Review Article

Ivica Zalud*

Shaping the future: advancing maternal-fetal medicine through educational standards and innovations

https://doi.org/10.1515/jpm-2025-0360
Received June 30, 2025; accepted July 4, 2025;
published online July 14, 2025

Abstract: The field of maternal-fetal medicine (MFM) stands at a transformative crossroads. Rising maternal morbidity and mortality in the United States, coupled with increasing clinical complexity driven by advanced maternal age, chronic diseases, and evolving reproductive technologies, demand a reimagining of MFM training. This review provides a comprehensive overview of current educational standards and innovations shaping MFM fellowship programs, drawing heavily from the frameworks of the American Board of Obstetrics and Gynecology (ABOG), the Accreditation Council for Graduate Medical Education (ACGME), and professional societies. Special attention is given to the MFM fellowship program in Hawai'i, which since its establishment in 2008, has emerged as a model of educational innovation, cultural responsiveness, and geographic adaptability. The integration of telemedicine, cultural competency, research, simulation, mentorship, and global health perspectives into MFM education is explored, culminating in a discussion on preparing the next generation of perinatal subspecialists for an evolving landscape of maternal and fetal health.

Keywords: maternal fetal medicine; educational standards; program development; innovations; mentorship

Introduction

Maternal-fetal medicine is undergoing profound transformation at a time of escalating global and national concern over maternal and perinatal outcomes. Worldwide, complications of pregnancy and childbirth remain among the leading causes of mortality for women of reproductive age, with approximately 295,000 maternal deaths annually, most of which are preventable through timely, skilled care and systems improvements [1]. Even in high-income countries such as the United States, maternal mortality and severe morbidity have paradoxically increased over the past two decades. The U.S. now reports maternal mortality rates more than double those of comparable nations, with persistent and alarming racial and ethnic disparities [2, 3]. Black women, Native American women, and Pacific Islanders experience maternal mortality at rates two to three times higher than their white counterparts, reflecting the interplay of biological risks and entrenched social determinants of health.

This crisis is compounded by an increasingly complex clinical landscape. More individuals are becoming pregnant at older ages, often with higher baseline rates of obesity, diabetes, cardiovascular disease, and other chronic conditions that elevate pregnancy risk [4]. Simultaneously, widespread use of assisted reproductive technologies has increased the incidence of multiple gestations and associated complications. The rapid advances in prenatal diagnostics, fetal therapy, genomics, and health informatics continue to reshape both the scope of care and the expertise required of providers.

Against this backdrop, MFM physicians lead multidisciplinary teams to manage medically and surgically complex pregnancies, interpret advanced imaging and genetic testing, implement evidence-based protocols to reduce morbidity, and drive system-wide quality improvement. To meet these demands, MFM education must move beyond traditional clinical models, incorporating telemedicine, artificial intelligence, cultural humility, patient safety systems, health policy, and a robust approach to lifelong learning. This review aims to provide a detailed synthesis of contemporary MFM fellowship training by examining the foundational standards set by the American Board of Obstetrics and Gynecology (ABOG) and the Accreditation Council for Graduate Medical Education (ACGME), exploring the structure and innovative strategies of MFM curricula, and highlighting the University of Hawai'i's MFM fellowship as a case study in tailoring rigorous national frameworks to local needs. Through this, we

***Corresponding author: Ivica Zalud**, MD, PhD, FACOG, FAIUM, Professor and Chair, Kosasa Endowed Chair, Department of Obstetrics, Gynecology and Women's Health, John A. Burns School of Medicine, University of Hawai'i, Honolulu, Hawai'i 96826, USA, E-mail: ivica@hawaii.edu

seek to identify best practices for shaping future maternal-fetal medicine specialists who combine clinical expertise with cultural insight and systems vision.

The educational framework: ABOG and ACGME standards

The ABOG establishes definitive benchmarks for MFM subspecialist competence, ensuring that certified physicians possess the expertise needed to manage complex pregnancies through ethical, evidence-based, patient-centered care [5]. Certification involves both a rigorous written examination covering maternal complications, fetal physiology, genetics, pharmacology, and procedural skills, as well as a subsequent comprehensive oral exam centered on research thesis developed by the candidate during fellowship and case list from active clinical practice after program graduation. This two-tiered approach guarantees mastery of both theoretical knowledge and applied clinical reasoning. ABOG also mandates continuing annual certification to promote ongoing learning, practice improvement, and adherence to evolving standards across a physician's career.

The ACGME complements this by setting explicit requirements for fellowship program structure and operations [6]. Programs must provide defined minimum case volumes across domains such as hypertensive disorders, diabetes, fetal anomalies, and critical care exposures, alongside protected time and infrastructure for scholarly activity. Faculty-to-fellow ratios must support robust mentorship and direct supervision, with structured mechanisms ensuring that fellows progress from closely guided clinical care to independent decision-making. A cornerstone of ACGME oversight is its competency-based Milestones framework, which charts fellow development in patient care, medical knowledge, systems-based practice, professionalism, communication, and practice-based learning [6]. The Clinical Learning Environment Review (CLER) adds emphasis on patient safety, quality improvement, and interprofessional collaboration, ensuring that fellows train in settings actively engaged in these essential domains. Together, ABOG and ACGME build a rigorous foundation, fostering graduates who are technically proficient and prepared to lead initiatives advancing maternal and neonatal outcomes.

Curricular structure and clinical training

MFM fellowship curricula typically span three years after four years of OB/GYN Residency training, and are carefully structured to transition fellows from foundational learning to advanced, autonomous practice. During the first year, fellows immerse in core rotations such as inpatient high-risk obstetrics, obstetric ultrasound, labor and delivery, and maternal medicine consults. They develop skills in high-resolution imaging, Doppler interpretation, and begin performing procedures like amniocenteses and cervical cerclages. Early exposure to multidisciplinary fetal boards fosters collaborative decision-making.

In the second year, training shifts to advanced procedural competencies, including chorionic villus sampling, intrauterine transfusions, and complex fetal imaging. Fellows increasingly lead the care of patients with multifaceted conditions such as cardiac disease, infections, or multifetal gestations. This period also includes structured, protected time dedicated to launching scholarly projects, supported by resources in study design, regulatory navigation, data analysis, and manuscript preparation.

By the third year, leadership development becomes paramount. Fellows often serve as chief fellow, mentoring junior trainees, leading didactics and case conferences, and refining preparation for ABOG oral boards through formal mock exams and oral defenses. Electives allow further customization in areas like advanced ultrasound, medical education, or global health. Throughout all three years, fellows meticulously log cases and procedures to document skill acquisition. Simulation augments clinical learning, providing high-fidelity practice for rare or high-risk scenarios such as maternal cardiac arrest, massive hemorrhage, or complex fetal interventions.

Didactics, conferences, and scholarly development

A robust didactic program forms the intellectual backbone of MFM fellowship, providing the structured learning environment essential to consolidating complex knowledge and nurturing habits of critical inquiry that extend well beyond training. Fellows participate in weekly core lectures that systematically address key topics in maternal physiology, placental biology, teratology, pharmacokinetics in pregnancy, advanced imaging modalities, and the evolving landscape of fetal therapy. These sessions are often delivered by a multidisciplinary cadre of experts, including maternal-fetal medicine faculty, geneticists, neonatologists, anesthesiologists, and radiologists, ensuring that fellows appreciate the interconnected dimensions of high-risk perinatal care.

Journal clubs are a cornerstone of the didactic curriculum, cultivating fellows' abilities to critically evaluate emerging

research, assess study design and statistical rigor, and consider how new findings may translate into clinical practice. Fellows typically lead these sessions, gaining experience in framing scientific questions, guiding peer discussions, and situating individual studies within the broader literature. This process not only strengthens analytical skills but also deepens fellows' confidence in appraising complex or even conflicting evidence – an essential competence given the rapidly evolving nature of perinatal medicine.

Interdisciplinary case conferences further enrich the educational environment by integrating diverse clinical perspectives. Complex cases involving congenital anomalies, maternal cardiac or hematologic disease, or multidisciplinary delivery planning are routinely discussed with neonatology, pediatric surgery, pediatric cardiology, and social work teams. These conferences offer fellows an invaluable forum to practice synthesizing diverse clinical inputs, advocating for patient-centered care, and appreciating the logistical and ethical nuances of high-stakes management decisions.

Fellows' scholarly development is also advanced through deliberate exposure to national and regional academic forums. Participation in major meetings such as those hosted by the Society for Maternal-Fetal Medicine (SMFM), the American College of Obstetricians and Gynecologists (ACOG), and subspecialty symposia provides fellows with opportunities to engage directly with cutting-edge research, network with leaders in the field, and refine their own presentation skills. Many programs require fellows to submit abstracts to such meetings, fostering early experiences in articulating research aims, defending methodology, and responding to peer critique. Attendance at webinars, specialty journal clubs beyond the home institution, and visiting professor rounds further broadens fellows' perspectives on evolving controversies and innovations in maternal-fetal medicine.

Central to fellowship is the expectation that each trainee completes a mentored research project. In alignment with ABOG requirements, many programs have developed dedicated infrastructure to support this endeavor, including formal instruction in study design, biostatistics, regulatory compliance, and scholarly writing. Fellows typically work under the guidance of experienced faculty mentors who help shape research questions that are feasible yet impactful, provide iterative feedback on manuscript drafts, and offer strategic advice on targeting high-yield journals for submission. This structured scholarly pathway not only ensures compliance with certification requirements but also often results in peer-reviewed publications or national presentations that significantly strengthen fellows' academic portfolios.

Collectively, these didactic and scholarly activities cultivate a culture of inquiry, rigor, and academic engagement. They prepare fellows not only to stay abreast of advances in maternal-fetal medicine but also to actively contribute to the generation of new knowledge, embrace leadership roles in collaborative teams, and sustain habits of lifelong learning that will underpin their careers as perinatal subspecialists.

Mentorship and professional development

Effective mentorship stands as one of the most influential determinants of success and fulfillment in MFM fellowship, shaping not only research productivity and career trajectories but also the deeper contours of professional identity [7, 8]. Strong mentorship relationships provide fellows with indispensable guidance as they navigate clinical uncertainties, balance scholarly endeavors with demanding service schedules, and grapple with the ethical complexities inherent to maternal and fetal care.

Robust fellowship programs intentionally cultivate a layered mentorship ecosystem. At the University of Hawai'i, formal dyads are established at the start of fellowship, pairing each fellow with a primary faculty mentor who provides structured oversight of scholarly projects, clinical progression, and board preparation. Beyond this, fellows benefit from informal mentorship across the faculty group, enabling them to seek guidance tailored to specific interests such as advanced imaging, global health, or quality improvement. This multifaceted approach broadens exposure to diverse leadership styles and scholarly pathways.

Mentorship at Hawai'i also extends beyond academic output to address the human dimensions of training, fostering resilience, wellness, and adaptability. Faculty mentors routinely check in on fellows' workload balance and psychological well-being, recognizing that emotional support is critical in a field where high-stakes decisions and adverse outcomes are inherent. Fellows are encouraged to cultivate reflective practices, participate in debriefings after challenging cases, and engage with institutional wellness resources to sustain personal equilibrium and empathy.

An important dimension of mentorship is the cultivation of fellows as future mentors themselves. By involving fellows in teaching medical students and residents, observing them provide bedside instruction, and guiding them through the nuances of professional communication, programs reinforce the fellows' emerging identities as educators and leaders. This near-peer mentoring fosters a culture of academic generosity and strengthens the fellows' commitment to nurturing the next generation.

Mentorship also plays a protective role against attrition by helping fellows navigate systemic stressors that disproportionately impact women and underrepresented minorities in medicine. Structured sponsorship, including nomination for national committees, presentation opportunities, and networking with leaders in the field through societies such as Society for Maternal Fetal Medicine (SMFM), American College of Obstetricians and Gynecologists (ACOG), International Academy of Perinatal Medicine (IAPM), Fetus as a Patient International Society and Ian Donald Inter-University School of Ultrasound expands professional horizons and solidifies the fellows' sense of belonging within the broader perinatal community. Deliberate mentorship in MFM contributes to building a pipeline of future academic leaders who not only advance clinical and research excellence but also champion cultural humility and health equity, priorities that resonate deeply in diverse regions like Hawai'i'. By embedding mentorship as a longitudinal, multidimensional process throughout fellowship, programs cultivate graduates who are confident, resilient, and poised to lead with integrity and vision.

The Hawai'i Fellowship Model: Regional Innovation, Governance, and Sustainable Funding

The MFM fellowship at the University of Hawai'is John A. Burns School of Medicine (JABSOM), established in 2008, arose in direct response to a critical regional workforce shortage that threatened the stability and quality of high-risk obstetric care across the Hawai'ian islands. Prior to its inception, the management of complex maternal and fetal conditions depended heavily on a small cadre of over-extended MFM specialists, raising significant concerns about continuity, clinical burnout, and the ability to deliver care that was sensitive to Hawai'i's rich tapestry of cultural identities. The fellowship was strategically designed to embed a pipeline of highly trained MFM subspecialists within the state, thereby enhancing local capacity and fostering long-term sustainability of advanced perinatal services. Over more than a decade and half, it has successfully trained and graduated more than a dozen board-certified MFMs, many of whom have chosen to remain and practice in Hawai'i. This locally cultivated workforce now underpins stable, year-round access to subspecialty care, enabling timely interventions and fostering the development of comprehensive perinatal networks that span urban and rural communities.

Given Hawai'i's extreme geographic isolation, stretching across 2,500 miles of the Pacific Ocean, and its profound ethnic diversity, the program integrates cultural humility and telehealth as foundational elements rather than peripheral enhancements. TeleMFM has been purposefully structured into the fellowship curriculum, with fellows routinely conducting virtual consultations and interpreting complex fetal imaging for patients residing on neighbor islands and in remote Pacific territories such as American Samoa. This robust telehealth infrastructure not only mitigates geographic barriers but also cultivates fellows' competencies in delivering high-quality, relationship-centered care via virtual platforms, an increasingly vital skill in modern medicine [9]. Structured engagement with Native Hawai'ian and Pacific Islander communities, including community-based rotations and research, targeted didactics on historical and social determinants of health, and workshops on addressing implicit bias, equips fellows with the perspectives needed to provide care that is both scientifically rigorous and culturally attuned [10].

Program governance is robust, reflecting a deliberate strategy to maintain alignment with ACGME standards while also responding dynamically to regional needs. Oversight is provided by John A Burns School of Medicine's Graduate Medical Education Committee, which conducts rigorous annual reviews involving fellows, core teaching faculty, health system partners, and institutional leadership. These evaluations examine milestone attainment, scholarly output, clinical case diversity, and fellow wellness, and they inform iterative improvements in curriculum and program resources. Core faculty, all ABOG-certified MFM faculty, play integral roles in curriculum design, recruitment, individualized competency assessments, and the nurturing of fellows' scholarly identities. The fellowship also benefits from a strong culture of interdisciplinary collaboration, with regular input from neonatology, genetics, pediatric surgery, cardiology, and public health leaders ensuring that training remains both comprehensive and forward-looking.

Financial sustainability is underpinned by a diversified portfolio that reflects a shared regional commitment to preserving and advancing maternal-fetal expertise. Major health systems such as Hawai'i Pacific Health and The Queen's Health Systems provide foundational funding that secures protected academic time for fellows and faculty, sustains essential educational infrastructure, including high-fidelity simulation and telemedicine platforms, and supports quality improvement initiatives that directly impact patient outcomes. Additional resources stem from state-driven maternal health initiatives aimed at reducing severe maternal morbidity, as well as philanthropic contributions dedicated to improving women's health across the

Pacific. This multi-pronged funding architecture not only buffers the program against economic fluctuations but also signifies a broad, collective investment in building a resilient perinatal care ecosystem that extends far beyond Hawai'i's urban centers to its most geographically and socioeconomically vulnerable populations.

By weaving together rigorous academic standards, culturally grounded care models, robust governance, and innovative funding alliances, the Hawai'i MFM fellowship exemplifies how regional programs can adapt national frameworks to meet local realities. In doing so, it ensures that the next generation of maternal-fetal medicine specialists is both deeply skilled and profoundly connected to the communities they serve.

Future directions

The future of MFM education depends on its capacity to adapt to a rapidly evolving landscape of clinical, technological, and societal change. As genomics and precision health advance, fellowship programs must integrate rigorous training in interpreting increasingly complex genetic data, paired with counseling approaches that honor patients' cultural contexts and autonomy [11]. The promise of individualized risk stratification and targeted interventions must be weighed against ethical concerns, such as ensuring equitable access and preventing genetic discrimination [12].

Simultaneously, artificial intelligence and machine learning are beginning to reshape obstetric imaging, risk prediction, and clinical decision support [13, 14]. MFM trainees must become not merely consumers of these technologies but discerning evaluators who understand algorithmic validity, recognize biases embedded in data, and integrate computational insights with nuanced clinical judgment. This evolution requires curricula that cultivate data literacy and ethical reasoning, safeguarding the centrality of the physician-patient relationship.

Global forces, including climate change, geopolitical instability, and pandemics – introduce new stresses to maternal health systems. Fellows will increasingly need frameworks to understand how environmental shifts, migration, and disrupted infrastructures exacerbate risks for pregnant populations. Incorporating global health and public health preparedness into MFM training prepares clinicians to respond adeptly to crises and appreciate the interconnectedness of local and global perinatal systems [15].

Educational models will likely embrace blended learning, combining in-person mentorship and procedural mastery with simulation, virtual platforms, and asynchronous modules. This hybrid approach expands exposure across rare conditions and aligns with generational preferences for technology-enhanced learning. Assessment methods are poised to evolve beyond traditional exams toward longitudinal portfolios, workplace observations, and multi-source feedback, offering richer portraits of fellow development across professionalism, leadership, and interprofessional collaboration.

As disparities in maternal outcomes continue to mirror broader societal inequities, future MFM curricula must sustain a profound commitment to cultural humility, reproductive justice, and advocacy. Programs should prepare fellows to navigate not only complex pregnancies within hospitals but also to engage in policy dialogues, spearhead quality, patient safety and experience initiatives that challenge systemic bias, and build trust in historically marginalized communities. Through these evolutions, MFM education can remain attuned to scientific advances while anchored in the ethical obligations at the heart of perinatal care, ensuring that tomorrow's specialists emerge as clinicians who are scientifically rigorous, culturally responsive, and prepared to lead within an increasingly complex global healthcare environment.

Conclusions

Maternal-fetal medicine fellowship training is a critical pillar in the effort to improve perinatal outcomes. Guided by ABOG and ACGME standards and enriched by local innovation, as demonstrated by the Hawai'i' fellowship, these programs have the power to produce clinicians who are not only technical experts but also compassionate, culturally aware, and systems-savvy leaders. As the challenges facing maternal and fetal health intensify, investing in thoughtful, adaptive, and equity-focused education remains one of the most impactful strategies for shaping the future of obstetrics and heathier generations to come. To care for women is to shape generations. We do not just deliver babies, we deliver hope and health. Invest in those who make that possible, and you invest in the future of humanity.

Acknowledgments: ChatGPT (OpenAI) was used to assist in improving the language and style of this manuscript. All content, concepts, and conclusions remain solely the author's own.
Research ethics: Not applicable.
Informed consent: Not applicable.

Author contributions: The author has accepted responsibility for the entire content of this manuscript and approved its submission.
Use of Large Language Models, AI and Machine Learning Tools: ChatGPT (OpenAI) was used to assist in improving the language and style of this manuscript. All content, concepts, and conclusions remain solely the author's own.
Conflict of interest: The author states no conflict of interest.
Research funding: None declared.
Data availability: Not applicable.

References

1. Dol J, Hughes B, Bonet M, Dorey R, Dorling J, Grant A, et al. Timing of maternal mortality and severe morbidity during the postpartum period: a systematic review. JBI Evid Synth 2022;20:2119–94.
2. Petersen EE, Davis NL, Goodman D, Cox S, Syverson C, Seed K, et al. Racial/ethnic disparities in pregnancy-related deaths - united States, 2007-2016. MMWR Morb Mortal Wkly Rep 2019;68:762–5.
3. Creanga AA, Syverson C, Seed K, Callaghan WM. Pregnancy-related mortality in the United States, 2011-2013. Obstet Gynecol 2017;130: 366–73.
4. Hirshberg A, Srinivas SK. Epidemiology of maternal morbidity and mortality. Semin Perinatol 2017;41:332–7.
5. American Board of Obstetrics and Gynecology (ABOG). Bulletin for fellowship in maternal-fetal medicine; 2025. https://www.abog.org [Accessed 29 Jun 2025].
6. Accreditation Council for Graduate Medical Education (ACGME). Program requirements for graduate medical education in maternal-fetal medicine; 2025. https://www.acgme.org [Accessed 29 Jun 2025].
7. Zalud I. Faculty retention in academic OB/GYN: comprehensive strategies and future directions. J Perinat Med 2024;53:696–701.
8. Sambunjak D, Straus SE, Marusić A. Mentoring in academic medicine: a systematic review. JAMA 2006;296:1103–15.
9. Sullivan C, Cazin M, Higa C, Zalud I, Lee MJ. Maternal telehealth: innovations and hawai'i perspectives. J Perinat Med 2022;51:69–82.
10. Yang KI, Chung-Do JJ, Fujitani L, Foster A, Mark S, Okada Y, et al. Advancing community-based participatory research to address health disparities in hawai'i: perspectives from academic researchers. Hawai'i' J Med Public Health 2019;78:83–8.
11. Van den Veyver IB, Chandler N, Wilkins-Haug LE, Wapner RJ, Chitty LS, ISPD Board of Directors. ISPD board of directors. International society for prenatal diagnosis updated position statement on the use of genome-wide sequencing for prenatal diagnosis. Prenat Diagn 2022; 42:796–803.
12. Chervenak FA, McCullough LB. Ethical issues in perinatal genetics. Semin Fetal Neonatal Med 2011;16:70–3.
13. Patel DJ, Chaudhari K, Acharya N, Shrivastava D, Muneeba S. Artificial intelligence in obstetrics and gynecology: transforming care and outcomes. Cureus 2024;16:e64725.
14. Grünebaum A, Chervenak J, Pollet SL, Katz A, Chervenak FA. The exciting potential for ChatGPT in obstetrics and gynecology. Am J Obstet Gynecol 2023;228:696–705.
15. Stanojević M, Chervenak FA, Zalud I, Dudenhausen JW. Perinatal responsibility in a fragmented world: reflections from the 2024 international academy of perinatal medicine New York meeting. J Perinat Med 2025;53:669–71.