

Rapid Communication

From Screening to Triaging, Timely Referral and Specialist Treatment: Striving for a Paradigm Shift in Cardiac Care for the Last-mile Population in Rajasthan, India

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ABSTRACT

ATOM (Accurate Tele-Electrocardiogram On Mobile), an innovation by CARDEA Labs, has the potential to revolutionize cardiac screening services for the vulnerable and marginalized population groups in developing countries. In order to provide cardiac screening services to the last-mile population, Wadhwani Initiative for Sustainable Healthcare (WISH), a non-government organization, implements ATOM screenings in six primary health centres of the state of Rajasthan in India.

This paper traces two cases of acute ST-elevation myocordial infarction that were successfully screened using ATOM and attempts to build a case for ATOM-driven cardiac care model for the remotest population of India.

Keywords: Primary healthcare; Cardiac screening; Health innovation; India; Electrocardiogram.

Background

Developing countries are witnessing an unabated increase in mortality attributable to cardiovascular diseases (CVD). The Global Burden of Disease study corroborates that age-standardized CVD death rate in India (282 per 100 000 population) is higher than the global average (233 per 100 000 population) [1]. CVD epidemic in India is particularly alarming owing to its accelerated buildup, the early age of disease onset, and the high case fatality rate. Markedly, CVD is the leading cause of death not only in urban but also in rural areas of India. In fact, socioeconomic gradients have reversed as the epidemic has progressed in India: tobacco use and low intake of fruits and vegetables are becoming increasingly prevalent among those from lower socioeconomic background. Also, base of the pyramid population in India usually do not have access to effective cardiac screening programmes or specialist cardiac services for individuals

screened positive, leading to poor outcomes in CVD in these populations [2]. The burden from the leading CVD in India—ischaemic heart disease and stroke—indicates the need for urgent policy and health system response appropriate for the situation in each state [3]. Investments in targeted CVD care programs as well as appropriate health policy measures are urgently needed if India is to minimize adverse consequences of CVD on health, well-being, financial risk protection, and economic growth [4]. Early diagnosis and treatment are crucial to ensure improved survival rates among patients of CVD. Specialist treatment should be initiated within the shortest period of time from the onset of symptoms (the golden hour). Transportation time to specialist hospital could vary from case to case, but the goal should be to keep total ischaemic time within 120 minutes. Notably, more than half the benefit achievable in the first hour is lost if reperfusion is delayed for more than 4-6 h after onset of symptoms in acute ST-elevation myocardial infarction (STEMI) patients [5]. Potential cardiac screening strategies include both resting and exercise electrocardiograms (ECG). ECG is an easily available, non-expensive, and non-invasive tool, which carries valuable information on electrophysiological properties of the heart. Resting ECG may show markers of unrecognized previous myocardial infarction, silent myocardial ischemia, and other cardiac abnormalities (such as left ventricular hypertrophy, bundle branch block, or arrhythmias) that may be associated with CVD or may predict future CVD events [6]. Unfortunately, as per the existing guidelines of the Government of India, ECG facility is not available in primary health centres (PHCs) or below across the country [7].

ATOM (accurate tele-electrocardiogram on mobile), an innovation by CARDEA Labs, has the potential to revolutionize cardiac screening services for the vulnerable and marginalized population in developing countries. ATOM is an ECG device tailor-made for cardiac screenings in primary healthcare settings and in outreach camps in the remotest of the areas. ATOM can record a medical grade, 12-lead simultaneous ECG on any low-cost smart phone. It works on all variants of Android OS, including Oreo Android 8.0. It is a low-cost, portable, compact, and a battery-operated equipment. The ECG recording is done using pre-gelled surface electrodes. ECG leads are attached to the body while the patient lies flat on a bed. The entire test takes about five minutes. Seamless Bluetooth connectivity between the hardware and the mobile ensures uninterrupted transmission of the ECG PDF file recorded on ATOM app through messaging services such as Whatsapp or through emails to a cardiologist for immediate teleconsultation and appropriate cardiac care, as applicable. Figure 1 shows normal electrocardiogram of a patient using the ATOM device. The precursor technology behind ATOM has been field-validated for diagnostic accuracy and patient safety in rural India [8]. In order to provide cardiac screening services to the last-mile population, Wadhwani Initiative for Sustainable Healthcare (WISH) , a non-government organization, implements ATOM screenings in six PHCs of the state of Rajasthan in India. These PHCs situated in villages Kotradeep, Barod, Chachhalao, Bhadoti, Odda, and Durgari are run by WISH under a public private partnership model with the Government of Rajasthan. The CARDEA project is supported by funds from Biotechnology Industry Research Assistance Council (BIRAC), Department of Biotechnology (DBT), Government of India.

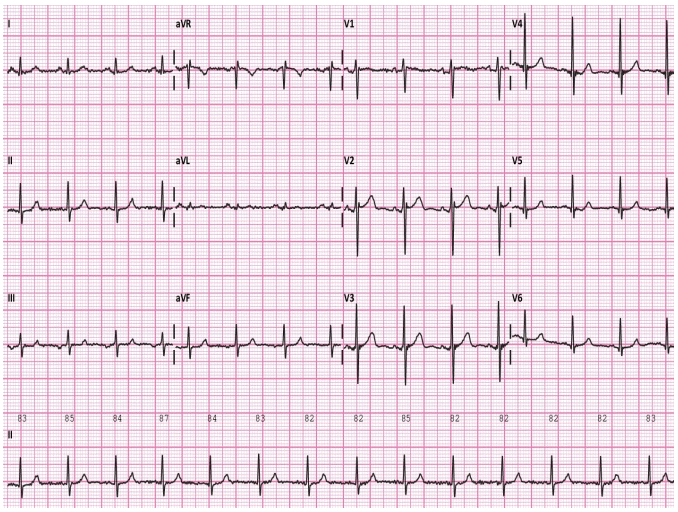

Figure 1: Showing normal electrocardiogram of a patient using **the ATOM (accurate tele-electrocardiogram on mobile) device**.

The cardiac screenings using ATOM were initiated in these PHCs from August 2018 onward. Patients who visit the PHCs and who are advised ECG by the attending medical doctor based on comprehensive history taking and thorough clinical examination undergo ECG using ATOM at respective PHCs by a trained auxiliary nurse midwife (ANM) under supervision of the medical doctor. The PDF file of each ECG recorded on the ATOM app is transmitted through a messaging service (Whatsapp) to a pre-identified cardiologist for immediate teleconsultation. Based on the interpretation of the ECG by the cardiologist through teleconsultation, subsequent clinical management of each patient is planned. A triage strategy is used to classify all these patients into three groups: first group that can be optimally managed by the medical doctor at the PHC itself, the other that has been advised a two-dimensional echocardiography (2-D ECHO) by the cardiologist for further cardiac workup, and the third group that is at high risk and needs immediate specialist cardiac treatment. Those patients, who are advised 2-D ECHO, are referred to the nearest district hospital for further cardiac workup. Patients in the third group are promptly transported to the nearest specialist cardiac care centre after providing emergency medical care as advised by the cardiologist through teleconsultation (e.g., 300 mg aspirin to be chewed, etc.). So far, more than 425 patients have been screened using ATOM in these PHCs, out of which 49 patients (11.5%) have been diagnosed of suspected CVD and have been advised 2-D ECHO. This is approximately in alignment with the current CVD prevalence rate in rural India [2]. Out of these 49 patients, two patients fell in the high-risk group with provisional diagnosis of acute STEMI. This paper traces these two cases from a public health perspective and attempts to build a case for ATOM-driven cardiac care model for the remotest population of India.

The Case Reports

First case was a 64 y old man who visited PHC Barod, District Kota, Rajasthan with chief complaint of sudden-onset chest pain. His past medical history was unremarkable. He was a non-drinker, an occasional smoker, and moderately active (between 30 to 60 minutes a week). He had a healthy body mass index of 21.3 kg/m^2. Pulse rate (88 beats per minute), respiratory rate (20 breaths per minute), and blood pressure (130/80 mm Hg) were measured and duly registered. He was advised by the attending medical doctor at the PHC to undergo ECG. The same was performed by a trained ANM using ATOM and the ECG PDF file recorded on the ATOM app was sent through Whatsapp to a pre-identified cardiologist for immediate teleconsultation. Figure 2 shows ECG of this patient that was sent for teleconsultation and the cardiologist's interpretation, received at PHC Barod through Whatsapp, suggestive of acute anteroseptal myocardial infarction. As the patient was symptomatic, based on the advice of the cardiologist, treatment with 300 mg (150 mg × 2 tablets) non-enteric coated chewable aspirin was immediately initiated, and he was rushed in a medical ambulance to the nearest speciality cardiac care centre at Kota. Notably, the total time elapsed between the arrival of the patient at PHC Barod and the initiation of the treatment at the emergency department (ED) of the speciality hospital at Kota was around 4 h. In the ED, patient underwent a thorough cardiac workup and all the necessary diagnostic tests were performed. Markedly, a repeat ECG at the ED re-established the findings of the ATOM ECG done by the ANM at PHC Barod. Marked increase in serum creatine phosphokinase-MB (CPK-MB) and high-sensitive troponin I-137 IU/L and >40 000 ng/L, respectively-supported the diagnosis of acute STEMI [9]. 2-D ECHO showed ejection fraction of 30%. Finally, conventional coronary angiography was performed to confirm the diagnosis. The angiogram revealed 100% ostial stenosis of the left anterior descending coronary artery (LAD) and also 100% proximal stenosis of the second obtuse marginal (OM2) branch of the left circumflex coronary artery. Accordingly, immediate percutaneous transluminal coronary angioplasty (PTCA) with stents placement in LAD and OM2 was recommended for the patient. Unfortunately, PTCA could not be done on this patient as he was uninsured and was not in a position to pay for the PTCA intervention. Therefore, a non-invasive, conservative management strategy was planned for the patient. It embodied recommended therapy for acute STEMI (standard initial therapy, pharmacologic reperfusion therapy, and antithrombotic and antiplatelet therapies), as applicable, along with ancillary medical therapy and continuous, careful non-invasive monitoring of the patient. Patient was stabilized and eventually discharged four days later. He had his first follow-up visit seven days after discharge, and was found to be stable.

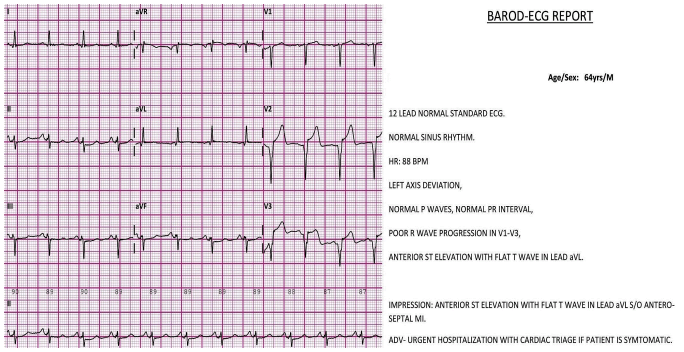

Figure 2: Showing electrocardiogram of the first patient that was sent for teleconsultation and the cardiologist's interpretation, received at PHC Barod through Whatsapp, suggestive of acute anteroseptal myocardial infarction.

Second case was that of a 70 y old man who visited PHC Dugari, District Bundi, Rajasthan with chief complaints of sudden-onset chest pain and breathlessness on exertion. The sequence of events was very similar to that of the first case. As in the first case, based on history and clinical examination by the attending medical officer at PHC Dugari, ECG was performed on the patient by ANM using ATOM. Figure 3 shows ECG of this patient that was sent for teleconsultation and the cardiologist's interpretation, received at PHC Dugari through Whatsapp, suggestive of acute inferior myocardial infarction. Treatment with 300 mg chewable aspirin was immediately initiated, and the patient was sent to the nearest speciality cardiac care centre at Bundi. A repeat ECG at the ED re-established the findings of the ATOM ECG done by the ANM at PHC Dugari. As patient was uninsured and could not pay for his treatment, even a coronary angiography could not be planned for this patient to confirm the diagnosis. Based on various non-invasive diagnostic tests, a provisional diagnosis of acute inferior wall myocardial infarction was arrived at. A non-invasive, conservative management strategy was planned for the patient. Patient was stabilized and eventually discharged three days later.

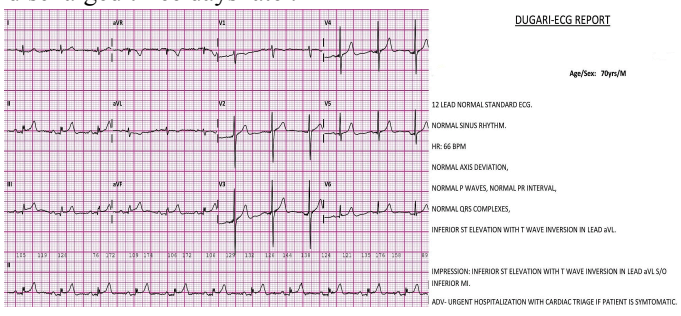

Figure 3: Showing electrocardiogram of the second patient that was sent for teleconsultation and the cardiologist's interpretation, received at PHC Dugari through Whatsapp, suggestive of acute inferior myocardial infarction.

The Way Forward

These case studies substantiate the effectiveness of ATOM in successfully screening high-risk cardiac patients at the last-mile in India. Existing literature corroborates the cost-effectiveness of an ECG-based doctor referral model, aimed at improving timely access to reperfusion at a specialist cardiac care unit, in terms of Quality Adjusted Life Years (QALYs) gained [10]. In fact, meagre cost is incurred for each QALY

gained out of ECG screening leading to early and appropriate referral of acute STEMI case to a hospital where thrombolysis can be administered [11]. The fact that ATOM screenings are being undertaken by WISH in the most remote parts of one of the less developed Empowered Action Group states of India would amplify the public health gains emerging out of such a cardiac care model.

However, the fact remains that the cardiac care loop could not be closed for these patients as both were uninsured and unable to afford the cost of the recommended treatment. Thus, thought needs to be given for what happens next after detecting a cardiac emergency in a primary healthcare setting. Financial implications associated with referrals for specialist cardiac treatment during the golden hour need to be addressed if we have to make a dent in tackling CVD and if screening models for CVD have to realistically contribute towards positive health and well-being of the last-mile population [12]. To this end, it is heartening to note that Government of India has recently launched the ambitious National Health Protection Mission, also referred to as Ayushman Bharat (which means "bless India with long healthy life"). This scheme has two main pillars: strengthening of universal comprehensive primary healthcare and a health insurance scheme to cover 500 million people in need to reduce catastrophic out-of-pocket health spending. Scheme will provide a cashless cover for identified secondary/tertiary treatments in public/empanelled private facilities without any cap on family size and age. All existing conditions will be covered from day one of the policy. The benefit cover will also include pre- and post-hospitalization expenses as well as transport allowance [13].

ATOM-driven cardiac care model has the potential to act as a catalyst for realizing the paradigm shift in cardiac care for the last-mile population in Rajasthan, India. In future, leveraging the transformational potential of health innovations such as ATOM, frontline health workers in India—accredited social health activists (ASHA), ANM, and anganwadi workers (AWW)—would play a pivotal role in screening and referring acute medical emergencies in the base of the pyramid population, thereby moving towards emergency-enabled primary healthcare services.

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