ARTIFICIAL INTELLIGENCE IMBEDDED GAMIFICATION TO PROMOTE THE EMERGENCY HEALTH CARE

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I. INTRODUCTION

Artificial Intelligence (AI) has developed over the years which has been empowered with path breaking innovation in information technology to have the ability of human way to think, analyses and function in similar way as the human cognitive moorings. There are various branches of modern AI which is based on continued profession in the algorithm based analysis and software which can update itself and become more relevant. AI also includes to a large extent human speech recognition, problem solving and predicating the outcome based on a model and contributing in solving the intricate and complex clinical problem. A new branch of AI has come to play a major role by automatically improve its ability to predicting the outcome known as machine learning. Simultaneously a new subset of the AI is evolving known as Dep Learning which keeps on improving its functioning by absorbing pattern and information's based on data input like human neural network of cognitive abilities. It can interpret the human speech and languages and update its algorithms which analyses the data. Hence the three level of AI , machine learning and deep learning work in synergy to help in many clinical situations which is rather difficult for human analysis (Figure 1). The up-gradation in AI is mostly automated by the algorithms employed but gets impetus by supervised learning, reinforced updates in the data, natural language processing's and improvement in the ability without supervised modifications based on more data inputs. The applications of AI in medical clinics has found wast applications as it is able to quickly outperform the human expertise in predicting the diagnosis, radiological evaluation and correlating all the diagnostic input in analyzing the treatment protocols for best management. Emergency Department (ED) attracts large variety of clinical services and demands quick disposal of large number of cases may be uniquely suited to apply the AI applications for best results. The AI in EM may be able to guide in arriving a decision in risk prediction, balancing the treatment protocol, stratification of cases and handle the diversity of patient information's. The applications of AI tools may be a boon in ED in managing the diagnosis and treatment regimen in variety of situations and supplemented human cognitive reach without getting biased or perturbed. AI can read a series of x-rays and CT images in quick succession and predict the diagnosis more accurately. A new diagnostic stream has evolved using AI for helping the accurate diagnosis and solve the diagnostic dilemma faced in many emergency situations. Artificial intelligence (AI) has ushered in a new era in management of Emergency Medicine (EM) and it is considered as important mile stone in the evolution of current EM clinical management. The new empowered AI has the potential to enhance the capacity of management, admission, efficient occupancy management and predicting the diagnosis. Thus it has the ability to affect all aspect of total patient management. The AI will influence the work flow in triage, patient waiting, helping in diagnosis in radiological investigations, and the enhance the efficiency of Emergency Physician (EP) in a seamless manner in overall delivery of care and services to patients. This is a tool which enhances the clinical service delivery of every worker and adds to the human cognitive ability in providing several options based on large data pools available in its model and algorithms.It is imperative to keep abreast with the development in literature of AI and its continued progress in managing the ED. Vast amount of scientific and clinical literature has been published das review of the experiences in application of AI in ED. Most of the finding are suggestive of the fact that ED has benefited largely n establishing quick and precise radiological diagnosis by use of AI. It has also been established that AI has contributed in predicting the cardiac events, strokes and infection and its management. It has demonstrated the ability in better prediction of clinical trials, mortality and management of triage area in alleviating the

suffering of the patients. In addition to clinical management AI has helped in stratification of admission, waiting time, ICU requirements and optimizing the staffing according to the work load needs.

AI categories	Description
Machine learning based on algorithm	Evolutions based on recognizing the patterns in millions of similar data and formation of an algorithm functions
Automated Machine Learning	The algorithm keeps updating based on the more input data and keeps on redlining to predict the patterns without any further input.
Continued up-gradation in Machine Learning	It is based on input of a base model and it has the ability to conclude based on information on its own.
Natural Language Processing	This is most important evolution where the pattern recognition is converted in human language and it is empowered to handle human language of languages, facial recognition, understanding, and generation of further outputs.

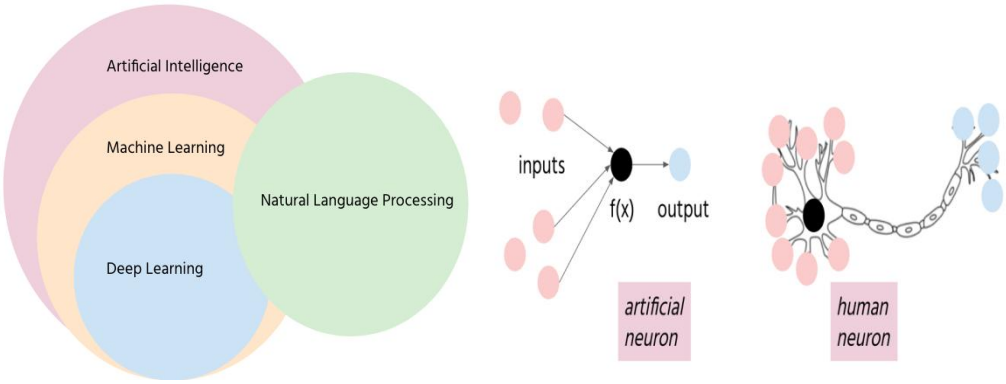

Figure 1: Artificial intelligence and its working principles.

Evaluation of various steps for implementing the AI: It has been deduced from many controlled studies that AI based tools are able to outperform human clinical reach both in diagnostic and therapeutic areas. AI has a large clinical data pool and has the ability to process multiple variables simultaneously across multi factorial need of the patient care. The approach of human is based on individual logics and many times it is difficult to process and analyses various inputs and arrive at a conclusion , hence the decision making become biased and poses limitations. Whereas AI takes advantage of information stored based on huge data for quick and accurate pattern recognitions. Machine learning algorithm keeps updating the predictive models as more relevant data is inputted. Diagnosis in radiology specially impending fractures, CT scans and many other areas have benefited by AI enabled tools such as computer added diagnosis (CAD). AI data base in radiology has the million sof radiographs and algorithm, thus, has the ability to accurately recognize the pattern in radiograph and make quick diagnosis in most difficult cases. Although in ED the pattern and profile of patients may be continuously changing hence the AI choses should be broad based and human approach may be the need to supplement the suggestions made by AI. Here AI may yet prove to be a very appreciable assistance in total management of the ED. Some of the concerns about AI is that its functioning is obscure and many time it may be difficult to

analysis the methods utilized by AI in its predictions and suggestions. Ordinary ED user may not know what are the domain expertise which is operating the AI and machine learning process. This need to be audited and evaluated by a multi-disciplinary team to verify the outcome. Thus a word of caution is important that AI may falter and inadvertently make an incorrect suggestions in certain patients whose data base is narrow in original data sets of AI. In one of the AI application in ED in USA hospital it was observed that the AI analysis has racial bias in radiological diagnosis which was attributed to inaccurate data pool.

Transparency and audits of AI should be made mandatory on regular basis by a public trust to build trust around. Ultimately the AI aims to provide assistance in human cognitive ability in the over worked environment of ED by accuracy of analysis of the input data of the patient approaching the ED. It may be prudent to add that hype around AI may be critically analyzed and while its judicious utility may be helpful yet an critical human eye on the suggestions must be an essential practice.

ED Triage with Assistance of AI: Triage is the back bone of any ED and work on the thematic focus to provide emergency care need by the right person at right time by the right specialty without lapse of time. Its coordinates should be well defined to segregate the medical need of the patient and arrange the sociality needs of medical assistance as soon as patient reaches to ED. AI has evolved as an powerful facilitator in helping the triage room managements. The algorithms and analytical capacity of AI has become more reliable over the past few years and could support the EP who has the variety of increasing and challenging work load to manage in patients care. What need to be appreciated of the fact that AI algorithms have developed around patient data pools and has been continuously updating its capacity in pattern recognitions using machine learning and deep learning to accumulate more clinical information's based on thousands of such patients reporting to ED. Thus its predicted information in ED is basically the patient data pool which guides the AI from behind the operating mechanism. AI is using data sets and insights to create algorithms that are capable of identifying the different layers of patient triage so that physicians can ensure that patients are accurately categorized and accordingly provided treatment and care. For developing a robust and trustworthy AI sysytems it is imperative to accumulate significant volume of relevant clinical data which is relevant for medical emergency room management. This will make AI applications in triage more reliable and fault free in a lifesaving settings. AI in triage has to base its strength by following rigorous process of data pooling, testing and modeling to get the optimum results. The recent advances in AI in emergency room triage practiced in few developed countries are designed to support the medical staff in managing all types of medical emergencies reporting the triage areas. In future the AI will increasingly develop its capability to provide solid foundation in triage in ED and will have the potential to minimize the risk, enhance accuracy, provide accurate diagnosis with speed and reduce the burden on emergency room physician. Application of AI based possesses have significant promise in the emergency setting, electronic record keeping and large pool of information's for research and academic updates. It has already begun to improve the efficacy and quality of care delivered in select interventions. The AI based management of patients in triage areas within the ED fundamentally impacts patient flow, reduces wait times, optimizes resource utilization and accurate specialty allocation for desired treatment and patients risk-stratification. In current practices EDs functions and relies on clinical decision making in triage. This is time consuming and highly taxing to ED team. Several studies have proved that AI systems could improve the triage process and reduce the time between the triage

process and specialty care. Commonly used triage scale in the United States is Emergency Severity Index (ESI) which is accumulating data to evaluate is efficacy in triage of ED. Several AI models have shown to be effective in delineating patients in triage and functions in a seamless manner Fig.2.

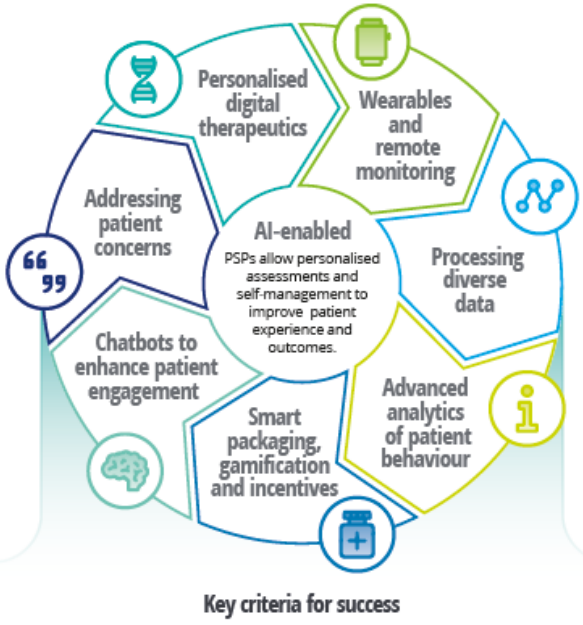

Figure 2: AI improves patient support in ED

Essential steps to delivering an AI-powered ED

1. INVEST IN DIGITAL COMPETENCIES,
2. INTEROPERABILITY AND INFRASTRUCTURE
3. PROVIDE AN INCREASINGLY PERSONALISED EXPERIENCE
4. BUILD COLLABORATIVE RELATIONSHIPS WITH REGULATORS
5. IMPROVE TRANSPARANCY AND TRUST IN TECHNOLOGY AND DATA

Evaluation of Impact of AI in Emergency Medicine: Artificial intelligence (AI) is one of the path breaking and paradigm in healthcare. It is a major technological breakthrough in the recent years in healthcare with futuristic approach to assist ED. This new technological marvel have the potential to substantially benefit the ED both to the physician and the health care system as a whole. AI will be utilized for numerous applications but it will be increasingly used in the interpretation of diagnostic imaging, predicting patient outcomes, triage management, and monitoring of patient vitals. The futuristic approach in AI must be developing reliable and user-friendly technology, legal frame work for its medical applications, and integration with ED in a synergistic fashion, it may also be tuned to help in patient monitoring in the out of hospital or home settings in communication with the treating physician. The advance applications of AI have been able to predict the possible heart attack prior to 72 hrs of the event in many patient under AI monitored programme and assessment of sepsis in trauma patients. AI has been able to predict the neurological complications based on CT head input and has suggested the other clinical and diagnostic measures to be taken for better outcome in patients attending the ED. AI tools have been developed to predict clinical

heart complication by monitoring heart rate, rhythm, blood pressure dynamics over time. AI based CT head in diagnosis have shown to have up to 94% sensitivity and 99% negative predictive value in detecting life-threatening pathology. It has demonstrated efficacy in predicting extent of subarachnoid hemorrhage, epidural hematoma, midline shift, hydrocephalus, and possibility of acute ischemic stroke. It may be prudent to add that AI provides quick and accurate diagnosis of CT head and other areas and these diagnoses is extremely valuable both in high-volume tertiary centers and over worked radiology department. This may be of immense clinical value in such center where availability of radiologist as specialty is not available. AI has proved to be very effective in diagnosis of fracture both in common orthopedic injuries to the extremities, such as wrist ankle and in more serious vertebral pathologies.AI has been useful in 2D echocardiograms in predicting the ejection factor and other cardiac ailments. It has been also in assisting in diagnosis from ultrasound investigations, such as detecting fluid and other pathology. AI monitoring has shown to be effective in detecting acute chronic obstructive pulmonary disease on an average of 5 days before the patient approached treatment. AI system has been developed with interaction of patricians, emergency physician and care givers to predict one week before the onset of asthma in children based on environmental changes, patients attributes and previous incidences of asthma. This may lead to develop self-reported asthma tracker system to help EP. The smart and AI enable wrist worn watches have been developed to predict and detect seizures with high degree of accuracy and consistency. A new AI empowered devise with audio interaction of elderly has been evaluated and it is able to report the presentation of myocardial infarction or stroke by analysis of speech of the elderly reporting to ED on phone. Thus, EDs would be better able to prepare for the acre of such patient both by reaching to home or the patient reporting the ED. The AI reporter systems will track the type and volumes of patients ED may have to encounter in the day.

Legislations far seamless implementation of AI in ED: The current legislations and its imperatives about electronic records and manual medical records are not very clear and well laid. It would therefore will be of utmost important to modify and strengthen the legal position about legal acceptability of electronic medical records and medical records based on AI. The progression and integration of electronic records are mandatory needs for rapid integration of AI in ED. The AI suggested diagnosis, clinical treatment protocol must have the legal strength for implementation of AI in ED across all the spectrum of the medical applications. The AI keeps evolving by machine learning and deep learning as large pool of clinical data goes in the algorithms of the Ai which would also be required to be ascertained with legal frame work across the medical facilities. It is clearly understood that the output from AI looks mostly opaque for general human and physician alike. The ascendance in data leads to better complain by AI in terms of its predictive capabilities. It keeps of evolving and the decision making is shifting from human to computer supported algorithm and codes generated and utilized by the AI systems. All these steps need to be in tune with existing medico legal frame works. As it is very clear that AI is not fully supported by legal sysytems which need to be modified far evolution of AI applications. All the ethical, clinical and medico legal frame works need to be passed as an appropriate legal work so that any complications in AI utility in ED is ruled out. The privacy of the medical data and protections of medical records are important for the protection of individual privacy. Thus the data sharing and safety of its electronic records through AI manipulations will require safe integration and protections. It is argued by many that AI will make the patients data vulnerable for manipulation and legally it can be altered. Many also argue that AI technology

and it applications will not be able to reach up to the expectations of human touch and human clinical acumen. Whereas the other argument that AI will be able to process vast amount of data of millions of such situations and provide more accurate and suitable treatment and diagnostic protocol than any one individual opinion. Most of the AI operations would be suggestive in nature and it would assist the EM in arriving at suitable protocol and it will not operate independently. Yet it is important to be aware that the AI algorithms have the allurement to be accurate and may indirectly influence the decision making in a mechanical manner. Hence its over dependence may be counterproductive and may not be legally tenable. AI with support of robust research based application has already started influencing the decision making in diagnostic radiology of ED and has improved the efficiency of patient care delivery, management of triage and proper segregation of ED patient in various segments for early management. Giving proper legal framework to AI and electronic medical records would improve the efficacy of ED and standards of care to the needy patients. AI will harness it strength based on millions of data of patients and models based on such predictive algorithms which has been tested under clinical trials.

Artificial Intelligence and Gamification in Clinical Medicine: Gamification has developed to help the patient care by providing a virtual reality to patients about the outcome of the treatment planned , diagnostic approaches, and process of recovery from ailments. This ability of the Gamification os further poised to be more realistic with the input from AI and machine learning processes. AI enabled and supported Gamification has the potential to give a realistic feedback and hope to a trauma and neurologically deficient patient about the path of recovery and hope of acquiring complete fitness. AI will be able to provide a road map with interactive research both to patent and EM about the pathways through which patient would recover quickly from a neurological deficiency or a stroke. This will stimulate a positive thinking in the patient about the time required for attaining total fitness. Robotics empowered with AI is the future of Gamification and this combination will make deep inroads as care providers with real time feed back to the clinicians about the measurement of the treatment response and recovery. It will do away with the conventional system of monitoring and evaluations with a reliable and real-time feedback. Robotics with AI is going to shape the clinical management of uncontrolled diabetic's, cancer care, trauma management and many cardiac care and strokes. Many times the ailments and symptoms such as stomach pain, back pain, headache, or other unexplained aches and pains may be consequence to mental illness of mental/ emotional trauma and pose a diagnostic challenge. AI empowered gaming has to potential by evaluating and differentiating the complete history and other feedback of the patients about the causative factors the pains from mental illness and it diagnostic inputs far its origin. It is understood that mental illness symptoms can affect emotions, thoughts and behaviors. AI can differentiate the symptoms of a mental health disorder which appear as physical problems. It has remained a challenge without the implementation of AI for the gaming industry to address these important issues in mental health areas. It is thus imperative for the Innovators in AI , researchers in robotics, clinicians and businesses to pool the resources to devolve a realistic AI empowered virtual human like gaming robotic arms to evolve the subject further to meet the futuristic needs in clinical managements.

