

# Artificial Intelligence And Machine Learning In Healthcare: Application And Challenges

Nada Otmani<sup>1</sup>, Noura Qarmiche<sup>3</sup>, Mohammed Omari<sup>1</sup>, Hind Bourkhime<sup>1</sup>, Nabil Tachfouti<sup>2</sup>, Samira El Fakir<sup>2</sup>

<sup>1</sup>*Biostatistic-Informatic unit, Department of Epidemiology, Clinical Research and Community Health, Faculty of Medicine and Pharmacy of Fez, Sidi Mohamed Ben Abdellah University, Fez, Morocco*

<sup>2</sup>*Department of Epidemiology, Clinical Research and Community Health, Faculty of Medicine and Pharmacy of Fez, Sidi Mohamed Ben Abdellah University, Fez, Morocco*

<sup>3</sup>*Laboratory of Artificial Intelligence, Data Science and Emerging Systems, National School of Applied Sciences Fez, Sidi Mohamed Ben Abdellah University, Fez, Morocco*

*nada.otmani@usmba.ac.ma, noura.qarmiche@usmba.ac.ma, mohammed.omari@usmba.ac.ma, hbourkhime@gmail.com, nabil.tachfouti@usmba.ac.ma, samira.elfakir@usmba.ac.ma*

## Abstract

**Introduction:** The use of AI in healthcare offers many opportunities that support decision making. The objective of this paper is to give an insight of artificial intelligence's main methods and applications in the field of healthcare. As well as to discuss its limitations and challenges.

**Methods:** A search was conducted on PubMed database. Results were reviewed for articles published during the 5 last years. Search terms included "artificial intelligence", "machine learning", and "healthcare".

**Result:** Machine learning was the method of AI most used in healthcare. It was used especially for prediction (36.9 %), to make a diagnosis (18 %), or for monitoring (9 %). The machine learning's algorithms most used were the random forest (29.6%), the regression logistic (27.8%), neural network (27.8%). The machine learning was used in 15.6% of case to improve the health system management. It was used in 12.5% of cases to describe and to try to understand the population's psychosocial behaviours. In the clinical practice, it was mostly used in infectiology (15.6%).

**Conclusion:** AI promises a lot of opportunities in healthcare. However, challenges about ethical implications and the adoption of this technology in daily clinical practice must be arise.

**Keywords:** Artificial intelligence, Machine learning, healthcare.

## I INTRODUCTION

Artificial intelligence (AI) is the subfield of computer science, that generally refers to computer systems and algorithms that simulate a specific aspect of human intelligence or behavior, such as learning, reasoning and problem solving (Jiang et al. 2017) (Chen et Decary 2020). Following the availability of open public databases and connected objects, the refinement of computational models and algorithms, coupled with powerful computers, there has been massive progress in AI in recent years, which has enhanced the human life in many areas, and has surpassed human performance in several domains.

Multiple approaches and techniques were developed and aimed to extracting knowledge from mega-data

using automatic or semi-automatic methods (Chen et Decary 2020) (Reddy, Fox, et Purohit 2019) (insemm 2018), particularly in machine learning (ML), Natural Language Processing (NLP), AI voice technology, and robotics (Chen et Decary 2020) (Jiang et al. 2017).

Machine learning (ML) is one of the most common forms of AI. It refers to a system that trains a predictive model by identifying patterns of data from input, then uses it to make useful predictions from new, never-before-seen data (Chen et Decary 2020) (T. Davenport et Kalakota 2019). The most common ML categories are supervised learning, unsupervised learning, semi-supervised learning, and reinforcement Learning (Chen et Decary 2020).

Healthcare is a system that generates a significant volume of heterogeneous data (Abidi 2019). The use

of AI in healthcare offers many opportunities that support decision making. It has demonstrated its potential to advance health service delivery, medical diagnosis, treatment decisions, biomedical research and health care administration, management of chronic conditions, delivery of health services, evaluation of different aspect of healthcare, assisted operations, remote patient monitoring, personalized treatments, intelligent prostheses, drug discovery, real-time statistical analysis, and others domains. This use is not restricted to retrospective interpretation, it can also be extended to prospective interpretation providing disease's prediction, to better prevent health risks, and early prognosis (Chen et Decary 2020) (Sivakumaran 2018) (GRUSON 2019) (Alsuliman, Humaidan, et Sliman 2020) (Cartron, Lecordier, et Jovic 2019) (Reddy, Fox, et Purohit 2019), in such a way that intelligent and interactive analysis of health data is becoming important to optimize resources and enhance quality of care and health outcomes (Abidi 2019).

The objective of this paper is to give an insight of artificial intelligence's main methods and applications in the field of healthcare. As well as to discuss its limitations and challenges

## 2 METHODS

A search was conducted on PubMed database. Results were reviewed for articles published between January 1st, 2016 and June 30th 2021.

Search terms included "artificial intelligence", "machine learning", "Supervised Machine Learning", «Unsupervised Machine Learning», "healthcare" and "Delivery of Health Care"

We proceeded in 2 ways

- We searched first publications about the use of any method of AI in healthcare using the query ("Artificial intelligence" AND healthcare). The articles obtained by this request were all included in the analysis,
- Then research has been launched specifically on the use of machine learning in healthcare using the query ("Machine Learning"[Mesh] OR "Unsupervised Machine Learning"[Mesh] OR "Supervised Machine Learning"[Mesh] AND "Delivery of Health Care"[Mesh]). In this stage of the search, only original articles that focused on the development or validation of an ML model in health were included.

Otherwise, there were no additional exclusion criteria

## 3 RESULTS

Our review showed that the number of publications of the applications of AI methods in the healthcare is constantly increasing (figure 1.A). Almost half of publications was from USA (figure 1.C), and most of the publications were literature reviews, and clinical studies (figure 1.B). About 4% of publications were dedicated totally to discuss the ethical considerations of the use of AI in healthcare (figure 1.E).

About a half of publications explored the use of machine learning in healthcare (figure 1.D), which was used especially for prediction (36.9 %), to make a diagnosis (18 %), or for monitoring (9 %) (figure 2.A). The machine learning's algorithms most used were the random forest (29.6%), the regression logistic (27.8%), neural network (27.8%), SVM (20.4%), deep learning (20.4%), gradient boosting (18.5%), and the decision trees (18.5%) (figure 2.C). The machine learning was used in 15.6% of case to improve the health system management. It was used in 12.5% of cases to describe and to try to understand the population's psychosocial behaviors. In the clinical practice, it was mostly used in infectiology (15.6%). (figure 2.B).

## 4 DISCUSSION

Our literature review showed that AI is a booming field that keeps motivating researchers to explore it. However, the proportion of publications attributed to the African continent is low. Majors disease areas that use AI tools include infectiology (our finding), cancer, neurology, cardiology and diabetes. (Sivakumaran 2018)

AI is frequently used for prediction. It can be applied to predict a health state, like as population's risk

of particular diseases or accidents (Potash et al. 2020) (Reddy, Fox, et Purohit 2019), or the people's perception of an event (Eder et al. 2021). it also used to predict the need of equipment, and the risk in the hospital setting (Spangler et al. 2019) (Chen et Decary 2020), the cost of a health service (Muremyi et al. 2020).

AI methods are also frequently used to diagnose and treat a disease. Many of these findings are based on radiological image analysis,12 though some involve other types of images such as retinal scanning13 or genomic-based precision medicine.14 (Chen et Decary 2020).

AI methods can as well have potential to help personalize treatment decisions. Studies showed how a decision-making support based on AI methods could recommend alternative treatments, and refine treatment plans whenever new information was received 32 (Reddy, Fox, et Purohit 2019). However,

the personalized treatment faces several challenges, which can refer to the accuracy of the clinical diagnosis, the uncertainty of the paramedical diagnosis based on ultrasound, tomodensitometry, anatomopathological or other examinations. the advances of AI methods to analyze these different informations will make individual medical strategies possible (L.-R. Li et al. 2020).

The use of AI techniques for monitoring patients allows to have details on patients' sleep patterns, blood pressure, heart rate, medication behavior, and other parameters (Ramesh et al. 2004) (Roh et al. 2021) (Reddy, Fox, et Purohit 2019) (Saria 2014). The intelligent rehabilitation assistant system which could record exercise details has also great relevance. it might be used to evaluate the quality and adherence to the prescribed exercise to the fragile group of patients. (Z. Li et al. 2020)

In Covid 19 era, it was showed that Social robots may assist Healthcare professionals by interviewing older adults for assessments of important health status measures (Boumans et al. 2019). Robots were also successfully used for Locomotor Training After Spinal Cord Injury (Ehrlich-Jones et al. 2021)

In view of the ageing society and the high costs of support and care in private households, the question arises as to what role assistive robots can play. in Germany there is already a significant minority of people who would accept nursing care robots as long as they do not replace but rather support traditional human nursing (Rebitschek et Wagner 2020)

In other hand, AI has been used for syndromic surveillance to spot emergence of disease outbreaks<sup>41</sup> (Reddy, Fox, et Purohit 2019). It's methods can be used in disease's screening as demonstrated by Hyunwoo, who suggest that patient-generated health data from a mHealth app could be a complementary tool for influenza screening (Choo et al. 2020). Xie (Xie et al. 2020) has shown in his paper that deep learning is an effective, and least expensive as human in detecting diabetic retinopathy from fundus photographs.

AI has been shown to be a good approach to automate and improve healthcare delivery and to support healthcare administration. It helps to reduce the administrative requirements<sup>24</sup> (Reddy, Fox, et Purohit 2019), by automating repetitive tasks. It can also enable the management of appointments, allowing to better manage urgent cases and to minimize waiting time (Reddy, Fox, et Purohit 2019) (Chong et al. 2020). It can be used to improve hospital management by predicting the length of stay; and inpatient costs (Karnuta et al. 2020). In the era of Covid 19, Robots have the potential to be

deployed for disinfection, delivering medications and food, measuring vital signs, and assisting border controls to improve efficiency of public health services (Yang et al. 2020).

Certainly, AI promises a colossal change in healthcare. However, the ethical challenges have frequently been an area of debate (Noorbakhsh-Sabet et al. 2019). The challenges that need to be raised concerning algorithm validation, interoperability, bias translation, security, and patient privacy protections (Safdar, Banja, et Meltzer 2020)

AI systems in healthcare may be subject to algorithmic bias (T. Davenport et Kalakota 2019). when the training data are biased by the prejudices and by the variables in the prediction models chosen by the designers. The algorithm therefore tends to reproduce, or even reinforce, these same biases. (inserm 2018) (T. H. Davenport et Keith J. Dreyer 2018) (T. Davenport et Kalakota 2019). Therefore, the use of those systems to make health care decisions rises questions about the responsibility for those decisions and about errors made in patient diagnosis and treatment (T. Davenport et Kalakota 2019). Intelligent systems are like a black box, unable to justify its decisions (inserm 2018)

Elseways, the patient-doctor relationship can be changed. For example, the elderly's assistant robot, used to imitate and to interact with humans, rise a lot of ethical problems, in particular the problems about the protection of private life and Personal data (inserm 2018). Also, patients feel more confident when receiving information from a human than from an intelligent system. (T. Davenport et Kalakota 2019)

## 5 CHALLENGES AND CONCLUSION

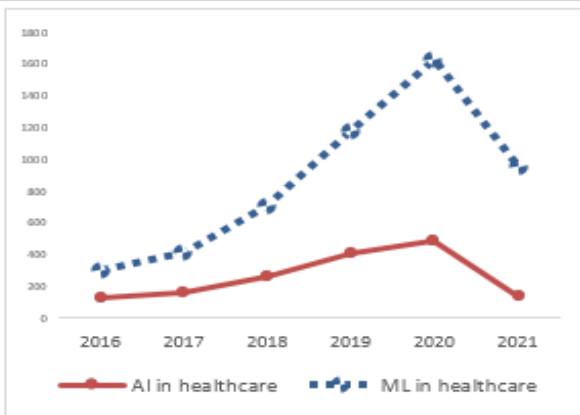
The development and usefulness of technologies are not up for discussion. However, the most important challenge is to ensure their adoption in daily clinical practice. For that, These systems must be combined with patient data and integrated into electronic health records (EHR) (T. Davenport et Kalakota 2019) (Ahmed et al. 2020).

Also, scientists and researchers from fields such as biomedical science, psychology, ethics, economics, law and policy need to be involved in the development of AI systems to create procedures to monitor technological developments, to define norms and identify the acceptable and safe behavior for AI utilized in healthcare domain, thereby to ensure that the AI future impact is more positive than negative (Keskinbora 2019) (Francesca 2016)

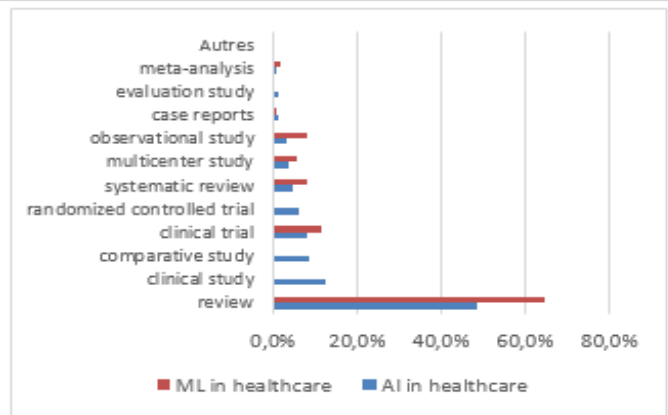
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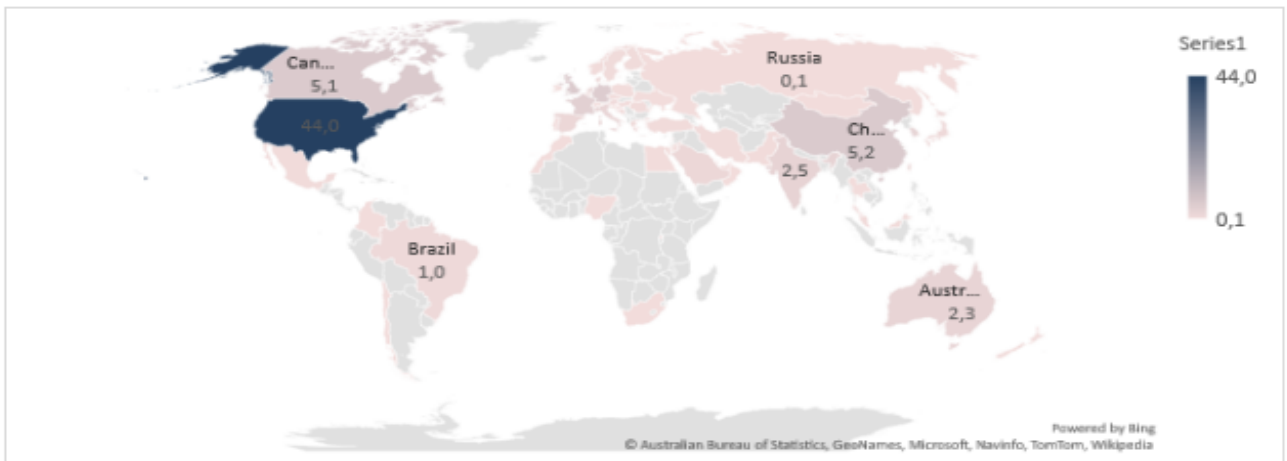
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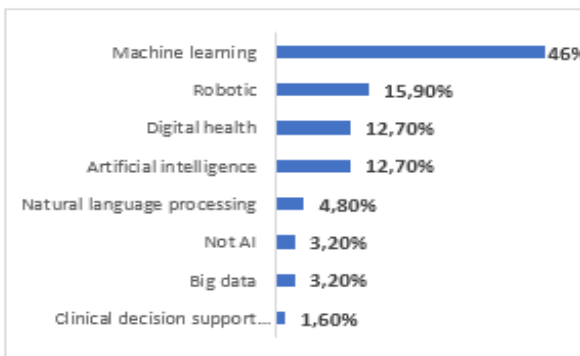
A: Number of publications about the use of the artificial intelligence and the machine learning in healthcare



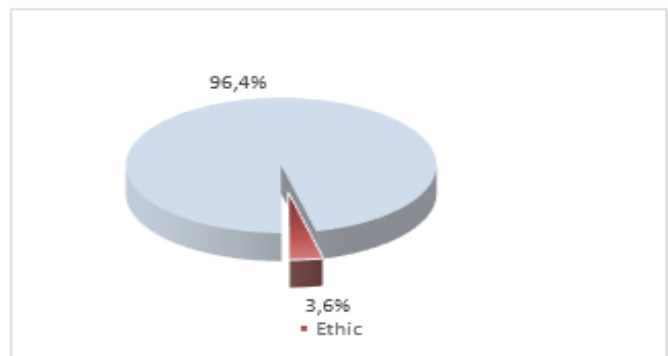
B: Number of publications by type, responding to our two queries



C: Number of publications of AI & ML in healthcare by country

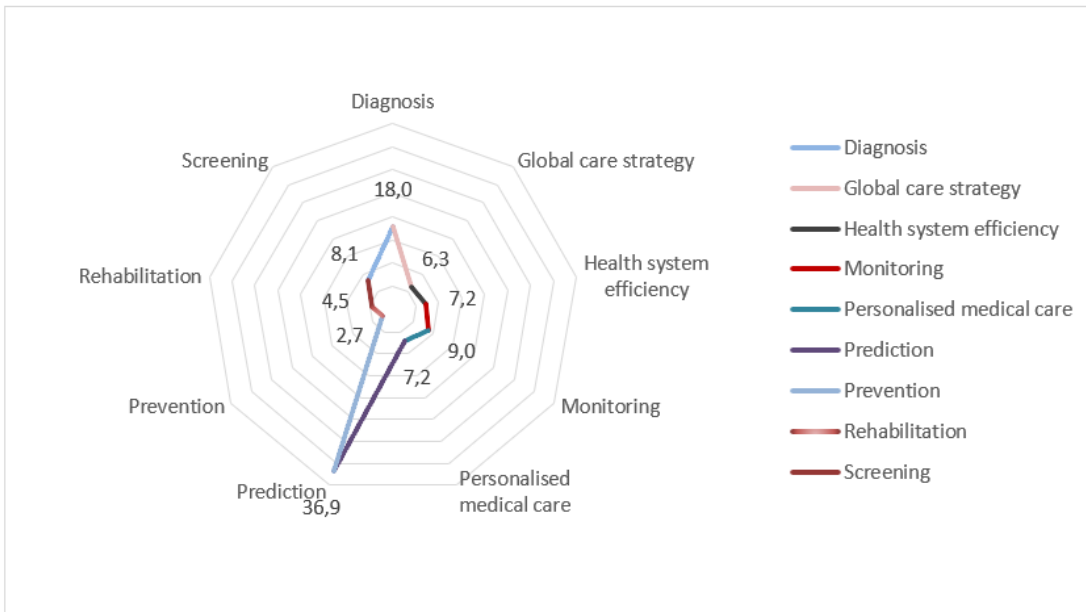


D: Methods of AI frequently used in healthcare

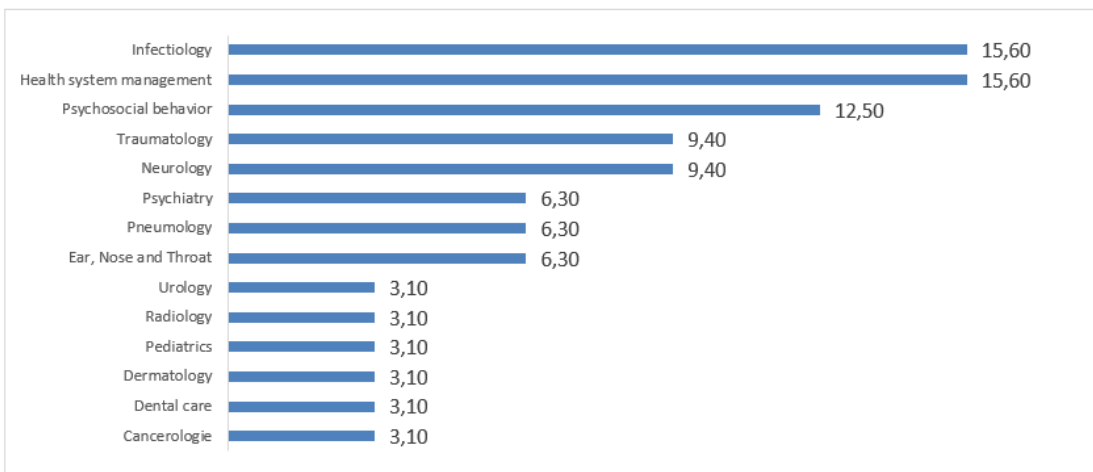


E: The proportion of articles dedicated totally to ethics of AI use

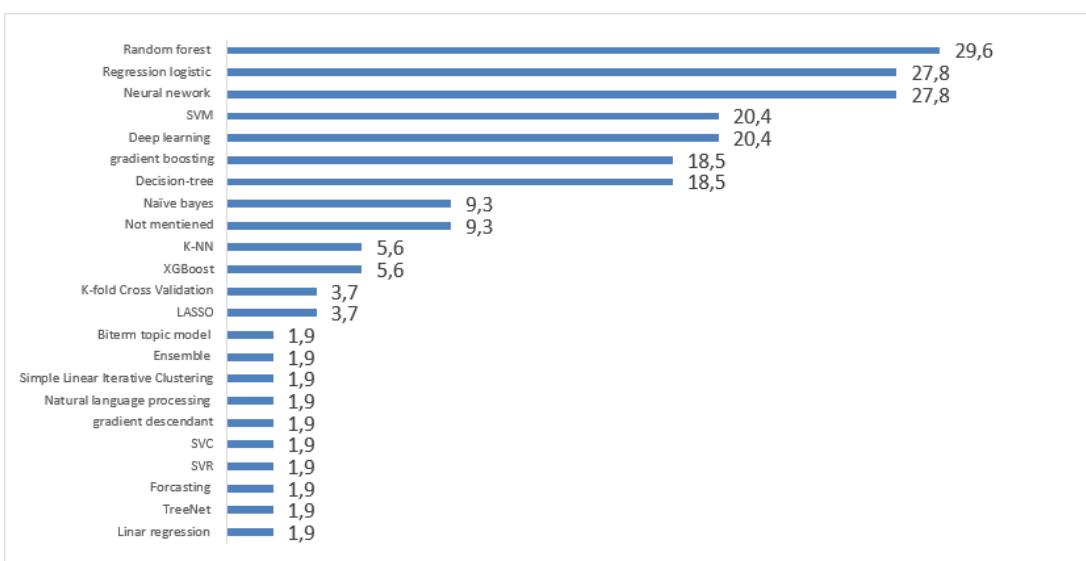
Figure 1: Distribution of publications on the application of AI in healthcare



A: Domains of application of AI & ML in healthcare



B: Publication in AI & ML in healthcare according to the specialty



C: Machine learning's algorithms used in healthcare

Figure 2: main AI's methods used in healthcare, and main areas of healthcare where AI is applicable