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Letter to the Editor

The Impact of Artificial Intelligence in Emergency Medicine

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Dear Sir,

The advent of big data set and Artificial Intelligence algorithms in health care settings have generated huge excitement suggesting improvement in diagnostic methods and treatment modalities. Artificial Intelligence (AI), Deep learning (DL) and Machine Learning (ML) has been coined as the cognitive revolution and now increasingly being used in healthcare institutions. Machine Learning algorithms invariably require structured data, whereas Deep Learning networks rely on layers of the artificial neural networks. Machine learning algorithms are built to "learn" to do things by understanding labeled data, then process it to yield further outputs with more sets of data.(1)

AI can be applied in most areas of the emergency department. Its application in emergency medicine (EM) provides algorithms for predictive modeling, patient monitoring and department operations in the emergency room. These methods involve classification and clustering algorithms, natural language processing, text mining, image understanding, computer vision, and robotics. (1)

Technology and problem-driven collaborations between computer sciences and medical sciences can be the focal points of AI in emergency medicine. In this era, there is a lot of conversation about innovations to develop novel solutions in particular of developing world settings, AI is likely to benefit EM through its digitization power and information storage. Current AI applications are meant to work across clinical domains and have potential to augment patient care with efficient and high-quality health care delivery.

AI is computer systems development based to perform tasks requiring human intelligence. AI algorithms so far proven benefit in time sensitive conditions such as the early warning systems for cardiac instability, sepsis, rapid triage screening, real time ultrasound analysis, higher accuracy in detecting abdominal free fluid, wrist-worn accelerometers to detect seizures and smart carpets to determine fall, public health surveillance, suicide risk identifications, detection of pneumonia, 3D segmentation of subdural hematoma, risk assessment of cerebral aneurysm rupture and stroke evaluation.(1)

The role of AI in our era has been stated by Dr. Thrun: (1)

"Did the phone replace the human voice? No, the phone is an augmentation device. The cognitive revolution will allow computers to amplify the capacity of the human mind in the same manner. Just as machines made human muscles a thousand times stronger, machines will make the human brain thousand times more powerful."

While the literature has suggested utilization of multiple AI applications in health care such as radiology, it has been barely used in the emergency room (ER). We believe that with the fast-paced momentum, AI in the ER will not only improve patient care but will accomplish efficiency.

Most of the research using AI are doing risk prediction, with inputs such as demographic data, admin data, lab and vital signs, and others such as imaging. However, the disadvantage of AI is that the prediction models are usually black box, i.e. clinicians cannot interpret the model and linkages outlined by inputs and outcomes. This hinders the real-world implementation of AI models. In the future, there might be solutions to overcome these deficiencies and also to make systems more robust through utilizing the previous successful outcomes.

From the emergency medicine perspective, AI possesses applications, which when applied in the right scenario will produce awesome results.

Ventricular fibrillation and ventricular tachycardia (VF/VT), known as shockable (SH) rhythms, is the main cause of sudden cardiac arrests (SCA). The performance of the shock advice algorithm (SAA) applied in the automated external defibrillator (AED) has been improved by using machine learning technique and variously conventional features by using a novel algorithm with relatively high performance for the SCA detection on electrocardiogram (ECG) signal. [2] Heart Hero, which was created with a simple mission to save more lives from SCA, has developed a revolutionary personal AED device to make lifesaving technology available to the consumer market. "Elliot," the purse-sized device weighs just over one pound, operates using store-bought batteries, includes step by step instructions and visual prompts, features artificial intelligence, and a partner smartphone app. [3]

Another algorithm, CheXNet, claimed as the biggest chest x-ray data set, when was compared with academic radiologists exceeds the performance. [4] It uses a heat map for localizing the areas of the image most indicative of pneumonia.

Out of hospital cardiac arrest (OHCA), ML framework which works in the background of incoming calls to the dispatchers showed higher sensitivity and specificity to emergency dispatchers. It was built with a goal of getting the text classified for communications around OHCA. The algorithm involves data mining of predictions for the ACS related deaths. ML based risk score to predict early mortality following ST segment elevation myocardial infarction has been developed using a statistical approach. On this ML algorithm using available variables, AUC (area under the curve) has been cited from 0.64 to 0.91. This model has performed equally well to Global Registry of Acute Coronary Events (GRACE) and has exceeded Thrombolysis in Myocardial Infarction (TIMI) score. [5]

ML outperformed the Trauma and Injury Severity Score (TRISS) studies revealed ML applications have been utilized for life saving methods in trauma and data mining processes to identify tweets about influenza hence increased use of data mining and geographical information systems to help detect maximum numbers of influenza cases. [6]

AI could be useful for developing risk stratification tools to triage patients. Subjective assessments at triage have shown limited ability to risk stratify sick patients. E-triage systems evaluation based on ML showed beneficial results that predict outcomes from serious illnesses hence will enable EM physicians and staff for better patient differentiation. [7]

Limitations for AI bears some ethical and legal implications. In a NEJM op-ed, it was stated, "Remaining ignorant about the construction of machine-learning systems or allowing them to be constructed as black boxes could lead to ethically problematic outcomes." [8]

Although deep learning involves in depth algorithmic data processing with relatively less human reasoning, careful approach for its utilization has to be taken into account. The accuracy in AI algorithmic predictions is persuasive to be considered for its usage in the emergency departments for solving key issues. However the reported limitations can shadow clinical decision making accuracy. Therefore intensive data interpretation involving close to live decision making scenarios is required before full adoption of the AI in the emergency department.

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