Title 2 - Radiology to the Rescue: Our Role in Global Disasters and Local Emergencies

From its traditional use in diagnosing acute conditions to its expanded use during large-scale crises, the importance of imaging cannot be overstated. Whether it is a local emergency or a global health crisis such as the COVID-19 pandemic, radiological tools help healthcare professionals investigate, diagnose and manage patients promptly and effectively. Radiology is closely tied with technology, with plain radiography being the first modality used, and newer modalities such as computed tomography (CT), ultrasonography (US) and magnetic resonance imaging (MRI) being later added to the diagnostic arsenal of radiologists (1). Recent innovations such as artificial intelligence (AI) and teleradiology are further transforming the field by enhancing its ability to meet the demands of emergency settings. This essay explores the significance of radiology during global pandemics and local emergencies and discusses how modern innovation can help address limitations during these large-scale crises.

The COVID-19 global pandemic took the world by surprise, disrupting everyday life and leading to over 6.9 million deaths worldwide (2). Radiological imaging played a crucial role in the early diagnosis of COVID-19 and in monitoring the disease's clinical course. While nucleic acid detection remains the gold standard for COVID-19 diagnosis (3), its practical use in clinical settings faced challenges such as shortages of test kits, irregular sampling, laboratory errors, insufficient viral material, contamination, and technical issues, all contributing to false negatives (4). In contrast, chest imaging, particularly chest computed tomography (CT), became an invaluable tool for healthcare workers in the rapid detection of COVID-19.

According to several studies, the sensitivity of CT in diagnosing COVID-19 ranges from 61% to 99%, with fewer false negatives when performed 48 hours after the onset of symptoms (5). Additionally, CT is non-invasive and can identify patients' mortality risk based on the extent of their lung consolidation. Moreover, CT findings, such as ground-glass opacifications and consolidations, evolve through different stages of the disease. This allows the CT modality to not only diagnose, but also monitor the disease's progression through its early, peak, and absorption stages (5).

Another context where radiology's value is key is during local emergencies where a large number of casualties from an event disrupt the normal flow of health care services. Such events, which can be anything from extreme weather to acts of terrorism, are referred to as mass casualty incidents (MCIs) and they require a high level of preparedness. From the forefront of first responders to triage centres and hospitals, radiological tools play a key role in preparedness for MCIs. Radiological tools, such as portable sonography, can provide real-time imaging which provides valuable insight in reaching fast and informed decisions in chaotic and stressful environments in the disaster site (6). This helps identify which patients need urgent care and who should be prioritised for evacuation.
However, the effectiveness of these radiological tools not just depend on technology but also collaboration and training among radiologists, disaster response teams, and public health professionals. A key example of this is ultrasound, which is highly user-dependent. First responders must be trained to use portable ultrasound machines effectively in real time to visualise anatomical structures, locate any foreign objects, and detect potential complications (6).

In parallel with this, emergency radiology has become an important radiological subspecialty and its recognition and the availability of training positions continue to grow to meet the demands of both daily emergencies and potential MCIs. Before cross-sectional imaging tools, many patients in the emergency department (ED) had to be ultimately admitted to the hospital to have more invasive investigations such as fluoroscopy and angiography (7). It would be an understatement that the widespread availability of CT, MRI and US has revolutionised patient care. These modalities not only improve diagnostic confidence but also expedite patient management and referrals, ultimately improving patient outcomes and reducing the length of hospital stays. In many emergency presentations, time-sensitive radiological imaging is essential. Some examples include suspected stroke, pulmonary embolism or intracranial haemorrhage where every minute counts (8). Efficiency and versatility are key in the management of emergency presentations, and this is often reflected in the layout, staff training and workflow processes of emergency departments (9). The fast-paced nature of emergency radiology and the unpredictability of case volumes during MCIs require radiologists to be highly versatile and adaptable. They need to be able to cover a wide variety of imaging modalities and shift between different organ systems and conditions rapidly.

During MCIs, several staffing solutions may be implemented to provide 24-hour imaging coverage support. The less essential imaging reports may be postponed to prioritise the MCI victim images. Teleradiology services can also be employed to use the expertise of radiologists afar to report MCI imaging. But the remote nature of teleradiology that makes it helpful also poses challenges, such as ensuring adequate communication and overcoming technology barriers. In situations where emergency reporting is in high demand and emergency radiologists are short-staffed, radiologists from other departments such as neuroradiology and musculoskeletal may be enlisted to interpret emergency images. However, asking subspecialty radiologists to report on cases outside their scope may compromise patient safety and raise liability risks if they are not comfortable interpreting emergency imaging (10).

There have been many recent innovations in the field of radiology but the most publicly recognised one is artificial intelligence (AI). There are many areas in which AI can potentially aid emergency radiology, particularly during MCIs and future global pandemics where healthcare systems become overwhelmed, and resources are under strain. One key application is in AI-assisted image interpretation and anomaly detection. While technology has not yet reached the sensitivity and specificity that satisfy hospital boards and ethical committees, it is progressing. Other noteworthy AI applications are patient positioning and worklist prioritisation which could become another tool for emergency radiologists. Taking patient positioning for instance, CT imaging is one of the most commonly used modalities in emergency cases but it requires the patient to be precisely positioned in the scanner isocentre to ensure clear diagnostic images with lower radiation exposure. AI-based autopositioning software can identify anatomical references in the body to predict the body dimensions and use this information to define start and stop scanning positions as well as align the body in the appropriate isocentre of the CT scanner. This can potentially reduce scanning time and patient radiation exposure while enabling more patients to be scanned in the same timeframe, using the same staff and resources. A recent study on AI-assisted positioning demonstrated a 28% decrease in scanning time and a 16% reduction in patient irradiation (11). This becomes invaluable during MCIs or global health crises where maximising efficiency is key.

Task prioritisation is another promising application of AI in emergency radiology. Front-line physicians often determine the initial imaging request priorities, which may be accompanied by human error at times. AI software can help pre-identify potential anomalies and outcomes to prioritise imaging and its reporting. By prioritising cases with potentially critical findings, AI can significantly reduce reporting turnaround times and improve patient outcomes by ensuring that urgent cases are flagged for immediate attention (12).

In summary, radiology plays a key role in managing local emergencies and global health crises, such as the COVID-19 pandemic. With the ability to diagnose and monitor various conditions quickly, radiology can therefore greatly improve patient outcomes. Recent innovations including IA and teleradiology, have the potential to transform emergency radiology by increasing efficiency and accuracy. While individual IA applications such as automated positioning and task prioritization can provide marginal gains in efficiency, their collective reduction in scanning time and increase in prioritised reporting can prove invaluable in large-scale crises such as MCIs or pandemics. When applied correctly, these innovations can help alleviate time and resource strain, ultimately improving patient care and saving lives.

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