

## EMBRACING ARTIFICIAL INTELLIGENCE FOR IMPROVED COMMUNITY HEALTH CARE

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The world population of approximately 7 billion people has millions of intelligent minds that grapple with constant immensely difficult challenges such as unemployment, epidemics, overpopulation, insecurity, pollution, famine and data overload. It is clear that these problems are here to stay despite many innovative approaches to try and solve them. The need is now apparent for a fresh look at human-computer augmented approaches to create more effective, accurate, affordable and accessible solutions. The aim of this literature review is to highlight artificial intelligence in community health care as a workable approach in achieving improved healthcare within communities. It objectively looks at: current use of artificial intelligence in health prevention, successful community health interventions that have used artificial intelligence and community health monitoring by use of artificial intelligence. This is a review of information drawn mainly from primary sources including research articles, seminar videos and blog posts. The review reveals that artificial intelligence now serves a purpose in health monitoring, consultation and treatment through various mobile applications that deliver instant feedback on health related issues. Major organizations such as Dimagi have used and distributed AI built software and devices to many communities around the world especially Africa. The success using artificial intelligence has achieved positive results in maintaining proper healthcare within remote communities, hence enabling awareness and providing skills and knowledge to those affected. The integration of artificial intelligence and medical tools is the way to go.

**Keywords:** Artificial intelligence, community health, e-health, health monitoring

### Introduction and Literature Review

Artificial Intelligence (AI) can simply be termed as the process of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience (Copeland, 2017). Big artificial intelligence related corporations such as Google and International Business Machines (IBM) have been involved in infusing AI into the health sector through new inventions and technologies. Major AI health related projects include Google's Deepmind Health (Deepmind Health, 2017) and the creation of the IBM Watson (Watson, 2017).

Google's DeepMind platform is being used by the United Kingdom's National Health Service (NHS) to detect certain health risks through data collected via a mobile app. Its second project with the NHS involves analysis of medical images collected from NHS patients to develop computer vision algorithms to detect cancerous tissues (DeepMind Health, 2017) while the IBM Watson was created to understand all forms of data, interact naturally with people through human-machine augmentation, learn and reason

(Watson, 2017). AI carries four major aspects:

- i. Understand - analysis and interpretation of all your data, including unstructured text, images, audio and video.
- ii. Reason - providing personalized recommendations by understanding a user's personality, tone, and emotion.
- iii. Learn - utilizing machine learning to grow the subject matter expertise in your apps and systems.
- iv. Interact - creating chat bots that can engage in dialogue.

Artificial intelligence can also be defined as “the science and engineering of creating intelligent computer systems that are able to perform tasks without receiving instructions directly from humans” (PwC, 2017, p. 1). A good example of course is the IBM Watson mentioned earlier. Different algorithms, decision-making capabilities and immense data are used by these computer systems to provide a solution or response to a request. There is potential to link data collected via applications and social media with remote patient monitoring, Electronic Health Records (EHRs) and genomics, and aggregate it into 'Predictive



and Prescriptive Analytics' to calculate future activities and model scenarios using simulation and forecasting. This extends the capability to do something about possible future health events eventually leading to the true personalisation of healthcare (PwC, 2017). "The rapid commercialization of machine learning and big data has helped bring AI to the forefront of healthcare and life sciences and is set to change how the industry diagnoses and treats disease" (Kite-Powell, 2017, p. 1).

In order to improve efficiency of treatments and avoid costs by minimizing the risks of false diagnosis, it is important to integrate Artificial Intelligence tools in everyday medical applications. This facilitates more targeted pre-operative planning and reduces the risk of intra-operative complications (Kannan, 2017).

### **Statement of the Problem: Accessibility and Affordability of AI Services**

According to the World Health Organization (WHO), 1.7 billion people globally still lack access to essential medicines and basic health services. Statistics also show that 4.5 million children under the age of five still die annually, and HIV claims 1.2 million lives a year. Traditional development projects have made little headway in reaching those living at the most extreme levels of poverty. Infrastructure in remote villages and slums is scattered, resources are limited, and doctors and nurses are few and far between (Milkowska, 2017). The infrastructural and human resource challenges led to Milkowska's (2017, p. 1) emphasis that "One small mobile for man. One giant leap for healthcare", she went on to further state that "We clearly need a different approach that will help us close that delivery gap", that is, making these assets accessible in undeserved and remote areas.

Healthcare provision has not yet been made global to a point where everyone has access to affordable quality health services, but it is yet to be witnessed. According to a WHO and World Bank Group report, 400 million people still go without access to essential healthcare (Rapolu, 2016). For the lucky, access to healthcare is a given (it's there when needed), just as any basic human requirement should be.

A research conducted by PricewaterhouseCoopers (PwC) based on a commissioned survey of over 11,000 people from 12 countries across Europe, the Middle East and Africa showed that across the region, more than half of respondents (55%) said they

were willing to use advanced computer technology or robots with AI that can answer health questions, perform tests, make a diagnosis and recommend treatment (PwC, 2017).

Three main themes emerged from the literature:

- Patients are increasingly willing to engage with AI and robots if it means better access to healthcare
- Speed and accuracy of diagnosis and treatment is a critical factor for this willingness
- Trust in the technology is vital for wider use and adoption; the 'human touch' remains a key component of the healthcare experience.

### **Purpose and Objectives**

This review therefore explores artificial intelligence as a workable approach at the community level in achieving improved healthcare within communities.

The specific objectives of the review include:

1. To determine current use of artificial intelligence in health prevention
2. To identify successful community health interventions that have used artificial intelligence
3. To outline ways of community health monitoring using artificial intelligence (at individual and communal levels)
4. To suggest a way forward for the use of artificial intelligence for community health improvement

### **Methodology**

This is a review which explores artificial intelligence in community health care as an approach in achieving improved healthcare at the community level. This is a review of information drawn mainly from primary sources including research articles, seminar videos and blog posts and are obtained in databases such as Web of Science, YouTube, and Google Scholarly Combinations of terms were used to find resources related to Artificial Intelligence and health care. Search words included: Artificial Intelligence, Healthcare, Artificial intelligence health prevention, Community Health, Health Monitoring.

A search that involved reading the title of each paper, project report in different publication archives

was conducted to find relevant papers. The reference lists of the articles and reports in the selected publications were scanned to obtain a wide variety of research evidence. Citations in seminar presentations and videos were also consulted. Out of the more than 500 hits, 20 sources were found the most relevant and have all been appropriately cited.

Data from the literature sources were organized using an annotated bibliography format and content analysis was done. Information from more than five years ago were used as historical data; otherwise more recent data was used to obtain the most current information on the status of artificial intelligence in community health care. Information from seminars and videos were also analysed and incorporated.

## Results

### Current Use of Artificial Intelligence in Health Prevention

Mobile Applications: Major AI mobile application platforms today include Fitbit, AiCure, Babylon and Your.MD, among others.

#### AiCure

Artificial Intelligence can now confirm the intake of pills. A company in the US called AiCure uses artificial intelligence on patient's mobile devices to confirm medication ingestion in clinical trials and high-risk populations. "AiCure's HIPAA - compliant software captures and analyses evidence of medication ingestion. A smart-phone's camera is used to understand whether patients took the medication correctly" (AiCure, 2016, p. 1).

AiCure uses real time data that is centralized to track medication adherence normals. Research has found that poor therapeutic outcomes, disease outcomes, high monetary health cost are a result of non-adherence to prescribed medications. What healthcare professionals need to do now is educate (themselves) and patients on how to use the software using their smart-phones (Verel, 2014).

#### Babylon

The UK is on a mission to change the way a patient interacts with a doctor through the creation of an artificial intelligence (AI) doctor in the form of an

AI chatbot. Babylon Health raised close to 60 million dollars in April 2017 to diagnose illnesses with an AI chatbot on your smartphone (Kite-Powell, 2017).

AI on-line consultations are part of the bigger picture towards efficiency and effectiveness in healthcare. You have a headache, you feel dizzy and you are sure that you have a fever. Your partner tells you that you do not look great, you should go to the doctor. So, you call to ask for an appointment. It turns out you have to wait two more days to get the chance for a visit. The British subscription, on-line medical consultation and health service, Babylon, launched an application this year which offers medical artificial intelligence consultation based on personal medical history and common medical knowledge (Babylon Health, 2016).

Babylon's main aim is to alter healthcare by putting an accessible and affordable health service into the hands of every person on earth. It takes users or patient symptoms input using speech recognition and matches them against a database of diseases taking into account the patient's history and circumstances. Just like AiCure application, Babylon reminds patients to take medication and follows up on the patients' conditions (Babylon Health, 2016). This increases efficiency in patient diagnosis and saves time. Babylon delivers primary health care through a mobile application, by:

- i. providing an artificially intelligent chat-bot 'virtual doctor' to analyse symptoms and offer medical advice
- ii. allowing patients to book their doctor appointments on-line.
- iii. putting patients quickly in contact with doctors via video or voice consultation.
- iv. ensuring quick delivery of medication via the application to pharmacies selected by the patient OR delivered direct to their home or office
- v. supplying self test kits for an increasing range of clinical tests, such as blood and saliva, with results processed and displayed in-app within 24 hours
- vi. self-health monitoring, connecting to over 150 wearable and Internet of Things (IoT) devices to track performance over time
- vii. providing full service transparency by allowing users to provide "star rating" feedback of their experience
- viii. providing prescriptions and referrals into

appropriate services where required.

## Your.MD

Your.MD, the company behind the world's first Artificial Intelligence (AI) Personal Health Assistant, typifies a new approach to mobile health (Marginalia, 2016). It is intelligent, personalised and gets cleverer as it reaps data from its users.

Your.MD achieves to improve the way we seek health related issues such as self-diagnosis information. It is a smart health assistant application (powered by AI and machine learning) that gives immediate feedback on your symptoms. Your.MD aims to more efficiently provide necessary information about your medical conditions, possible causes and what steps you should take to remedy your illness, including, of course, when to see a doctor (O'Hear, 2015).

## Community Health Interventions that Have Used Artificial Intelligence

Many more corporations have engaged in the race to make problem solving in health more prosperous.

## Health Assistance and Medication Adherence through Mobile Healthcare AI Applications

The Babylon service was founded in January 2013 and released to the public in April 2014. It now covers over 650,000 people worldwide. It's major operating stations are located in the United Kingdom, Ireland and Rwanda preceded by an East Africa launch. A number of leading health insurance providers including Bupa and Aviva and over 120 companies have also partnered with Babylon to offer its services to their employees as part of their benefits packages.

Babylon partnered with the Government of Rwanda in July 2016 as a way of promoting cultural awareness to give Rwandese one of the most progressive solutions the world has ever seen through the 'babyl' app. This provided users with health information, prescriptions and video consultations via smartphones. Babylon has recently witnessed over 300,000 registered users and has completed over 80,000 consultations (Curda, 2017).

On the other hand, Africans living where internet access may be less affordable and healthcare

professionals less readily available will now have access to highly personal, NHS clinically certified and trustworthy health information, thanks to OneStop Health. This will be possible through Your.MD application which uses AI to provide fully personalised information, guidance and recommendations on next steps, alongside OneStops's network of trusted health service providers and products.

As a flagship company of an emerging healthcare sector, pre-primary care, Your.MD aims to reduce the burden on NHS by assisting people in self-caring via AI and mobile technology. Your.MD's strategy is to deliver pre-primary care (personalised, trustworthy and actionable health information) to everyone (Marginalia, 2016).

## Corporations

A World Bank grantee by the name Dimagi is a good example of a company that is trying to close the 'delivery gap'. Founded in 2002, Dimagi provides community health workers with customized mobile-based applications that run on inexpensive phones. Provision of basic diagnostics and counselling tutorials are included in the mobile applications to guide these front-line workers. CommCare (Dimagi's platform) has been used in over 50 countries by partners ranging from Bill & Melinda Gates Foundation and USAID to Google, Microsoft, and General Electric.

There are other countless examples of social enterprises apart from Dimagi effectively using health technology in low-income contexts. Other enterprises include; Magpi which monitors disease outbreaks, MeraDoctor that supports diagnostics, SMS for Life which majors in pharmaceutical supply chain management or Sproxil that supports counterfeit medicine prevention. Through SMS, verification of authenticity of medicines can be achieved in countries such as India, Nigeria and Mexico (Milkowska, 2017).

New AI applications will tragically improve the inefficient healthcare industry such as a startup call Qventus which uses AI to take all data flowing through a hospital to learn how to free up doctors and nurses to see more patients and improve results or outcomes (Maney, 2017).

## Discussion

"Although success behind these organizations lies in careful customization, smart implementation,

and an innovative business model, technology can and often does bring extraordinary benefits” (Milkowska, 2017, p. 1).

It can enable:

- i. Access to populations in remote areas,
- ii. Cost reduction and economies of scale,
- iii. HR management and deskilling – leverage lower skills labour to deliver higher quality services,
- iv. Closer feedback loops through better data tracking, and even
- v. Behaviour change and treatment compliance support.

### Community Health Monitoring Using Artificial Intelligence

**Wearable health.** Fitbit is a famous health tracking company that provides wearable artificial intelligence devices that keep track of an individual’s health, through heart rates, sleep, exercise, food intake and so on. According to Borukhovich (2015), this monitoring platform connected to artificial intelligence and machine learning capabilities, and the way we take care of patients in the future could significantly change. Many upcoming algorithms will know enough about the user and her biometrics in a steady state to be able to recognize patterns and opportunities to improve user health and fitness.

*Fitbit* is arguably the most well-known fitness tracker brand, but there are other companies that are involved in health monitoring. *Pebble* and *Pebble steel* mainly focuses on sleep activity. *Withings* tracks activities like steps, elevation, distance, running, and calories burned. It also tracks sleep, and even supports real-time coaching through the *Health Mate* application. *Garmin Vivofit* has a notable feature, their “move bar,” a bar that shows up after you have been inactive for an hour (Stables, 2017). *Jawbone UP* tracks steps, exercise, overall calories burned, hours slept and quality of sleep. You can also use the *UP App*’s food score capability to judge the balance of your food, drink, calories, and nutrient intake. It also has a similar form and profile to the *Fitbit* line. *Jaybird* tracks your sleep patterns, and helps suggest when you should sleep so that you can have the energy to tackle tomorrow’s troubles. *Misfit Shine* can be used to monitor sleep, as well as common activities like walking, running, swimming, cycling, soccer, tennis, or basketball (Miller, 2015). *The Samsung Galaxy Gear Fit* allows you

to quickly respond to notifications and track your heart rate. Lastly, *adidas miCoach Fit Smart* also offers heart rate monitoring. The only difference between the adidas and samsung product is that adidas offers continuous heart rate monitoring (Stables, 2017).

“Internet of Things is one of the biggest - and least credited - enablers of AI. Wearables are gradually becoming more commonplace. These gadgets produce a wealth of data about their owners” (Dickson, 2017, p. 1).

The information that health-monitoring wearables collect, once advanced to medical-grade solutions, and what that information can connect to for more in-depth personal health records, is the next frontier for wearable health monitoring technology.

### Ethical Standards

If artificial intelligence is to stand any chance at revolutionizing the health sector, some form of ethical standards need to be set. We need the following preparations to avoid the pitfalls of the utilization of AI: Creation of ethical standards which are applicable to and obligatory for the whole healthcare sector. Gradual development of AI in order to give some time for mapping of the possible downsides. This will enable a bland day-to-day operation and an increase in understanding of artificial intelligence control. For medical professionals: acquirement of basic knowledge about how AI works in a medical setting in order to understand how such solutions might help them in their everyday job.

For patients: getting accustomed to artificial intelligence and discovering its benefits for themselves – e.g. with the help of *Cognitoys* which support the cognitive development of small children with the help of AI in a fun and gentle way or with such services as *Siri* (A smart-phone voice assistant).

For companies developing AI solutions (such as *IBM*): even more communication towards the general public about the potential advantages and risks of using AI in medicine.

For decision-makers at healthcare institutions: doing all the necessary steps to be able to measure the success and the effectiveness of the system. It is also important to push companies towards offering affordable AI-solutions, since it is the only way to bring the promise of science fiction into reality and turn AI into the stethoscope of the 21st century (Vanity Fair, 2014).

## Conclusion and Recommendations

Globally and especially in poor countries and remote settings, health indicators suggest that there is need for innovations for improved healthcare. Solutions are being sought for more accessible, cheaper ways to improve health and health-care. Artificial intelligence is the way to go, whether in consultation, treatment or monitoring. There is need for further research for scaling up the use of the available applications and their effectiveness.

The first glimmers of AI in healthcare are being experienced today but alot more lies ahead. We're closing in at an accelerating pace. Some people may trust that only a human being can take care of another and they are not wrong at all. Artificial intelligence is proving to be an important assistant to healthcare professionals such as doctors, not a replacement. What does the future hold?

### Way Forward for the Use of Artificial Intelligence for Community Health Improvement

There is need for better awareness of the available applications. The information that health-monitoring wearables collect, once advanced to medical-grade solutions, and what that information can connect to for more in-depth personal health records, is the next frontier for wearable health monitoring technology.

Further research into ways of educating the public on the use of the available applications and on the effectiveness and impact of AI in healthcare. For practicality while these mobile applications use internet, they should come with cheap phone without internet connected to a central database otherwise they may not be useful in remote areas.

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