

Management of Non-Communicable Diseases Using Hand held Mobile Phone

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Abstract

Mobile is poised to play a significant role in healthcare...

In contrast to healthcare access, mobile access is becoming almost ubiquitous worldwide. Almost all developed markets already have mobile penetration greater than 100%. Mobile penetrations in Africa, Asia-Pacific and Latin America are also expected to increase to 82%, 98% and 119% respectively in 2014. Also, the increasing penetration of smartphones as well as the 3G and 4G networks will provide a significant boost to the use of the mobile platform for providing healthcare services.

Thus, the feasibility of mobile devices supporting healthcare is greater than ever before. Mobile health - the use of mobile communication and devices for providing healthcare services or achieving health outcomes - stands at a significant inflection point.

In India we have 900 million mobile phone users. Almost every family has one mobile set and hence tremendous potential to reach out in the remote area. The people are fairly well conversant with the use of mobile phone for call and messaging. The smart phone too is becoming popular. The IT enabled health related Mother and Child tracking system (MCTS) is one such example. The government is keen to expand these initiatives into other areas of health care delivery.

With the phenomenal growth of mobile network and mobile users the opportunities for its application in engaging the families in managing Non- Communicable diseases is immense.

Keywords: Smart Phone; Health Kiosk; Diabetes Patient; Axillary Nurse; Specialist Doctor.

Introduction

We are witness to bounty (1,2) in food/milk/meat/fish/vegetables/fruits all because of high technology. Similarly countries are preparing deficit budget, print paper money and promote welfare economics. Then there are human rights advocates championing equity. Perhaps these changes have touched most of

the countries. There are some rich people so also poor people-unequal distribution of money, materials and means. For this inequality of distribution whom are we to blame? Blame the government/blame the policy/ blame the procedure/culture? In any case demographical/epidemiological transitions are occurring, epidemics of infectious diseases are thing of the past, people are living longer, manual work is more and more replaced by machines, markets are filled with ready to eat energy rich food, people eat, not because they are hungry but due to aroma of food and its vicarious taste resultant is NCDs(3)(Non Communicable Diseases). The revenue generated by sale of tobacco/ alcohol can sustain the government.

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Beside the robust media advertisement drives people to insatiable desires compounding the situation.

The current situation of wide spread T2D (Type 2 diabetes) 70 million people, COPD (Chronic respiratory obstructive disease) (22 millions), cardiovascular diseases (30 millions), stroke, cancers, substance abuse (270 millions), depression, aberrant sexual behavior...etc., account for 53% deaths and 44% DALYs lost. Unlike the infectious diseases, NCDs can't be managed by vaccines, slow in their onset, need visit to doctors, medications, out of pocket expenditure, no credible health insurance make the scenario a complex condition to handle. Our health care system has shown no matching transition to respond to rising NCDs besides providing just acute emergency care. The referral system is rudimentary with heterogeneous providers, wide variations in availability, quality and accessibility. There is no system in place to emphasize prevention, risk factor reduction, early detection and evidence based approach in management of NCDs. The patients do visit the health care providers, the records are disjointed, fragmentary and lack credibility.

ICT (Information Communication Technology)

Have a look at the -Banks -money transactions from any bank to any other bank with in a fraction of a second. Travel agency- you can buy travel tickets from any place to any other place. If you have GPS system positioned in your vehicle think of the ease and comfort in the travel. This technology is widely used in agriculture/Poultry/Farm/Dairy industry. Perhaps you have heard of "Integrated cattle health monitoring system using wearable sensors" [4].

Hence we are championing "**Digitalization of community data and creation of Data base**". Information and Communication Technology has made it possible to analyze the data, understand the health needs of the community, **engage the community through periodical text messages/SMS**, so that one can:-

Focus on an individual, build on his/her sensibility to identify early symptoms of the ill health, adopt self-care as near to his house as possible with available community resources.

Stakeholders

- General Physician Doctor at Primary Health Centre at Village Level. Specialized Doctors (Endocrinologists/Diabetologists/MD) at Community Health Centre (Town Level) and at District Government Hospital (City Level). Public

Healthcare Worker (Primary/Community) at Village level, Type-2 Diabetic Patient, Pre-diabetic Patient, Family of Type-2 Diabetic patient, Rural populace which is susceptible to Type-2 Diabetes

Surroundings (To Describe the Surroundings Premise for this Project we have Considered a not so Prosperous and not So Down Trodden Village Scenario)

- Most houses made of bricks and baked tiles. Few houses made of mud bricks and thatched roofs. Various economical background families. Majority belong to low income group. Few belong to middle income group. Very few belong to rich class. Major occupation is small time farming and daily laborers. Few villagers are small store owners of items like grocery, vegetables & fruits, tea stall, snacks stall, small restaurant, phone booth. etc. Most common family size is 6 members (adult couple, grandparents, 2 children). Families with 10 members and 3 members are on the extreme of the scale. There is a social order based on caste system with Scheduled Tribes and Scheduled Castes (ST & SC) being at the bottom of the caste ladder. Other Backward Castes (OBC) come above them. The Brahmins occupy the top spot in the caste hierarchy. There are many temples and shrines in the village. Many are dedicated to the local protecting God and few to the commonly worshipped Gods like Shiva, Vishnu, Durga. etc., There is one mosque in the village. The population of the village is 3000. Many families in the village possess a TV set and a cable connection.
- Most of the families have one mobile phone per household (basic handset). Few families have multiple mobile phones per household and very few even have smart-phones. Families with girl child are tensed about saving money for the daughter's marriage and finding the right match. The concept of saving money for health-care is mostly absent. There is no presence of any health insurance.

The only available facility for health-care at village level is the Primary Healthcare Centre (PHC) located a few kilometers from the village (which serves 3 villages). A General Physician is supposed to be available at the PHC all the time. But, sometimes a pharmacist or healthcare worker diagnose and provide basic medication to the patients. Few basic tests are done at the PHC. There is no blood sugar or any other diabetes related test done at the PHC. A part from basic medication and vaccines, specialized medicines for Tuberculosis and Malaria are available

at the PHC. But no medication for type-2 diabetes patients is available at the PHC (NO metformin, NO insulin vials), even if available always run short of stock.

Figures and Facts

Prevalence of Diabetes in the World

The world prevalence of diabetes among adults (aged 20-79 years) is 6.4%, affecting 285 million adults, in 2010, and will increase to 7.7%, and 439 million adults by 2030.

Between 2010 and 2030, there will be a 69% increase in numbers of adults with diabetes in developing countries and a 20% increase in developed countries.

Indian Scenario

According to the International Diabetes Federation, 61.3 million people in India had diabetes in 2011. That figure is projected to rise to 101.2 million by 2030. IDF data reveal that India has more diabetes than the

United States. In fact, India is ranked second in the world in diabetes prevalence, just behind China.

The sanofi-aventis India SITE study (Screening India's Twin Epidemic), rolled out during 2009/2010, was a cross-sectional epidemiological study of 16,000 patients from 800 centers in Maharashtra, New Delhi, Tamil Nadu, Andhra Pradesh, West Bengal, Karnataka, Gujarat, and Madhya Pradesh. About 60 percent of the surveyed population suffered from diabetes, hypertension, or both, and 70 percent of the patients had uncontrolled diabetes.

Currently there are 23,109 Primary Health Centres (PHC) in India. (Source: Data.Gov.in Site)

Compliance or adherence problems are common in diabetes management. Many factors are potentially related to these problems, including demographic, psychological, social, health care provider and medical system, and disease-and treatment-related factors. The findings from the recently published Cross-National Diabetes Attitudes, Wishes, and Needs (DAWN) Study showed the following:

Patients	type 1 diabetes	type 2 diabetes
patient-reported adherence rates for medication	83%	78%
SMBG adherence was	70%	64%
appointment keeping adherence	71%	72%
The adherence rates observed for diet	39%	37%
exercise they were	37%	35%

Providers reported significantly better adherence for type 1 than for type 2 diabetic patients across most regimen domains.

Review of Existing Solutions to Solve this Problem

- Video Conferencing Facility at Belgaum, Karnataka - One of the Primary Healthcare Centre (PHC) at Belgaum in Karnataka, India has one primary Doctor there to treat patients. This is supported by a video conferencing facility to help the patients. The video conferencing facility is situated around 10 km away from the PHC in a medical college and has surgeons and specialized Doctors to provide additional assistance through video conferencing to the PHC. (Source: Discussion with Dr Mohan, a team member, who is involved with the initiative)
- The health care providers - Government/Non Government/others are there but access is a problem and costly. Recently a mhealth solution in the form of "Arogyavani" has been started in Karnataka, India, by the Government. Anyone can dial toll free number 104 and get access to talk to doctors, who listen to them, counsel them and suggest remedy 24*7*365. A similar service for Emergency care, toll free number 108 has been working successfully for last few years. <http://kshsrc.org/arogyavani/>
- Dimagi (<http://www.dimagi.com/>) They deliver open and innovative technology to help underserved communities everywhere in the world. They have taken major initiatives in India in the mhealth space. Some mhealth initiatives by Dimagi:
- CommCare (<http://www.commcarehq.org/home/>) is a turnkey solution for community health and extension workers that provides case management, data collection, and data management. It provides job aid for community health workers (CHWs). It is a free and open-source software application with mobile and cloud infrastructure. It acts as a tool for supervision and evidence-based change. It provides way to capture data in an electronic repository that otherwise sits in thousands of

paper notebooks.

- CommConnect is a solution for building SMS applications allowing for two-way messaging, conditional reminders, surveys and broadcast messages. It can be used on its own, or integrated into a CommCare application. It is a turnkey platform for building messaging applications (SMS and IVR). It allows the user to send conditional reminders and two-way surveys to clients. It also allows users to send broadcast communication or do large scale surveys. It integrates with information collected using CommCare.
- CommTrack is a tool for mobile logistics and supply chain management. It supports mobile workers for better stock tracking, requisition planning, and delivery acknowledgement using either SMS or a CommCare application. Through the use of mobile technology, CommTrack supports health workers and other mobile agents who manage commodities in low-resource settings. It has been proven at scale, through real-world deployments, to provide reliable, real-time, and actionable information to improve the performance of new and existing supply chains. CommTrack is integrated seamlessly with Dimagi's suite of industry-leading tools for empowering the mobile workforce.
- Teledoc Program in India TeleDoc uses leading-edge communications technology to bring high-quality healthcare and health related information directly to rural villages. Local healthcare personnel can enter disease symptoms and patient information into the database over the widely-available GPRS network. Doctors retrieve that information at an IT-enabled central clinic, where they input diagnoses, prescriptions and treatment for retrieval by the local personal. TeleDoc is a low-cost, highly effective and broadly applicable networking solution. TeleDoc uses Java-enabled mobile phones to connect village-based healthcare workers with doctors in urban areas for remote diagnosis and treatment. <http://www.wsis-award.org/winner/teledoc-59620100625>, <http://healthmarketinnovations.org/program/teledoc>
- Digital Inclusion Kit in health and Higher Education (DIKHA) Researchers at the University of Buenos Aires are developing a system that collects data from portable medical diagnostic equipment and transmits it wirelessly to a database that is instantly available to medical specialists in other locations. this technology can help bring preventive healthcare to many people who currently have little or no access to it, thereby allowing them to address risk factors before they develop an acute condition. The main goal of the project is to provide a fast way of communications between physicians and patients in underserved zones, both rural and urban, using mobile technology. <http://research.microsoft.com/en-us/collaboration/papers/buenosaires.pdf>
- Integrated Healthcare Information Services through Mobile telephony in Botswana University of Botswana researchers are developing an Internet based healthcare information service that can process text message queries from cell phone users and deliver relevant information about how to self-manage chronic health conditions such as HIV/AIDS. The service will also allow health workers to look up patient records and monitor follow-up care between treatment and lower healthcare costs. <http://research.microsoft.com/en-us/collaboration/papers/botswana.pdf>, <http://healthmarketinnovations.org/program/integrated-healthcare-information-service-through-mobile-telephony-ihism>
- Blabla Doctor, Blabla Doctor is a health based social networking site that helps people suffering from a variety of health conditions, including Breast Cancer, to globally connect, help and share information with others in similar situations, by focusing on bridging the gap of patient-to-patient communication, and patient-to-practitioner, with all the social networking features and functionality expected in today's society. With BlablaDoctor community support; real people in similar situations come together, to circumvent negative feelings like disconnection and loneliness, and focus on improving self-esteem, understanding, communication, relationships, and peer support. <http://www.blabladocor.com/>
- Robust and Low-Cost Networking for Rural Kiosks, The KioskNet project is designing an innovative and low-cost computer kiosk system for developing countries that is reliable, easy to deploy and operate, and equipped with advanced security protections. The system will allow kiosks to exchange large amounts of data with the Internet without the need for dial-up, cable or satellite connections. <http://research.microsoft.com/en-us/collaboration/papers/waterloo.pdf>
- Portable Diagnostic Device, This low-cost portable diagnostic system will monitor vital health parameters, record them in a database and send the data directly to a remote doctor's mobile

phone. the system will collect ECG and pulse-oximetry data, with additional parameters such as diabetes monitoring to be added in future versions. <http://research.microsoft.com/en-us/collaboration/papers/hyderabad.pdf>

- Effects of a mobile phone short message service on antiretroviral treatment adherence in Kenya (WeITel Kenya1), Mobile (cell) phone communication has been suggested as a method to improve delivery of health services. However, data on the effects of mobile health technology on patient outcomes in resource-limited settings are limited. We aimed to assess whether mobile phone communication between health-care workers and patients starting antiretroviral therapy in Kenya improved drug adherence and suppression of plasma HIV-1 RNA load. Patients who received SMS support had significantly improved ART adherence and rates of viral suppression compared with the control individuals. Mobile phones might be effective tools to improve patient outcome in resource-limited settings. [http://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(10\)61997-6/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)61997-6/abstract).
- Mobile Health: The potential of mobile telephony to bring health care to the majority. <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1861959>
- SMS for Life: Tanzania Pilot Project, With around 11 million malaria cases annually it is vital that we have enough stocks of effective malaria treatments in all our health facilities, at all times, especially at the district level. It's simple. If there are no malaria treatments, someone will die. It is very likely to be a child. Reducing the frequency of local health facilities running out of ACT stocks (stock-outs) saves lives. The SMS for Life pilot project, designed to address this challenge, has been tried and tested in three districts of the country and, based on the results presented in this report, has showed remarkable success in keeping health facilities in those districts almost fully supplied with malaria treatments. The benefits for our health systems are potentially far reaching. Not only do we have the makings of a national stock management approach that can improve the availability of, and access to, lifesaving malaria drugs across the country, but we also have the possibility to apply this stock management approach to other essential health commodities. <http://www.rollbackmalaria.org/docs/SMSdetailReport.pdf>
- MiDoctor (MyDoctor) automatically monitors

individuals with chronic diseases and promotes self-care by providing a timely diagnosis, automated calls, and continual reminders via text messaging (SMS). This system ensures the continuity of care and reduces the morbidity and costs associated with care. <http://ehs.cl/en/solutions/continuous-monitoring/>

Materials and Method

Populations across the world are at the risk of lifestyle diseases- Diabetes, Cancer, Hypertension, Heart attack..etc People have access to Mobile phone...if they are able to seek help...anytime.....can the Doctor located remotely respond?Yes, it is Possible :First: Create a database of all the users. and give user id. Second: People contact through Mobile set regarding health problem. Third: Interphase with Doctors. Fourth: Suggested intervention Fifth: May use diagnostic devices- ECG/ Blood sugar/ O2/X-Ray/ CT. In this effort the Community, Community Health Workers, Doctors, communicate through mobile for their health care needs.

We have thought of Spice M9000 Mobile (mobile handset with projector) useful and affordable for our purpose. It can be bit a more comprehensive unit: Mobile handset with Diagnostic mode which is wirelessly connected with diagnostic devices like ECG/ X-Ray/ CT/ Glucometer/ Oximeter, so that patient symptoms plus comprehensive diagnosis can be made by Doctors and useful interventions provided.

Discussion

The PHC has a General Physician Doctor, Primary/Community Healthcare Workers and ASHA workers who work to provide basic medical care to the village population. Villagers come to the PHC for medical treatment. Healthcare Workers visit villagers homes to collect basic health and medical data. There is a tie up with a Medical University which is 10 km from the PHC. The Medical University currently supports a video conferencing facility between the patients at the PHC and the Specialized Doctors at the Medical University Hospital.

The solution proposes having a full- fledged 'Health Kiosk' at the PHC. The health kiosk will act as a focal point of the service model. Along with the existing video conferencing facility the proposed health kiosk will have many more features to provide

a comprehensive care. We plan to sync wireless/ remote diagnostic devices with the health kiosk.

The healthcare workers will be provided with a smartphone with a projector.

Most of the villagers already have a basic mobile handset, one basic mobile handset per family.

There are Specialized Doctors available at the Medical University Hospital situated at 10 km from the PHC.

Service Model

Details

Health Kiosk Features

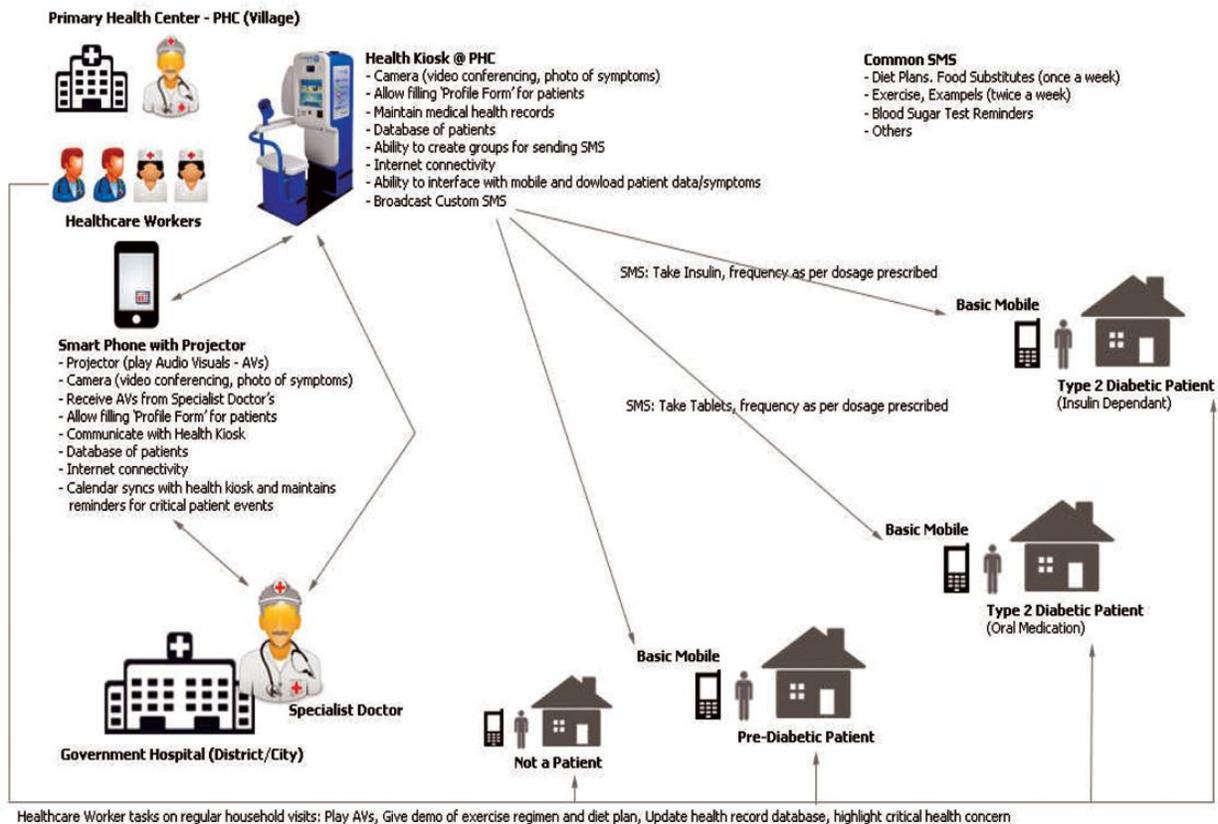
Patient friendly, ability to do demonstration for nutrition and health education, Facility to do Blood Sugar Test Ability to sync data with remote/wireless diagnostic devices, Video conferencing facility, Capture symptoms as photographs, Maintain medical health records (also known as personal health records), Maintain database of patients, Ability to create groups from patient records and send custom SMS, Internet connectivity, Ability to sync patient data with Mobile phone and remote diagnostic devices.

Smart Phone with Projector Features

Projector with ability to project Audio Visuals (AVs), Camera for video conferencing, taking photo of symptoms, Ability to fill in profile form for patients, Ability to update medical health records, Ability to receive AVs from Specialized Doctor at University Medical Hospital, Internet connectivity, Ability to sync patient data with the Health Kiosk at the PHC, Phone Calendar syncs with health kiosk and maintains reminders for critical patient events.

Broadcast SMS Details

Common SMS to be sent to all types of diabetes patients: Diet Plans, Food Substitutes, Exercises, Blood Sugar Test Reminders, Tip of the day for healthy living with diabetes, others, Customized SMS to be sent to various groups of diabetic patients (insulin dependant, oral medication, dependant, pre-diabetic) like reminders for medication adherence. Frequency of SMS is dependant on the criticality and occurrence of the events. If unusually large number is detected for certain disease, for example communicable disease like malaria and dengue, we will leverage this setup to send a general precaution and awareness SMS to all the people in the village.





Details of the Role of Healthcare Worker

Collect demographic data, family history, contact information and feed it in the smart phone, Reinforce health messages during regular visits, Health promotion by nutrition advice, Promote early detection in obese/ patient relatives/hypertension patients, Facilitate the usage of health kiosk at the PHC, Project AVs in the villagers homes during regular visits, Act on the calendar reminders on critical patient events. For example: If a patient has an average blood sugar level of 350 (considered very high) and based on this a calendar reminder is pops up in the phone of the health care worker that it is time for the regular blood sugar test for this patient, then the healthcare worker should call the patient's mobile number and remind to come for blood sugar test and in event that patient doesn't turn up, go to their house and do the blood sugar test there.

Details of the Role of Specialized Doctor at University Medical Hospital

Protocols/ Procedures for Detection/ Diagnosis/ Treatment of Diabetes, Referral advice during complication, Inpatient care, Surgery, Expert advice during Video Conferencing, Create and send AVs to the healthcare workers smartphones regularly, Help identify trends/patterns through patients medical health records and help Doctor at PHC.

Details of the Role of Doctor at Primary Health Centre

Case detection - early detection, suspect diabetes in relation to obesity/ unusual weight gain during pregnancy/ excessive hunger, thirst, loss of weight/ hypertension/ patient relative Diagnosis, treatment regimen, guidelines, Consult Specialized Doctor during complications through video conferencing, Facilitate the usage of the health kiosk, Help form the customized SMS which needs to be sent to various patient groups.

Conclusion

The mobile technology has expanded considerably and people are equally familiar with its use. The commercial sectors like railways, banks, business enterprises have already applied this technology. Even in health care attempts are being made, example (MCTS) to track pregnant women in our country. Our frontline health care workers are smart and any attempt made to strengthen their hands can certainly increase the outreach of quality health care especially for Non Communicable diseases.

Limitations

The information Technology is a very complex science. We can get the software necessary for our use but works out costly and takes some time to develop. There are existing softwares readily available and are affordable. However we should be able to bear with risks if any while we use this newer technology. Hence many policy and decision makers prefer to wait and watch for some time till the situation reaches a tipping point. Perhaps the doctors of present generation are fully conversant with computer use while the older age are not so familiar and it is these older age group who decide policy matters!!! Hence projects may get stuck up.

Recommendation

Given the present scenario and the need of the community for smart health care facility we strongly recommend the use of Mobile technology in Health Care. It is safe, secure and smart for contemporary use.

Disclaimer

The authors have their individual significant, contribution in the article; have no conflicts, no competition or contradictory interests. Dr. Sunkad initiated the study, Ms. Shilpa collected the details of families in communities and Dr. Javali did the critical review. All the authors read and approved the final manuscript.

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References

1. PerPinstrup-Andersen Peter B., R. Hazell The impact of the green revolution and prospects for the future Food Reviews International. 1985; 1(1): 1-25.
2. John Beddington Food security: contributions from science to a new and Published 24 November 2009. DOI: 10.1098/rstb.2009.0201.
3. Kalpa Sharma. Burden of non communicable diseases in India: Setting priority for action REVIEW ARTICLE Int J Med Sci Public Health. 2013; 2(1): 7-11 doi: 10.5455/ijmsph.2013.2.7-11.
4. Anselemi B. Lukonge 1, Dr. Shubi Kaijage 2, Ramadhani S. Sinde 3. Review of cattle monitoring system using wireless network International Journal Of Engineering And Computer Science ISSN:2319-7242. May 2014; 3(5): 5819-5822.

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