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"Research in Earnest"

Title Page

Full Title of Abstract Book: BioMed4Youth Research Case Competition Abstract Book 2025

Ahyan Alam, BHSc Student [1]*, Jiya Prajapati, BSc Student [2], Pratishtha Prashar, BSc Student [2], Jasleen Kaur [2]
[1] Faculty of Health Sciences, McMaster University, Hamilton, Ontario, Canada L8S 4L8
[2] Faculty of Science, McMaster University, Hamilton, Ontario, Canada L8S 4L8

*Corresponding Author Details: ahyanalam07@gmail.com

Abstract

The BioMed4Youth Research Case Competition, organized by the nonprofit organization BioMed4Youth, under the leadership of presidents **Ahyan Alam** and **Jiya Prajapati**, provides university and high school students with the opportunity to conduct research and develop literature reviews. Guided by university student mentors with prior research experience, participants are introduced to the fundamentals of literature review, scientific analysis, and academic writing, while receiving personalized mentorship that fosters both professional and

personal growth. The 2025 program brought together students from across the world with diverse academic interests, allowing them to pursue projects in biomedicine. Over the course of the case competition, participants translated their work into research papers, which are presented in this abstract book as a reflection of their dedication and intellectual curiosity. At the conclusion of the competition, students were judged on their projects by professionals, who provided feedback on the participants' work. By creating accessible and supportive pathways into research, BioMed4Youth aims to bridge the gap between youth and scientific engagement, inspiring the next generation of researchers, healthcare providers, and innovators. Moving forward, the Research Case Competition will continue to grow and adapt, incorporating feedback from participants and mentors to strengthen its impact

Keywords: undergraduate research; high school research; mentorship; biomedicine; Biomedical sciences; nonprofit education.

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BioMed4Youth Research Case Competition Abstracts

Integrating Psychological & Physiological Insights to Optimize Low-Cost Portable Ultrasound for Maternal Health in Rural Communities

Shamim Sadat Sharif
Faculty of Arts & Science, University of Toronto, Toronto, Ontario, Canada M5T1P8

Maternal mortality in rural and underserved communities remains a critical global health challenge, exacerbated by limited access to diagnostic tools and high levels of perinatal psychosocial stress. Low-cost portable ultrasound presents a promising technological intervention. This review synthesizes recent evidence to propose a novel, integrated model for deploying portable ultrasound that addresses both physiological risks and psychological well-being. A narrative literature review was conducted, analyzing peer-reviewed studies on point-of-care ultrasound, perinatal stress physiology, and community-based health interventions. The analysis was organized thematically to critically evaluate the evidence. Portable ultrasound enables early detection of obstetric complications like fetal growth restriction, which are linked to maternal stress dysregulation. Concurrently, integrating validated psychological screening during ultrasound visits identifies women at high risk for anxiety and depression. Community Health Worker-led models are cost-effective and enhance accessibility. The proposed Psychophysiological Ultrasound Initiative is a tiered, equity-focused solution. By training CHWs, utilizing solar-powered devices, and establishing tele-support networks, this model offers a feasible and innovative approach to holistically improve maternal health outcomes.

Keywords: portable ultrasound; maternal health; perinatal mental health; community health workers; rural health; implementation science

Beyond the Hospital: Portable Ultrasound for Improved Maternal Health in Underserved Communities

Celina Dang [1], Tina Wang [2]
[1] Department of Health Sciences, McMaster University, Hamilton, Ontario, Canada L8S 4L8
[2] Department of Science, McMaster University, Hamilton, Ontario, Canada L8S 4L8

Globally, maternal health is a top concern between the more developed and less developed worlds. However, regional discrepancies between individuals within a country are highly prevalent, although they are often masked by global statistics. This paper focuses on underserved communities within Central America and Southeast Asia, exploring the potential of inexpensive portable ultrasound devices to enhance maternal health outcomes in environments with limited resources, where maternal healthcare is inaccessible and underfunded. Evidence from The Healthy Pregnancy Project in Guatemala showed that intervention groups with portable ultrasound prevented maternal deaths and reduced newborn mortality by 64% (Milart et al., 2016). In the Philippines, community health workers who received portable ultrasound training were able to detect prenatal abnormalities, in 95-99% agreement with radiologists (Dalmacion et al., 2018). In the future, further developments in computer-aided detection for frame selection in obstetric sweep protocols (OSP) have the potential to automate biometric fetal measurements, as demonstrated by the accuracy of fetal head circumference (HC) measurements obtained using OSP and low-cost devices (L.A. Van Den Heuvel et al., 2018). With improved technological applications, underserved communities can alleviate reliance on professional sonographers in rural settings where healthcare workers are limited and maternal health training is inaccessible.

Keywords: maternal health, global health disparities, underserved communities, portable ultrasound, resource-limited settings, prenatal care, maternal mortality

The Role of Point-Of-Care Ultrasound (POCUS) Technology in Improving Maternal Health Outcomes for Underprivileged Communities: A Literature Review

Akriti Sodhi [1], Eileen Lin [2], Isha Patel [2]
[1] Department of Science, McMaster University, Hamilton, Ontario, Canada L8S 4L8
[2] Department of Health Sciences, McMaster University, Hamilton, Ontario, Canada L8S 4L8

Point-of-Care Ultrasound (POCUS) is a low-cost handheld ultrasound device that is transforming prenatal diagnostics in rural and underserved regions by addressing financial and infrastructural challenges and barriers to conventional imaging. Unlike traditional clinic-based ultrasound systems, POCUS enables rural healthcare professionals to detect maternal complications during pregnancy, facilitating timely referral to alternative procedures and reducing maternal mortality. Evidence from international rural medical research demonstrates the improvements in maternal health outcomes after integrating POCUS into primary care as there is higher anomaly detection and reduction in maternal deaths. Beyond clinical outcomes, POCUS minimizes training

demands, allowing healthcare professionals to effectively conduct examinations and reducing the time and cost of training to address demands. Novel research in the field of POCUS integrates computer-assisted technology by incorporating artificial intelligence into POCUS, further streamlining diagnostic processes. This research led to the development of Computer-Assisted Low-Cost Point-of-Care Ultrasound (CALOPUS), which minimizes training requirements for personnel and improves the diagnostic accuracy through machine learning. Its effectiveness is shown in detecting fetal presentations and placental location with significant improvements in visualization compared to standard ultrasound. By combining affordability, automation, and AI integration, POCUS technologies represent patient-centered solutions that improve maternal health outcomes and narrow the urban–rural health gap.

Keywords: Point-of-Care Ultrasound (POCUS); maternal health; rural healthcare; artificial intelligence; prenatal diagnostics; low-cost imaging; CALOPUS

Portable Ultrasound for Maternal Health: Bridging Gaps in Rural and Low-Income Communities

Iffat Iqbal [1], Don Tran [2], Jeffrey Zhu [3]
[1] University of California Davis, Davis, California, United States of America 95616-8678
[2] Department of Biological Sciences, University of Toronto Scarborough, Toronto, Ontario, Canada M1C 1A4
[3] Faculty of Applied Science & Engineering, University of Toronto, Toronto, Ontario, Canada M5T1P8

In spite of technological advancements in today's healthcare industry, maternal mortality remains disproportionately high in low and middle-income countries, where approximately 700 women die every day from preventable pregnancy-related causes. Despite its role as a cornerstone of safe, non-invasive pregnancy care, ultrasound remains inaccessible to 3.5-4.7 billion people globally. Major obstacles such as lack of equipment, subpar operator skills, and inaccessibility are reported in these marginalized areas. This paper synthesizes the current literature on point-of-care ultrasound (PoCUS), with emphasis on cost barriers, limitations in training, and gaps in infrastructure. To address these proven barriers, we present the Low-cost Obstetrics Care Ultrasound Technology (LOCUST), a solar-powered, modular ultrasound unit integrating open-source hardware, 3-D printed protective case, and local processing and artificial intelligence on a Raspberry Pi. Our system will provide real-time audio and visual guidance in local languages and dialects, reducing reliance and costs dedicated to training sonographers while remaining affordable and repairable in low-resource settings. LOCUST addresses the aforementioned barriers of cost, training, and access simultaneously, enabling a sustainable deployment of ultrasound technology in rural clinics and crisis zones. Through facilitating early detection of avoidable pregnancy-related drawbacks, LOCUST has the potential to transform maternal health outcomes globally.

Keywords: maternal mortality; point-of-care ultrasound (PoCUS); low-cost medical technology; artificial intelligence; solar-powered devices; maternal health; healthcare accessibility.

An In-Depth Analysis of Low-Cost Portable Ultrasound Devices: Improving Maternal Health in Rural and Underserved Communities

Armita Bagheri [1], Kimmy Kwok [2]
[1] Department of Cellular and Physiological Sciences, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z4
[2] Department of Biochemistry, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z4

In underserved communities, the greatest health burdens fall upon expectant mothers. Their health outcomes often depend on the medical opportunities accessible to them, such as routine examinations. The usage of low-cost portable ultrasound devices has been shown to significantly benefit expectant mothers in rural areas through earlier detection of complications, leading to a reduction in maternal mortality and morbidity. As the use of portable ultrasound devices grows, the demand for medically trained professionals also increases. Introducing Point-of-Care Ultrasound (POCUS) can enhance clinical practice and meet this rising demand. While healthcare professionals need to be properly trained in using these devices, governments must prioritize maternal health in marginalized communities. By doing so, rural communities obtain better access to ultrasound equipment for monitoring maternal health. Moreover, this prioritization allows nations to strive to meet the United Nations' Sustainable Development Goals, particularly Goal three, which focuses on health equity for expectant mothers. Despite the advantages of portable ultrasounds, further clinical studies are needed to validate the proposed solutions.

Keywords: Maternal health; Underserved communities; Portable ultrasound; Point-of-care ultrasound (POCUS); Rural healthcare; Maternal mortality; Health equity

Transforming Maternal Healthcare: Reducing Inequities Through Portable Ultrasound

Felice Law [1], Chloe Yip [2], Yuriko Yong [1]
[1] Department of Health Sciences, McMaster University, Hamilton, Ontario, Canada L8S 4L8
[2] Department of Science, McMaster University, Hamilton, Ontario, Canada L8S 4L8

Despite the ultrasound's role as a mainstay in modern prenatal care practices in most high-resource countries, limited access to ultrasound remains a barrier in rural and underserved communities. Many of these populations face inequities driven by financial constraints, long travel distances, and limited education, resulting in a gap in maternal health outcomes. This paper examines the effectiveness of portable ultrasound in overcoming the above obstacles and how this may alleviate the maternal healthcare disparities in low-resource communities. Implementing low-cost portable ultrasound devices also involves more than providing the equipment, it requires additional resources such as mobile clinics, tele-ultrasound programs, and training for sonographers to ensure that care being delivered is culturally sensitive and easily accessible. However, several limitations of portable ultrasound include ethical issues, such as misuse through sex-selective abortions, technical issues, including ultrasound machine errors resulting in diagnostic inaccuracies, and financial issues, like the cost of implementing these solutions in governments. Ultimately, it is essential to develop innovative solutions while

considering the practicalities of health systems, as well as continuing to advance existing resources to guide future interventions in order to promote maternal health outcomes in a safe, sustainable, and equitable manner.

Keywords: Maternal health; Underserved communities; Portable ultrasound; Prenatal care; Healthcare disparities; Tele-ultrasound; Low-resource settings

Low-Cost Ultrasound for Maternal Care in Underserved Communities: A Review of Global Evidence

Fayezah Khodayari
Department of Cell & Systems Biology, University of Toronto, Toronto, Ontario, Canada M5T1P8

Maternal mortality remains disproportionately high in rural and underserved populations, where 94% of maternal deaths occur due to delayed or absent prenatal diagnostics (WHO, 2023). Portable ultrasound offers a scalable, low-cost solution to bridge this gap in care. To evaluate its impact, a literature review was conducted across peer-reviewed studies, WHO reports, and global case studies. Evidence from Ethiopia shows that introducing portable ultrasound led to detection of abnormalities in 12.7% of pregnancies, with 98% successfully referred for higher-level care (Abawollo et al., 2022). In Guatemala, a nurse-operated program achieved a nearly 40% reduction in maternal mortality and a 64% reduction in neonatal mortality (Crispín Milart et al., 2016). Innovations such as AI-enabled interpretation in Uganda, mixed-reality tele-ultrasound in Canada, and tele-mentorship in rural China demonstrate how technology extends expertise beyond urban centers. Persistent barriers include unreliable electricity, limited internet access, insufficient training, and cultural hesitancy. Portable ultrasound initiatives can significantly reduce maternal and neonatal mortality when coupled with community-based training, telehealth integration, and youth-led advocacy. Scaling access through midwife empowerment, policy partnerships, and grassroots mobilization represents an ethical, cost-effective strategy to advance maternal health equity and accelerate progress toward Sustainable Development Goal 3.1.

Keywords: Maternal mortality; Portable ultrasound; Rural healthcare access; Prenatal diagnostics; Midwife training; Telehealth integration; Global health equity

Early Detection of Postpartum Hemorrhage Using Portable Ultrasound with Colour-Coded Myometrium-to-Endometrium Ratio Assessment

Anika A. Agashe [1], Trisha Suraj [1]
[1] Department of Biological Sciences, University of Toronto, Toronto, Ontario, Canada M1C 1A4

Postpartum hemorrhage (PPH) remains the leading cause of maternal mortality worldwide, disproportionately affecting women in low-resource settings (Zhang et al., 2025). Approximately one in eighty women experiences PPH, yet nearly half of these cases go underdiagnosed (Komatsu et al., 2024). Further, delayed diagnosis can result in preventable complications such

as hypovolemic shock, anemia, coagulopathy, and infection, ultimately compromising maternal health. This study introduces a portable ultrasound device integrated with a colour-coded risk indicator to facilitate early detection of PPH. Designed for affordability, usability, and accuracy, this device addresses barriers to implementation in resource-limited settings. The system uses a real-time, light-based screening method to interpret myometrium-to-endometrium thickness ratios, an emerging biomarker of hemorrhage risk (García et al., 2022). Immediate visual feedback through a simplified interface enables healthcare workers to identify high-risk patients without specialized training. Device performance will be assessed through a preclinical validation study using simulated uterine models and retrospective ultrasound datasets representing normal and pathological thickness ratios. Measurements will be compared with gold-standard readings performed by trained clinicians, and statistical analyses, including correlation testing and Bland-Altman methods, will be used to ensure reliability (Giavarina, 2015). Ultimately, this work aims to develop a low-cost, accessible screening tool that supports timely intervention and improves maternal outcomes in underserved communities.

Keywords: postpartum hemorrhage; placental abruption; myometrium-to-endometrium ratio; portable ultrasound; maternal health; low-resource settings

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

AA: Planned and oversaw the entire program, providing feedback across multiple phases of the program; conceptualized and organized the research conference, ensured quality checks at each stage of the literature review, and gave final approval for publication.
JP: Assisted in preparing and organizing the conference, recruited the guests for the conference, mentored select teams, and reviewed the final abstract book.
PP & JK: Assisted in recruiting guest judges for the conference, organized the conference abstract book, and reviewed the final abstract book.

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