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Emergency Radiology: Current Status and Recent Advances

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Emergency radiology is one of the newest subspecialties in radiology, focusing on the imaging and management of acutely ill and trauma patients. The key characteristic of emergency radiology is its focus on acute and traumatic conditions, where readiness, speed, and diagnostic accuracy are equally critical for clinical management. Emergency radiology is becoming increasingly important in the aging world because older patients are more prone to acute health issues and complications [1]. Furthermore, conflicts in various regions have intensified, leading to an increased number of cases of traumatic injuries [2]. The post-COVID-19 era also indicates the possibility of emergence of new infectious diseases at any time. The volume of emergency imaging has been and is likely to continue to rise further [3,4], driving the need for the field to scale up accordingly. A recent article discussed strategies for establishing and sustaining emergency radiology services, detailing the associated opportunities and challenges [5]. Beyond clinical services, areas such as education, research, and quality improvement in emergency radiology must evolve.

Emergency radiology practices vary between regions and even within countries. Typically, its scope includes emergency imaging across different modalities and teleradiology; some practices in Asia also cover emergency procedures and interventions. Organizations such as the American Society of Emergency Radiology (ASER) [6] and the European Society of Emergency Radiology (ESER) [7] play crucial roles in advancing the subspecialty by focusing on education, training, quality standards, and promotion. The journal *Emergency Radiology* has emerged as a central publication in the field, while annual meetings held by ASER and ESER attract diverse groups of practicing emergency radiologists globally. Over the past decade, emergency radiology has gained prominence at international and national radiological conferences. Fellowship training programs are well-established in North America. In response to the COVID-19 pandemic, emergency radiologists worldwide formed the World Federation of Emergency Radiology to facilitate knowledge sharing and collaboration in the field.

At the forefront of modern medicine are precision and personalization, wherein diagnosis and treatment are tailored to each patient's specific condition. The Society of Academic Emergency Medicine [8] identifies several aspects of precision in emergency medicine, including omics, technology, data science, and health informatics, most of which apply to emergency radiology. For example, radiomics enables the earlier detection of potential disease development and helps predict certain health outcomes. Cardiac CT scans, for instance, can provide insight into future adverse cardiac events [9].

Technological advances in imaging hardware and software have significantly improved emergency radiology. Recent innovations include the hybrid emergency room system (HERS), photon-counting detector (PCD) CT, rapid MRI protocols, and software improvements in ultrasound. HERS, pioneered in Japan, represents a significant evolution in trauma care that integrates diagnostics and treatments, such as transcatheter embolization and damage control surgery, into one room [10]. This setup streamlines the

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care process and reduces patient transfers among the resuscitation, CT, angiography, and operating rooms, making it particularly valuable for time-sensitive trauma cases. PCD CT revolutionizes imaging by counting individual photons passing through detectors and converting them into electronic signals, bypassing traditional light conversion. This modality provides greater detail, which is essential for trauma and acute diagnoses such as detecting renal stones and fractures that might be overlooked on conventional CT [11]. The multi-energy applications of PCD CT allow for better tissue differentiation and more accurate attenuation measurements [12], reducing the need for non-contrast scans. Rapid MRI protocols have transformed acute care by delivering high-quality images in a significantly shorter time. For example, a 5-minute MRI can alter management in nearly 10% of acute stroke cases compared to non-contrast CT alone [13]. Specialized protocols, such as pediatric appendicitis, endorsed by the Society of Pediatric Radiology, provide accurate diagnoses without radiation exposure [14]. Advances in ultrasound technology, including tissue harmonic imaging and spatial compounding, have also enhanced image quality [15]. Additionally, contrast-enhanced ultrasound can detect active bleeding in real-time, improving diagnostic accuracy compared to traditional focused assessment with sonography for trauma [16,17].

Artificial intelligence (AI) represents the next frontier in radiology, reshaping imaging workflows, diagnosis, health prediction, and care personalization [18,19]. The role of AI in radiology is transitioning into one where it routinely assists in clinical settings, helping radiologists manage patient care in real time. Noteworthy developments include predictive analytics, which uses AI to analyze multisource data and predict health status, and opportunistic screening, in which it extracts additional insights from imaging data. For example, body fat composition on appendicitis CT can provide information on cardiac health [18,20-23].

Emerging technologies like portable MRI scanners, natural language processing (NLP), large language models (LLMs), and extended reality (XR) are making waves in healthcare. Portable low-field MRI machines can be brought to a patient's bedside, improving access in critical care and low-resource areas [24,25]. AI enhances workflow efficiency with NLP and LLMs by automating tasks such as drafting radiology reports and prioritizing urgent cases [18,26,27]. LLMs can assist in diagnosis, clinical decision support, report simplification, patient communication, and education [28]. XR and LLMs offer great potential for emergency radiology education by providing immersive simulations and virtual patients in a risk-free learning environment [29,30].

Teleradiology has become the cornerstone of emergency radiology and has evolved into a thriving industry [31]. Beyond offsite imaging interpretation, teleradiology combined with AI and mobile imaging units can enhance access to radiology expertise, alleviate radiologist shortages, and support population-screening programs [31,32]. This technology also plays a significant role in education and training and is essential for preparing the next generation of radiologists.

In conclusion, driven by technological advancements, AI, and teleradiology, emergency radiology is poised for significant growth. These innovations will not only benefit radiologists but also improve patient outcomes as the field moves toward a more personalized, precision-driven approach to healthcare. As the demand for emergency radiology continues to grow, emergency radiologists must remain dedicated to the core qualities of their subspecialties, namely readiness, speed, and accuracy, which are essential in acute and trauma cases. By embracing these evolving opportunities and adhering to the foundational principles of the field, emergency radiologists can meet the increasing demands of modern medicine while delivering optimal patient care.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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REFERENCES

1. United Nations Department of Economic and Social Affairs. World social report 2023: leaving no one behind in an ageing world [accessed on October 16, 2024]. Available at: https://

www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2023/01/WSR_2023_Chapter_Key_Messages.pdf
2. Our World in Data. War and peace [accessed on October 16, 2024]. Available at: https://ourworldindata.org/war-and-peace?ref=gentlereformation.com
3. Dan Lantsman C, Barash Y, Klang E, Guranda L, Konen E, Tau N. Trend in radiologist workload compared to number of admissions in the emergency department. *Eur J Radiol* 2022;149:110195
4. Poyiadji N, Beauchamp N 3rd, Myers DT, Krupp S, Griffith B. Diagnostic imaging utilization in the emergency department: recent trends in volume and radiology work relative value units. *J Am Coll Radiol* 2023;20:1207-1214
5. Camacho MA, Dunkle JW, Mughli RA, Johnson JO, Stephen Ledbetter M, Nicolaou S, et al. Starting an emergency radiology division: scheduling and staffing, compensation, and equity and parity. *Radiol Clin North Am* 2023;61:111-118
6. American Society of Emergency Radiology. Mission & history [accessed on October 16, 2024]. Available at: https://aser.org/mission-history
7. European Society of Emergency Radiology. Society [accessed on October 16, 2024]. Available at: https://www.eser-society.org/society
8. Strehlow M, Gisondi MA, Caretta-Weyer H, Ankel F, Brackett A, Brar P, et al. 2023 Society for Academic Emergency Medicine consensus conference on precision emergency medicine: development of a policy-relevant, patient-centered research agenda. *Acad Emerg Med* 2024;31:805-816
9. Lambin P, Leijenaar RTH, Deist TM, Peerlings J, de Jong EEC, van Timmeren J, et al. Radiomics: the bridge between medical imaging and personalized medicine. *Nat Rev Clin Oncol* 2017;14:749-762
10. The Founding Members of the Japanese Association for Hybrid Emergency Room System (JA-HERS). The hybrid emergency room system: a novel trauma evaluation and care system created in Japan. *Acute Med Surg* 2019;6:247-251
11. Grunz JP, Huflage H. Photon-counting computed tomography: experience in musculoskeletal imaging. *Korean J Radiol* 2024;25:662-672
12. Mergen V, Racine D, Jungblut L, Sartoretti T, Bickel S, Monnin P, et al. Virtual noncontrast abdominal imaging with photon-counting detector CT. *Radiology* 2022;305:107-115
13. Kazmierczak PM, Dührsen M, Forbrig R, Patzig M, Klein M, Pomschar A, et al. Ultrafast brain magnetic resonance imaging in acute neurological emergencies: diagnostic accuracy and impact on patient management. *Invest Radiol* 2020;55:181-189
14. Morin CE, Karakas P, Vorona G, Sreedher G, Brian JM, Chavhan GB, et al. The Society for Pediatric Radiology Magnetic Resonance Imaging and Emergency and Trauma Imaging Committees' consensus protocol recommendation for rapid MRI for evaluating suspected appendicitis in children. *Pediatr Radiol* 2024;54:12-19
15. Clevert DA, Beyer G, Nieß H, Schlenker B. Ultrasound—new techniques are extending the applications. *Dtsch Arztebl Int* 2023;120:41-47
16. Di Serafino M, Iacobellis F, Schillirò ML, Ronza R, Verde F, Grimaldi D, et al. The technique and advantages of contrast-enhanced ultrasound in the diagnosis and follow-up of traumatic abdomen solid organ injuries. *Diagnostics (Basel)* 2022;12:435
17. Sutarjono B, Kessel M, Alexander D, Grewal E. Is it time to re-think FAST? A systematic review and meta-analysis of contrast-enhanced ultrasound (CEUS) and conventional ultrasound for initial assessment of abdominal trauma. *BMC Emerg Med* 2023;23:8
18. Najjar R. Redefining radiology: a review of artificial intelligence integration in medical imaging. *Diagnostics (Basel)* 2023;13:2760
19. Petrella RJ. The AI future of emergency medicine. *Ann Emerg Med* 2024;84:139-153
20. Heart T, Ben-Assuli O, Shabtai I. A review of PHR, EMR and EHR integration: a more personalized healthcare and public health policy. *Health Policy Technol* 2017;6:20-25
21. Pickhardt PJ, Summers RM, Garrett JW. Automated CT-based body composition analysis: a golden opportunity. *Korean J Radiol* 2021;22:1934-1937
22. Yoon JH, Pinsky MR, Clermont G. Artificial intelligence in critical care medicine. *Crit Care* 2022;26:75
23. Cui C, Yang H, Wang Y, Zhao S, Asad Z, Coburn LA, et al. Deep multimodal fusion of image and non-image data in disease diagnosis and prognosis: a review. *Prog Biomed Eng (Bristol)* 2023;5:022001
24. Wald LL, McDaniel PC, Witzel T, Stockmann JP, Cooley CZ. Low-cost and portable MRI. *J Magn Reson Imaging* 2020;52:686-696
25. Cooley CZ, McDaniel PC, Stockmann JP, Srinivas SA, Cauley SF, Śliwiak M, et al. A portable scanner for magnetic resonance imaging of the brain. *Nat Biomed Eng* 2021;5:229-239
26. Baltruschat I, Steinmeister L, Nickisch H, Saalbach A, Grass M, Adam G, et al. Smart chest X-ray worklist prioritization using artificial intelligence: a clinical workflow simulation. *Eur Radiol* 2021;31:3837-3845
27. Ranschaert E, Topff L, Pianykh O. Optimization of radiology workflow with artificial intelligence. *Radiol Clin North Am* 2021;59:955-966
28. Keshavarz P, Bagherieh S, Nabipoorashrafi SA, Chalian H, Rahsepar AA, Kim GHJ, et al. ChatGPT in radiology: a systematic review of performance, pitfalls, and future perspectives. *Diagn Interv Imaging* 2024;105:251-265
29. Gelmini AYP, Duarte ML, Silva MOD, Guimarães Junior JB, Santos LRD. Augmented reality in interventional radiology education: a systematic review of randomized controlled trials. *Sao Paulo Med J* 2022;140:604-614
30. Alexander SM, Friedman V, Rerkpattanapipat PM, Hiatt WA, Heneghan JS, Hubal R, et al. Adapting novel augmented reality devices for patient simulations in medical education. *Cureus* 2024;16:e66209
31. Morales Santos Á, Del Cura Rodríguez JL, Antúnez Larrañaga N. Teleradiology: good practice guide. *Radiologia (Engl Ed)* 2023;65:133-148
32. Kanne JP, Chung JH. A case for academic teleradiology. *J Am Coll Radiol* 2022;19:1177-1179

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