Designing culturally acceptable screening for breast cancer through artificial intelligence-two case studies

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Abstract

Diffusion of Innovation (DOI) theory explains how, over a period of time, an idea or behavior diffuses (or spreads) through a targeted population or society. The major thing about adoption is that the people must perceive the idea, behavior, or product as new or innovative and it should be useful to them. The more the perceived benefit, the quicker is the diffusion. Same thing can be expected for adoption of new technology in healthcare also. In this paper, we have described two novel breast cancer screening technologies and have concluded that implementation of a new technology should consider the cultural aspect and mindset of local people so that quick diffusion of healthcare technology takes place among all segments in our society to make it a better world.

Keywords: Artificial intelligence, diffusion of innovation, technology adoption

Introduction

Diffusion of Innovation (DOI) theory was developed by a social scientist E.M. Rogers in 1962. This social science theory explains how, over a period of time, an idea or behavior diffuses (or spreads) through a targeted population or society. The final result of this diffusion phenomenon is that public, as part of a social system, adopt a new idea, or behavior.[1] The literal meaning of adoption means that a person demonstrates a different behavior/idea than what they had done previously (using sanitary napkin instead of using clothes during menstrual periods). The major thing about adoption is that the people must perceive the idea, behavior, or product as new or innovative and it should be useful to them. The more the perceived benefit, the quicker is the diffusion. The same thing can be expected for adoption of new technology in healthcare also.[1] As an example, breast cancer screening technology is developing day by day. Previously it started with self-breast examination, later X ray and mammography came into existence, and now it can be detected using artificial intelligence embedded with thermolytic technique.[2,3]

Globally, 500000 women die every year due to breast cancer. In India, the figure is around 75000 per year. Mortality due to breast cancer is more in rural areas than urban areas. It is due to various factors, among which cultural factor plays an important role.[4]

Female breast cancer accounts for almost 11.6%, and is the most commonly diagnosed cancer and the leading cause of cancer death. As stated by GLOBOCON 2018, 2.1 million new breast cancer cases will be diagnosed worldwide in 2018, which will account to 1 in 4 cases among females. Breast cancer is the leading cause of death in many countries. Fifty percent women who are diagnosed with breast cancer die within five years in India. There is an expeditious rise of incidence rate of breast cancers in South America, Africa, and Asia.[5]

Nearly 70% women are detected when the cancer is in the advanced stage, which leads to unpropitious impact on survival rate as advanced stage cancers have poor (25%) chances of

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Access this article online

Quick Response Code: Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_391_18

How to cite this article: Bhattacharya S, Sharma N, Singh A. Designing culturally acceptable screening for breast cancer through artificial intelligence-two case studies. J Family Med Prim Care 2019;8:760-2.

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survival as compared to early stage cancer. Also, the cost of treating the advance stage cancer increases 10–16 times.[9]

Breast cancer is preventable if screening is done early by self-breast examination or mammography. Discussing self-breast examination or performing mammography is difficult in rural due to cultural barriers. Performing mammography is also costly, which is why many rural women do not undergo through this screening test resulting in increasing cancer burden in rural areas.[7]

**Case Study-1**

To combat this issue, there are two well-known start-ups namely UE Lifesciences and Niramai that have adopted artificial intelligence to accurately diagnose breast cancer. In 2016, Niramai Health Analytics (Bangalore) developed a noninvasive, low cost solution to screen early breast cancer based on mapping body heat embedded with artificial intelligence technique.[8]

Niramai is an acronym for non-invasive risk assessment with machine-learning and artificial intelligence. This Thermalytix technology can detect tumors five years earlier than mammography or clinical exams.

In this screening technique, no doctor or technician is required (i.e., no touch technique). The machine is portable and costs 1/10 (350–500 INR) of routine mammography (3500–5000 INR). Moreover, the skillset required for operating this machine is not very high. Nurses and paramedics can operate it very easily. This technology enables teleradiology also for remote consultation, lowering full-time staffing costs for the hospitals. Now the company/technique is growing at a rapid pace. Till date, 12 hospitals have tied up with this company which stands for noninvasive risk assessment with machine learning. They have already screened nearly 4200 women and detected cancer early on in some of them.[9]

In this test, the patient enters a room and instructions are given from outside. The test is carried out with complete privacy. Later, it was realized that the privacy component played a very important role, particularly for rural women. This resulted in easy and wider acceptance of this technology.[10]

**Case Study-2**

To address the similar issue, Mihir Shah and Matt Campisi, co-founders of UE Lifesciences developed “iBreastExam (iBE),” which is a hand-held, clinically validated, noninvasive, painless, and radiation free device that can help front-line care providers for early detection of breast lesions and at the point of care. It gives breast tissue “map” that indicates about the abnormalities that can be evaluated for malignancies. Dr Katke, Medical Superintendent at Cama and Albless Hospitals and a professor of obstetrics and gynecology at Grant Medical College, is also pioneering this device for breast cancer screening. Nearly 50,000 women have been screened over a year using iBreastExam, out of which 2251 women were detected to have breast lumps and among those 75 were cancerous. Initially, only few patients were turning around but gradually the number increased. Thus, early screening through this user-friendly technique can help under served people and improve the 5 year survival rates of affected patients.[9,10]

**Discussion**

AI based screening for breast cancer has lesser chances of false positive reports as compared to contemporary methods.

Patient centered approach is the key of success of emerging medical technologies. These examples demonstrate that how diffusion of a new technology among populations become easy and fast if it considers the cultural aspect of a specific population.

So, whenever we try to implement a new technology it should consider the cultural aspect and mindset of local people so that quick diffusion of healthcare technology takes place among all segments in our society to make a better world.[11]

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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