinal designs. Lessons-learned analysis enables systematic reflection on implementation processes, contextual challenges, and adaptive strategies to guide future policy and practice.

Setting

The study was conducted during disaster health response activities in Bener Meriah District, Aceh Province, Indonesia, following the November 2025 floods and landslides. The area experienced significant disruptions to transportation routes, primary healthcare facilities, and referral systems. Several villages temporarily became isolated or accessible only by trail motorcycles, creating major barriers for pregnant women attempting to reach primary health facilities for antenatal checkups. Conditions in several affected areas were severe, with critical issues due to disrupted logistical support, lack of clean water, and broken transportation routes and communication networks that hampered health services.

Intervention: Mobile Health Service with Portable USG

The UGM disaster health team incorporated portable ultrasound devices into a mobile health service package. The UGM Emergency Medical Team (EMT), made up of multidisciplinary staff including general practitioners, specialists, nurses, and technicians, was deployed on a weekly rotating schedule. Services were provided directly within affected communities and coordinated through temporary health posts and existing community midwifery networks.

Portable USG was chosen for its mobility, quick deployment, and relevance in addressing clinical uncertainty about women's health issues in settings with disrupted referral systems. Point-of-care ultrasound is especially valuable in resource-limited environments because it is relatively inexpensive, accessible, and can be deployed quickly. USG assessments were complemented by basic clinical exams, counseling, and, when necessary, referral recommendations. The presence of community Midwives/Nurses at each service site facilitated culturally appropriate communication and follow-up.

Participants and Service Recipients

Service recipients mainly included women living in affected villages who faced difficulties accessing fixed health facilities. These comprised pregnant women, postpartum women, and others with reproductive or general health issues. In disaster situations, pregnant women and children are at higher risk than other groups because they have special physical and psychosocial needs that require ongoing care despite community challenges.

Community Midwives/Nurses served as vital links. They identified women needing assessment, shared information about available services, and coordinated schedules. Many of

these midwives/Nurse-midwives had been affected by disasters themselves, experiencing personal loss, damage to their homes, or displacement, yet they continued to provide care within their communities.

Data Sources

Data were derived from multiple complementary sources:

1. Structured field observation notes documenting service delivery processes, access barriers, and contextual challenges.
2. Service logs recording the number and types of assessments conducted, including USG examinations.
3. Informal interviews and conversations with affected women and community Midwives/Nurses, capturing experiential perspectives on access, trust, and perceived value of services.
4. Team debriefings provide reflective insights into operational challenges, ethical considerations, and adaptive strategies used during the response.

No identifiable personal data was collected; information was recorded in aggregate or anonymized narrative form.

Data Analysis

Data were analyzed thematically through repeated review of field notes, service logs, and debriefing summaries. The analysis aimed to identify themes related to gendered vulnerability, access barriers, trust, continuity of care, and women's roles as community anchors.

The response team discussed emerging themes to confirm interpretations and improve lessons learned. These lessons were combined into shareable insights relevant to disaster health management in similar resource-constrained and disaster-prone settings.

RESULTS

Disrupted Access to Health Services and Gendered Vulnerability

Destruction of roads and health infrastructure severely impeded women’s access to medical services. Visiting operational facilities tended to be difficult due to travel distances, transportation availability and financial constraints in post-disaster scenarios. These barriers

especially affected women due to their caregiving responsibilities and social norms that restricted them from moving.

The hilly terrain in Bener Meriah and a damaged road network from the disaster, made geographic distance a major health barrier. The reliance on trail motorcycles for access highlighted the infeasibility of facility-based antenatal care for pregnant women and an urgent necessity to decentralize maternal health services through a mobile approach in hilly disaster-prone areas. Women frequently waited to seek care until symptoms were more severe and consulted informal advice rather than formal health services. Moreover, the additional responsibility for house-hold recovery, child-care and care of injured family members limited their ability to access timely care.

Figure 1. Collapsed Bridge Infrastructure Limiting Access to Health Facilities in Disaster-Affected Highland Areas of Bener Meriah Regency.
Source: Kosim et al., 2026

Portable USG as a Bridging Mechanism for Access and Reassurance

In this situation, portable USG to rapidly conduct evaluation at the community level fills in well when referral pathways are disrupted. Ultrasonography mobile health services Progressive ultrasonography mobilization enables very difficult travel to be avoided along damaged roads on dangerous trail motor-bikes across the mountains to reach isolated facilities. This supports solving urgent diagnostic problems, bridging physical distances and relieving psychosocial uncertainties associated with broken referral pathways. Premature ultrasound eliminates the time lag in receiving a diagnosis to deliver life-saving treatment. This fact is particularly critical in the field of obstetrics, when a delayed treatment of pregnancy related complications can result in death or serious injury to baby and/or mother.

Figure 2. Portable Ultrasonography Transported by Trail Motorcycle to Support Antenatal Assessments in Remote, Disaster-Affected Areas

Source: Kosim et al., 2026

Portable USG, in addition to its diagnostic role, also had an emotional and symbolic meaning. The presence of the USG machine at village level showed that formal health care remained available and functional despite damaged infrastructure. Women described the comfort of having an examination performed in local services, particularly if referral pathways were ambiguous. This demonstrates how proximity and visible services can help recover feelings of safety and agency in times of crisis.

Figure 3. Portable Ultrasonography Enabling Clinical Examination in a Disaster-Affected, Low-Resource Setting

Source: Kosim et al., 2026

Community Midwives/Nurses as the Backbone of Service Delivery

Community Midwives/Nurses, using health posts and village networks were critical in facilitating mobile services. They tracked women requiring assessment, scheduled time for the provision of services, and served as a means of communication between the disaster health team and community members. Trust and identification in the community were key for promoting women's use of services.

Emphasizing, many were Midwives/Nurses disaster survivors who had losses, homelessness, or displacement. Despite the difficulties, these women continued to serve as frontline health workers. This unique background where they are the affected person but also the first responders, underscores women health workers being the heartbeat of service continuity and community resilience during crisis. Initial disaster response generally occurs at the community level, with emergency service agencies and other organizations arriving after additional time has passed until the initial emergency phase ceases. As midwives/nurses make up a significant part of the health workforce and often work closest to affected communities, their contribution to disaster risk reduction and rapid response is vital.

Figure 4. Volunteers and Community Midwives Sustaining Health Services Within Disaster-Affected Communities.

Source: Kosim et al., 2026

Trust, Gender, and Continuity of Care

For women, use of mobile services were heavily dependent on trust in local midwives/nurses. Familiarity between female local health care workers and external medical teams reduced anxiety, facilitated culture-appropriate care and communication.

Continuity of care was fostered in this approach, with women being more likely to disclose issues, accept referrals or come back for follow-up if their Midwives/Nurses had encouraged them. By working in circumstances where formal systems were weak, the relational continuity made available by community Midwives/Nurses sustained an essential if tenuous health-care presence for women.

DISCUSSION

This lessons-learned review of the response illustrates the paradoxical position of women in disaster environments, who experience heightened risks and vulnerability as well as being integral to shoring up health system resilience. Sensitivities of community level health workers In Bener Meriah, damage to infrastructure and broken referral pathways exacerbated pre-existing gender-related barriers to care, although the Midwives/Nurses and other women's health at community level were sensitized by the UGM team delivery services through mobile ultrasound. This is consistent with general evidence for the increased vulnerability that gendered social roles bring in crises, but also their contribution to people's ability collectively to cope (21–23). In addition, the profound social and cultural barriers endemic in more deprived communities frequently restrict the capacity of women to influence change with their significant role in disaster response invisible or undervalued (24).

Gendered Vulnerability Beyond Clinical Outcomes

Results from Bener Meriah indicated that medical criteria are insufficient to lower women's susceptibility in emergency conditions. Women experienced multiple barriers including inability to move around, more caregiving roles and lesser decision making right after the disaster. Biological and social factors linked to health and well-being combine to render gender a site of vulnerability in the face of natural disasters (4). Consequently, they are at higher risk for maternal death, genitourinary infections and being violated in post-disaster shelters, which further compromise their already marginalized status (25).

Traveling to functioning health facilities involves navigating damaged roads, arranging scarce transportation, and leaving children or injured family members behind (25). In coastal Bangladesh, compelling evidence has been gathered to show that restricted mobility and delayed evacuation due to caring obligations within the family, as well as inadequate shelter capacity, have resulted in differential impact of cyclones on men and women (25). Women and adolescent girls have to contend with different health challenges during disasters—besides being unable to access adequate water, sanitation and hygiene facilities in the majority of cyclone shelters and temporary accommodation (25). In such disaster settings, shelters in Bangladesh commonly did not have privacy, thus exposing occupants to a high risk of abuse, including sexual violence that can result in unwanted pregnancies and sexually transmitted infections. There is an added social stigma for women who are displaced from their homes

during a crisis (25). These overlapping perils are consistent with gendered disaster literature, which conceives of vulnerability as a product of social roles, power relations and resource disparities instead of biological sex alone (24). Gendered roles, norms and values influence women's and men's preparation for, response to and recovery from disasters in ways that may lead to uneven disaster impact (21, 22). Such dynamics also are important to recognize when tending survivors in the days following a disaster--and will better enable out-of-country aid responders to tailor health promotion strategies. Recognition of these dynamics is critical for developing post-disaster health interventions that reach beyond basic "vulnerable group" labels and call for action to minimize gendered vulnerabilities at their source.

Women as Anchors of Community Resilience

At the same time, field experience highlights the vital role of women, especially community Midwives/Nurses, as pillars of resilience in disrupted health systems. Community Midwives/Nurses linked external response teams with affected women, identified those needing assessment, coordinated mobile clinic schedules, and offered ongoing emotional and informational support.

Their contributions go beyond clinical tasks to include negotiating with community leaders, reassuring anxious families, and advocating for women with limited voices in household decision-making. Research from Bangladesh's coastal areas confirms that women assume primary disaster response roles through their vital responsibility of providing for their dependents' food, water, and healthcare needs, often facing disproportionate effects due to socio-cultural conditions and limited resources (26). After Cyclone Aila in 2009, many reports documented women who saved children and elderly family members, worked with neighbors to share information, and coordinated childcare arrangements and group food preparation reflecting broader evidence of women as active agents who organize community activities, communicate risks, and build partnerships during disasters (9). These informal support networks help families stay safe until formal assistance networks are operational. This illustrates that women's embodied caregiving and their disproportionate household management responsibilities make them key stakeholders in equitable recovery planning, even though they are often overlooked in official disaster response frameworks (24). Ignoring these contributions creates a major gap in disaster preparedness, as women's perspectives are frequently missing from planning committees, resulting in inadequate attention to their unique needs and capacities (26).

Studies from disaster-prone areas, including Indonesia, show that strong family and community support, cooperation with partners, and empathy among workers are vital for enhancing women's economic and social resilience during crises (23, 24, 25). During the COVID-19 pandemic in Indonesia, women's leadership became prominent as they coordinated openly through practical digital means, earning recognition, trust, and support from family, community, and society echoing the essential roles of community health workers in resource-limited settings (21). Similarly, research from Iran on women's resilience in natural disasters confirms that while such events threaten everyone differently, strengthening resilience through relational networks can effectively address gendered vulnerabilities (22). These findings emphasize the importance of understanding the complex roles women play, including their greater vulnerability to disaster impacts and their essential contributions to recovery and resilience efforts (9, 26). However, despite their demonstrated resilience, a significant gap remains in how these contributions can be used to systematically reduce women's vulnerability over the long term, moving beyond anecdotal evidence toward comprehensive policy and program interventions (9).

Many Midwives/Nurses in Bener Meriah were themselves affected by disasters, yet they continued to serve in these critical roles, exemplifying women's vital contributions to resilience during crises, as documented in disaster-prone settings such as coastal Bangladesh and Indonesia (24–26). However, their contributions often remain informal, under-recognized, and under-resourced within formal disaster management frameworks, with women's perspectives frequently missing from planning committees (24, 26). Despite the essential role Midwives/Nurses play providing most reproductive, maternal, and child health services in resource-limited and conflict-affected areas, studies have found that only a small percentage have received training on disaster management (21, 23). In one study of public health Midwives/Nurses in disaster-affected regions, 58.1 percent had not received any disaster management training during their careers, and 94.6 percent had not participated in any training program. The lack of training is a missed opportunity to systematically support and integrate this vital workforce into preparedness planning, response efforts, and recovery programs through task-shifting, specialized capacity-building, and expanded community-based midwifery initiatives (21, 23). Such professional development could enable Midwives/Nurses to operate more effectively in emergency situations and help build community resilience by

ensuring access to essential sexual and reproductive health services, which are often disrupted during crises (27).

Technology as an Enabler Within Social Systems

The deployment of portable ultrasound in Bener Meriah shows that technology alone cannot solve deep-seated access issues. The success of USG depended on how well it was integrated into existing social and professional networks led by women, similar to task-shifting innovations in Uganda, where trained Midwives/Nurses performed scans and used telemedicine for interpretation to provide services in remote areas. Mobile health initiatives are becoming more widespread in low-income countries, but current research often misses implementation challenges related to design and technology needs, such as excessive complexity, loss of trust from end users, and poor feedback systems that hinder community health workers adoption.

Portable USG-enabled point-of-care assessments in villages have become temporarily isolated, reducing the need for risky and costly travel to damaged facilities. Yet, their impact was magnified because trusted Midwives/Nurses mediated their use, explained findings, and connected women to further care when possible, mirroring task-shifting innovations in Uganda, where trained Midwives/Nurses conducted ultrasound scans with telemedicine support for remote interpretation, thereby extending services effectively in low-resource settings (23). Conversely, studies from Uganda have documented that when community health workers faced technological failures, their trust in the technology declined, along with their use of it (23). Research on mHealth implementation in resource-limited settings identified key challenges, including lack of adaptability, excessive complexity, loss of trust among end users, and ineffective feedback systems that hinder community health workers adoption (21).

The presence of portable ultrasound in Bener Meriah also carried symbolic weight, signaling that the health system, though strained, remained present and responsive. Women's reports of feeling reassured when examinations were performed locally by familiar Midwives/Nurses suggest that trust and perceived safety are as important as technical capability in driving service utilization (21, 23). This aligns with task-shifting innovations in Uganda, where trained Midwives/Nurses conducted ultrasound scans with telemedicine support for remote interpretation, extending services effectively through trusted local providers and thereby enhancing women's access in low-resource settings (23). This underscores the need to integrate technological solutions into existing community frameworks and to leverage trusted local

health workers to bridge critical healthcare gaps, especially in areas with limited infrastructure and medical personnel (23, 28).

These observations support the view that mobile health technologies should be seen as enablers that strengthen trusted local systems—such as task-shifting to Midwives/Nurses with telemedicine support—rather than standalone solutions imported from outside (23,28). Insights from rural Peru reveal critical implementation barriers beyond technical issues, including inadequate training for health staff, limited community engagement, poor infrastructure, and a lack of support for maintenance and monitoring, along with common challenges like security, cost, interoperability, scalability, and limited local knowledge (28). Implementers should anticipate and work to avoid these barriers by investing in and adapting to local human and material resources (e.g., community health workers), prioritizing feedback from end users to foster trust, and enhancing data management and quality assurance procedures (21, 28).

Implications for Disaster Health Management Policy and Practice

The lessons learned from this field experience have important implications for policy and practice in disaster health management. Recognize women as both vulnerable and capable individuals. Disaster preparedness and response plans should go beyond viewing women solely as a vulnerable group needing protection rather than inherently weaker, their distress often results from disproportionate caregiving responsibilities and instead acknowledge their roles as health providers, organizers, and decision-makers (24). Midwives/Nurses and female health workers, who deliver most reproductive, maternal, and child health services in resource-limited settings, are often absent from planning committees despite their vital contributions (21, 24, 26). Research confirms that despite challenges such as entrenched gender roles that re-emerge after a disaster, which frequently exclude women from decision-making, including women in disaster response and recovery leads to better outcomes and quicker recovery by harnessing their adaptive skills and community trust (24, 26). Improving gender equality is essential not only for human rights but also for strengthening nations' resilience to disasters. It is vital for sustaining development gains and building community resilience through empowered local providers (24, 27).

Invest in community-based female health workers. There is a need for intentional investment in training, protection, fair pay, and official recognition of these workers, including Midwives/Nurses, as essential parts of emergency health systems (21, 27). The International

Confederation of Midwives/Nurses encourages governments and humanitarian groups to include Midwives/Nurses in emergency preparedness and response efforts and to assign them to multidisciplinary response teams (27). Supporting caregiving roles during and after disasters and reducing the workload shaped by gender norms may better unlock the potential of female healthcare workers (24, 26). Studies show a strong link between Midwives/Nurses roles and disaster management outcomes for pregnant women, with specialized disaster training for Midwives/Nurses greatly lowering the negative impact of emergencies (23, 27).

Integrate mobile technologies with local networks. The integration of mobile diagnostic tools, such as portable ultrasound, should be planned alongside community-based networks, with clear protocols for collaboration, referral, and follow-up in disrupted settings (23). Point-of-care ultrasound training concepts have been successfully used in low- and middle-income countries, as shown by task-shifting innovations in Uganda, where trained Midwives/Nurses performed ultrasound scans with telemedicine support, but this requires investment in local capacity and suitable training frameworks (23). Mobile health technologies have the potential to make public health interventions more direct and efficient, but success depends on adapting to local contexts, overcoming barriers like inadequate training and infrastructure, and integrating with existing health worker networks (21, 28).

Incorporate gender-responsive analysis into planning. Gender-responsive disaster health planning should clearly examine how mobility restrictions, caregiving responsibilities, and social norms influence access to services (24). Mechanisms for effectively involving women in the design, implementation, and evaluation of interventions should be institutionalized, as research shows that including women in disaster response enhances outcomes and speeds up recovery by utilizing their adaptive abilities (26). Specific sex, age, and disability disaggregated vulnerability and capacity data, along with gender analysis, are essential to accurately understand different vulnerabilities and needs, address the gendered aspects of risk, and support intersectional risk management (24, 26). Studies from community-based interventions demonstrate that leveraging community members, especially women, as change agents helps close knowledge gaps, shift attitudes, and improve emergency skills in resource-limited settings (26).

Together, these measures can help ensure that mobile health responses address immediate clinical needs while also strengthening the gendered foundations of community resilience in future disasters. Disaster management policies must evolve beyond viewing women as passive victims to recognizing their active roles in caregiving, household recovery, resource

sustainability, and community resilience. This approach aligns with gender-responsive strategies that emphasize integrating gender disaggregated data in health planning and recognizing the specific needs and capacities of different genders within disaster management to tailor effective response and resilience-building efforts (29).

LIMITATION

This study relies on qualitative field observations and reflective analysis, which may limit its applicability to other disaster contexts and geographic regions. Quantitative outcome measures, such as changes in service utilization rates, clinical results, or comparative effectiveness, were not the focus of this manuscript and were not systematically gathered. The lessons-learned framework, although suitable for quick disaster response documentation, does not allow for causal inference or controlled comparisons.

Data collection took place during ongoing disaster response efforts, which limited the depth and standardization of the methodological procedures. Informal interviews, conducted under tight time constraints and difficult field conditions, may have restricted the range of perspectives gathered. Additionally, this manuscript focuses on a single intervention in one geographic area, which might not fully represent the range of disaster health issues or all possible mobile health solutions.

Nevertheless, the lessons provided offer transferable insights for disaster health management in similar resource-limited, disaster-prone settings, especially where geographic isolation, damaged infrastructure, and reliance on community-based health workers define the disaster response environment.

CONCLUSION

Lessons from Bener Meriah highlight that women are simultaneously among the most vulnerable populations and the backbone of disaster health resilience. Mobile health technologies such as portable USG are most effective when embedded within community-based female health worker networks that already hold community trust. Disaster health management strategies should explicitly recognize and strengthen women's roles as both recipients and providers of care. The evidence from this field experience demonstrates that portable ultrasound, when integrated with community midwifery networks, can bridge critical access gaps created by damaged infrastructure and disrupted referral systems. However, the success

of such technological interventions depends fundamentally on the trust, contextual knowledge, and relational continuity provided by local female health workers. Integrating gender-responsive planning with investments in community-based female health workers and appropriate mobile technologies can contribute to more equitable, trusted, and resilient health systems in the face of future disasters. Moving forward, disaster preparedness and response frameworks must systematically include Midwives/Nurses and other community-based female health workers in planning, recognize and support their contributions, and ensure that mobile health interventions are designed to reinforce, rather than bypass, the trusted local systems upon which affected women depend.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ETHICAL APPROVAL

This manuscript focuses on humanitarian service delivery and reflective analysis without collecting identifiable personal data. An ethical review was waived following institutional guidelines for disaster response activities. Verbal consent was obtained for informal discussions, and confidentiality was maintained throughout documentation.

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