JMI Journal of Medical Imaging

GUEST EDITORIAL

Special Section Editorial: Artificial Intelligence for Medical Imaging in Clinical Practice

Claudia Mello-Thoms,[a] Karen Drukker,[b] Sian Taylor-Phillips,[c] Khan Iftekharuddin,[d] and Marios Gavrielides[e]

[a]University of Iowa, Department of Radiology, Iowa City, Iowa, United States
[b]University of Chicago, Department of Radiology, Chicago, Illinois, United States
[c]University of Warwick, Warwick Medical School, Department of Health Sciences, Coventry, United Kingdom
[d]Old Dominion University, Department of Electrical & Computer Engineering, Norfolk, Virginia, United States
[e]AstraZeneca Pharmaceuticals, Cambridge, United Kingdom

Artificial-intelligence-driven technologies have shown potential for transforming the landscape of clinical practice, offering innovative solutions to longstanding challenges in diagnosis, treatment, and patient care. In the field of medical imaging, numerous AI-enabled devices have been approved by the Food and Drug Administration for marketing in the United States.[1] It remains to be seen, however, how widely these devices will be adopted for clinical use and how they will impact clinical practice.

This JMI special section focuses on the translation to clinical practice of AI-enabled medical imaging technologies. The collection of articles in this section embodies the advancements and diverse applications as well as remaining challenges of AI within the realm of medical imaging. From predicting lung transplant metrics to improving breast cancer detection, from streamlining aortic measurements to enhancing cardiac MRI resolution, each article illustrates the potential of AI to help revolutionize patient care. The regulatory considerations outlined in one of the review papers underscore the complexities and nuances surrounding AI's entry into clinical workflows, emphasizing the need for meticulous evaluation and standardized practices. Moreover, the exploration of class imbalance solutions and the deployment of AI in pathology demonstrate the diversity of challenges and opportunities in different medical domains.

The first paper, "Predicting left/right lung volumes, thoracic cavity volume, and heart volume from subject demographics to improve lung transplant" by Lucas Pu et al. (https://doi.org/10.1117/1.JMI.10.5.051806), delves into predicting vital lung and thoracic cavity metrics crucial for successful lung transplant procedures. Their study harnesses machine learning techniques to infer these metrics from patient demographics, offering a promising avenue for enhancing organ compatibility and patient outcomes.

The second paper, "Multi-vendor robustness analysis of a commercial artificial intelligence system for breast cancer detection" by Mercedes Riveira-Martin et al. (https://doi.org/10.1117/1.JMI.10.5.051807), tackles the challenge of breast cancer detection through an AI system's lens. The authors explore the system's performance across different vendors and technical aspects, fostering an understanding of its generalizability and potential implications for broader clinical deployment.

The third paper: "Integration and evaluation of chest X-ray artificial intelligence in clinical practice" by Koon-Pong Wong et al. (https://doi.org/10.1117/1.JMI.10.5.051805), the authors investigated the integration of AI for endotracheal tube placement assessment on chest X-rays. The authors conclude that such a system alerting for tube misplacement could be adopted more widely in their institution following their evaluation and highlighted the need for post deployment monitoring of the effectiveness of the system and for user feedback on the correctness, usefulness, presentation, and frequency of alerts. This work exemplifies AI's role in enhancing

clinician decisions and workflow optimization, as well as the need for adequate controls to ensure smooth clinical implementation.

The fourth paper, "Deep learning architecture for 3D image super-resolution of late gadolinium enhanced cardiac MRI" by Roshan Reddy Upendra et al. (https://doi.org/10.1117/1.JMI.10.5.051808), addresses the challenge of improving cardiac MRI resolution. By proposing a novel convolutional neural network architecture, the authors offer a solution to enhance the diagnostic accuracy and visualization quality of cardiac images.

The fifth paper, an invited review paper by Nicholas Petrick et al., "Regulatory considerations for medical imaging AI/ML devices in the United States: concepts and challenges" (https://doi.org/10.1117/1.JMI.10.5.051804), navigates the intricate landscape of AI/ML regulatory processes for medical imaging devices. This comprehensive review explores the evolving regulatory framework and the implications for AI deployment in clinical practice.

The sixth paper, "Batch-balanced focal loss: a hybrid solution to class imbalance in deep learning" by Jatin Singh et al. (on the issue cover, https://doi.org/10.1117/1.JMI.10.5.051809), takes a pragmatic approach to handling class imbalances in AI models. With a focus on improving disease classification on imbalanced datasets, the authors showcase the potential of this method to enhance diagnostic accuracy across various medical conditions.

The seventh paper, an invited review paper by Mark Zarella, David McClintock, and coauthors associated with the Digital Pathology Association, "Artificial intelligence and digital pathology: clinical promise and deployment considerations" (https://doi.org/10.1117/1.JMI.10.5.051802), examines the transformative role of AI in digital pathology. The review delves into the diverse applications of AI in pathology workflows and outlines potential solutions to address barriers and challenges in clinical adoption.

The eighth paper, "Fully automated pipeline for measurement of the thoracic aorta using joint segmentation and localization neural network" by Sudeep Katakola et al. (https://doi.org/10.1117/1.JMI.10.5.051810), presents a novel approach to automated aortic diameter measurements. Their study showcases a convolutional neural network's ability to seamlessly perform segmentation, localization, and measurement, streamlining an essential task in thoracic aortic aneurysm diagnosis. The performance of the network reported by the authors varied across aortic regions, highlighting the need for understanding the strengths and limitations of such tools before clinical deployment.

As AI development and clinical translation continue to grow in the domain of medical imaging, these articles provide a snapshot of the current progress toward potential evidence-based integration in clinical practice. The collective insights offered by these studies highlight both the progress and the challenges in leveraging AI's capabilities for improved diagnosis, treatment, and patient outcomes.

References

1. U.S. Food and Drug Administration, "Artificial intelligence and machine learning (AI/ML)-enabled medical devices," 2022, https://www.fda.gov/medical-devices/software-medical-device-samd/artificial-intelligence-and-machine-learning-aiml-enabled-medical-devices (accessed 10 October 2023).