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RESEARCH ARTICLE

USING TECHNOLOGY TO EMPOWER RURAL HEALTHCARE IN INDIA

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ABSTRACT

Although being one of the most populous countries, the public healthcare system in India operates at a dismal ratio of 0.08 doctors for every 1000 people. As of 2020, Data shows that only nine among India's 28 states meet the World Health Organization (WHO) recommendation of a 1:1000 doctor-population ratio. With the country's present policies to tackle the issue receiving staunch opposition from Medical practitioners, out of the box ideas are the need of the hour to sustain the healthcare system. India possesses a strong rural healthcare infrastructure in the form of trained non-medical healthcare workers such as "dais" and "village health guides", and with the rise of cheap technology it would be apt to empower these workers with the same. In this article, we briefly describe a cheap, affordable, indigenously built Electrocardiography (ECG) machine and how the healthcare workers could be taught to use it to detect impending myocardial infarctions and to decide on timely higher centre referrals. We further provide plans to expand this system to detect and prevent dehydration in young children through the use of Artificial Intelligence; Thus assisting these healthcare workers to be more astute and also aid as a redundancy tool to detect and prevent clinician errors. It is high time a growing economy like India capitalise on the recent advancements in technology and medicine to rescue its burdened healthcare system.

INTRODUCTION

Although being one of the most populous countries, the public healthcare system in India operates at a dismal ratio of 0.08 doctors for every 1000 people (1). As of 2020, Data shows that only nine among India's 28 states meet the World Health Organization (WHO) recommendation of a 1:1000 doctor-population ratio. What this entails is that the Healthcare system in the country is overburdened, which poses a risk to the ailing patients, and also indirectly affects the healthcare professional's lives too. While the government has acknowledged this burden, the steps taken by it to resolve the issue have been questionable. A gazette notification by the Central Council of Indian Medicine (CCIM)(2), a Ministry of AYUSH statutory body, formally authorised postgraduate students of certain 'streams' of Ayurvedic study to perform 58 surgical procedures (including various excisions, drainages and -ectomies;) This has received staunch opposition from multiple institutes and bodies, notable of which being Indian Medical Association(IMA) which represents a

majority of Allopathic Medicine practitioners' doubting the competency and training of alternative medicine practitioners. In this paper, we propose another take on the issue- to use present available technology to aid and improve on the available skillset at the rural level. **Empowering rural healthcare with urban tools:** India, as a country, has already invested in a vast healthcare infrastructure for its rural areas that includes Dais and Village Health Guides- trained non medical staff who dispense basic healthcare to the poorest of the nation's population. They, though, are not well equipped at diagnosing and differentiating complex health issues such as a Myocardial Infarction from simple gastritis, or recognising dehydration in a child before it progresses to shock. A lot many of health conditions could be prevented from worsening by early detection and intervention.

Technology has always represented empowerment. We propose a system of cheap, reliable and versatile electronic tools that could aid these healthcare workers to improve on rural health. India has a high cardiovascular disease burden, and with early detection and treatment

providing significant improvement in morbidities could be gained (3)(4). Using a cheap AD8232 ECG module (7\$) along with an Arduino microcontroller board(\$5), the author has worked on building a simple prototype that wirelessly transmits ECG data from three leads connected to the chest to any smartphone running the Android Platform. The AD8232 ECG module senses the electrical potentials from the subjects chest via three electrodes and through the Arduino microcontroller transmits it to a smartphone connected using an HM-10 bluetooth wireless module(\$2.8).

An app on the smartphone then filters and formats the raw data to output a clean readable ECG record. Keeping in mind the paucity of electricity in Indian villages, the author's system runs off a standard rechargeable USB powerbank (\$5), and fits in a traditional backpack. Doctors in remote peripheries could use the lightweight portable system to record and self analyse ECGs for patients presenting with lightheadedness or chest pain- to rule out arrhythmias and myocardial infarctions. Being an Android app based system, Healthcare workers untrained in ECGs need only to place the electrode leads at the appropriate places on the patient's chest and then may whatsapp or email the record to a qualified doctor sitting miles away who could aid in interpreting the readout. This system would allow significant "missed" diagnoses by bringing reliable diagnostic tools to the masses.

With the advancements in Artificial Intelligence, we also propose that the system being software based for it's analysis, a lot many modem smartphones would have the computing capacity to provide automatic AI driven arrhythmia detection which could prevent missed diagnosis' by untrained doctors (the majority in rural peripheries being passed out graduates with no cardiology or ECG specialization) (5)(6)(7). Furthermore, the author believes that the system could be used and expanded further with cheap sensors such as a temperature sensor(\$3.5 for an arduino temperature module), an accelerometer(2\$) and a gyroscope(2\$) to detect dehydration in a subject(8).

The heart is very sensitive to changes in posture in a volume depleted state, the heart rate increasing from the supine to the standing position. An AI system could detect the change in heartrate during repeated supine-standing manoeuvres to predict the amount of dehydration and suggest appropriate interventions for the patient on the smartphone screen(such as prompt referral to a higher centre). Further development in Machine learning would aid in accuracy of such a system (9). The pediatric population is one of the most vulnerable to dehydration, most commonly due to rotaviral infections, and early detection of impending shock would significantly decrease the mortality burden in this vulnerable age group.(10)

CONCLUSION

Bringing together the current progress and research in electronics and healthcare, we have proposed early detection of arrhythmias, infarctions, dehydration and shock using a cost effective system all under \$30, with scope for further automation and diagnosis in the near future.

With significant advancements in the technological and AI field, it is high time that the government seize the opportunity to invest in a platform that would encompass the aforementioned technologies in a single smartphone based application to aid in improving the healthcare burden of the country. This system would not replace the healthcare professionals such as qualified doctors, but rather empower the present non-professional peripheral infrastructure and act as a redundancy tool to limit potential human error in healthcare.

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