ISSN No. 0976-5697

Volume 5, No. 8, Nov-Dec 2014

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

eHealth Model for Early Detection of Breast Cancer

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Abstract: The incidence of breast cancer is on the rise world-wide and it is the most prevalent form of disease among women. The world has lost good number of women from this disease – breast cancer. Earlier research has it that "the earlier a breast cancer is found, the more likely it is that treatment will be successful", thus early detection and identification of its signs and symptoms become very important. The aim of this work is to design an eHealth Model that runs on both desktop and mobile device(s) to assist women in conducting breast self examination. This model carries steps for this exercise and questionnaire constructed with the signs and symptoms which the user fills and sends/uploads to the hospital server over the internet. The medical professional(s) at the receiving end will then have access to the hospital database and scrutinize the feedbacks sent by the user from a distance. After thorough examination or analysis of the feedback sent by the patient(s), she would be invited to the hospital if any abnormality is found for proper screening and examination.

Keywords: biopsy, eHealth, fibroadenomas, false-positive, Menarche, self-examination, ultrasonography.

I. INTRODUCTION AND MEANING OF eHEALTH

The advent of use of Information and Communication Technology (ICT) in health care system (Health Technology) has led to significant innovations that have greatly improved human health and quality of life. Health technology is used to avoid illness onset, reduce the risk of occurrence, and limit impact. It helps clinicians to screen abnormalities and contributes to the diagnosis of clinical signs for recognizing the nature and cause of pathological events. Moreover, technology is expected to reduce mortality and morbidity rates, to shorten disease period, to improve the quality of care (also increasing access to it), to reduce risk of relapse, and to limit the decay of a person activities/functionalities which corresponds to an increase in life expectancy [1]. Meanwhile, advancement in Health Technology has given rise to Biomedical Engineering (BME) and Electronic Health (eHealth) System.

Biomedical engineering which is a product of ICT (Health Technology) has played very important roles in health care technological development. It adopts engineering principles and techniques to solve problems in biological and medical environments. Biomedical engineering provides tools and methods for improving health care delivery in both diagnosis and disease treatments [2]. These tools include instrumentation, medical imaging, computer-aided detection and diagnosis and medical devices.

eHealth is the application of Internet and other related technologies in the healthcare industry to improve access, efficiency, effectiveness, and quality of clinical processes utilized by healthcare organizations, practitioners, patients, and consumers in an effort to improve the health status of patients. [3]. It is the use of emerging information and communications technology (ICT) to improve or enable health and healthcare system [4]. eHealth is a relatively recent term for healthcare practice supported by electronic processes and communication, dating back to at least 1999.

Usage of the term varies: some would argue it is interchangeable with health informatics with a broad definition covering electronic/digital processes in health while others use it in the narrower sense of healthcare practice using the Internet. eHealth includes many dimensions: Delivery of key information to healthcare partners, Provision of health information delivery services, Facilitation of interaction between providers and patients, Facilitation of the integration of healthcare industry-related business processes, Both local and remote access to healthcare information and Support for employers and employees, payers and providers [5]. However, this study aims in design and development of an eHealth model that runs both mobile and desktop devices to provide assistance to women to conduct Breast Self-Examination (Screening) that helps in early detection of breast cancer.

II. SOME AVAILABLE BREAST CANCER SCREENING METHODS

Breast cancer screening is the medical screening of asymptomatic, apparently healthy women for breast cancer in an attempt to achieve an earlier diagnosis. The

assumption is that early detection will improve outcomes. A number of screening tests have been employed, including breast-self exams, mammography, genetic screening, ultrasound, and magnetic resonance imaging [6].

A. Breast-self Examination:

Breast-self examination involves feeling the breast for lumps or other abnormalities. This method is known to be the effective way of detecting breast cancer early. It could be done under shower. Steps in breast self-examination are presented in figure 1. Steps 1-3 involve visual inspection of the breasts with the arms in different positions. Step 4 is palpation of the breast. Step 5 is palpation of the nipple. Step 6 is palpation of the breast while lying down. However, Breast-self Examination was once widely recommended by experts [7], though, however they are not supported by evidence and may, like mammography and other screening methods that produce false-positive results, contribute to harm. Meanwhile, medical evidence, however, does not support its use in women with a typical risk for breast cancer [6].

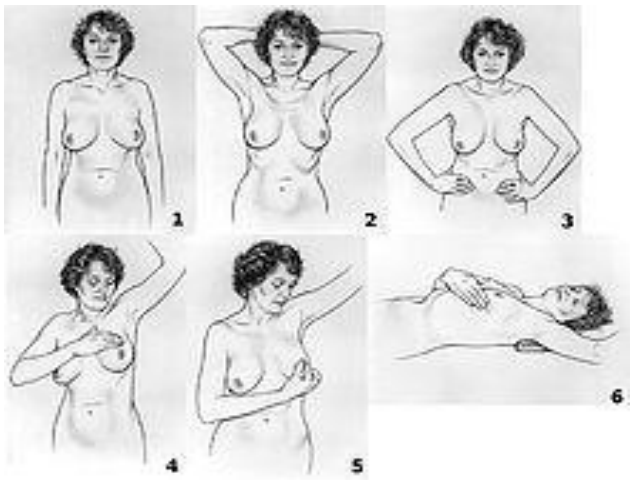

Figure 1 – Breast Self-examination.

B. Mammography:

Mammography is the process of using low-energy X-rays (usually around 30 kVp) to examine the human breast and is used as a diagnostic and a screening tool. The goal of mammography is the early detection of breast cancer, typically through detection of characteristic masses and/or microcalcifications. Like all X-rays, mammograms use doses of ionizing radiation to create images. Radiologists then analyze the images for any abnormal findings [7].

Mammography is not very useful in finding breast tumors in dense breast tissue characteristic of women under 40 years. In women over 50 without dense breasts, breast cancers detected by screening mammography are usually smaller and less aggressive than those detected by patients or doctors as a breast lump. This is because the most aggressive breast cancers are found in dense breast tissue, which mammograms perform poorly on [7].

Screening mammography is usually recommended to women who are most likely to develop breast cancer. In general, this means women with a personal or family history of breast cancer, and most older women, but not frail elderly women, who are unlikely to benefit from treatment. Women who agree to be screened have their breasts X-rayed on a specialized X-ray machine. This exposes the woman's breasts to a small amount of ionizing radiation, which has a very small, but non-zero, chance of causing cancer. The X-ray image, called a *radiograph*, is sent to a radiologist. The image may be on plain photographic film or digital mammography on a computer screen; despite the much higher cost of the digital systems, the two methods are generally considered equally effective. The equipment may use a computer-aided diagnosis (CAD) system.

If a suspicious signs are identified in the image, then the woman is usually recalled for a second mammogram, sometimes after waiting six months to see whether the spot is growing, or a biopsy of the breast [8]. Most of these will prove to be false-positives, resulting in sometimes debilitating anxiety over nothing. Most women recalled will undergo additional imaging only, without any further intervention. Figure 2 shows the picture of mammography.

Figure 2 – Breast being screened with Mammography

The presumption was that by detecting the cancer in an earlier stage, women will be more likely to be cured by treatment. This assertion however has been challenged by recent reviews which have found the significance of these net benefits to be lacking for women at average risk of dying from breast cancer.

C. Ultrasonography:

Medical ultrasonography a diagnostic aid to mammography. Adding ultrasonography testing for women with dense breast tissue increases the detection of breast cancer, but also increases false positives [9], [10]. Meanwhile, figure 3 shows the picture of patient been screened with ultrasonography.

Figure 3 –Woman being examined with Ultrasonography.

D. Magnetic Resonance Imaging (MRI):

Magnetic Resonance Imaging (MRI) has been shown to detect cancers not visible on mammograms. The chief strength of breast MRI is its very high negative predictive value. A negative MRI can rule out the presence of cancer to a high degree of certainty, making it an excellent tool for screening in patients at high genetic risk or radiographically dense breasts, and for pre-treatment staging where the extent of disease is difficult to determine on mammography and ultrasound. MRI can diagnose benign proliferative change, fibroadenomas, and other common benign findings at a glance, often eliminating the need for costly and unnecessary biopsies or surgical procedures. The spatial and temporal resolution of breast MRI has increased markedly in recent years, making it possible to detect or rule out the presence of small *in situ* cancers, including ductal carcinoma in situ.

However, breast MRI has long been known to have disadvantages. For example, although it is 27–36% more sensitive, it has been claimed to be less specific than mammography [11]. As a result, MRI studies may have more false-positives (up to 30%), which may have undesirable financial and psychological costs.

Figure 4 – Patient being screened with Magnetic Resonance Imaging (MRI)

E. Molecular Breast Imaging (MBI):

Molecular breast imaging is a nuclear medicine technique that is currently under study. It shows promising results for imaging people with dense breast tissue and may have accuracies comparable to MRI. MBI is claimed to be cheaper than MRI. Molecular Breast Imaging observed to be more effective than Mammography at detecting Cancer in high-risk women with dense breast [12].

III. OUR PROPOSED MODEL

Considering the fact that earlier, more aggressive, and more frequent breast screening is recommended for women especially those at particularly high risk of developing breast cancer, such as those with a confirmed BRCA mutation, those who have previously had breast cancer, and those with a strong family history of breast and ovarian cancer, we designed an eHealth model that would help women conduct breast self-examination. This model is loaded with the breast self-screening module which helps them conduct periodic or regular breast self-examination.

This model is accessible using both desktop and mobile device(s) which are obtainable and usable by most women even those in rural areas. They would use the model to conduct breast-self examination as often as they can. Before the first examination, the patient is expected to fill her personal details as shown in figure 5. After which, a passcode will be generated and given of which she would use always to get access into her account for subsequent examinations. Meanwhile, after each the examination, the patient fills the questionnaire/feedback form with respect to signs and symptoms (observations) found during examination and sends to the hospital main server through internet (private cloud). These data are then accessed by the medical professional(s) and the patient is contacted for further instructions if need be.

However, the general architecture of how this system is implemented is shown and explained in figure 6.

A. Steps of Conducting Breast-Self Examination:

Reference [13] and [14] suggest the following steps to conduct breast self-examination.

a. Begin by looking at your breasts in the mirror for changes in shape, size or appearances and for rashes, dimple, nipple retraction/withdrawal or discharge with your shoulders straight and your arms on your hips as demonstrated in pictures 1, 2 and 3 of figure 1.
b. Using the pad of your three middle fingers of your hand, examine the opposite side by covering the entire breast from top to bottom side to side, from collarbone to the top of your abdomen, and from your armpit to your cleavage. This is done either by lying down or standing and demonstrated in picture 4 and 6 of figure 1.
c. Palpate the nipples with your fingers to look for signs of fluid coming out from one or both nipples (this could be a watery, milky or yellow fluid or even blood). This is done as demonstrated in picture 5 of figure 1.

NB: Reference [13] also suggests the following for proper and accurate breast-self examination result.

a. Breast self examination is best done 7–10 days after menses starting from Menarche.
b. For women in menopausal, pick a constant date to conduct this examination every month.

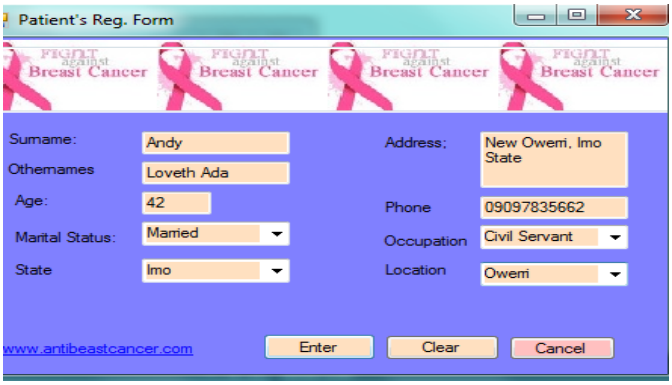

Figure 5: Patients' Registration Form

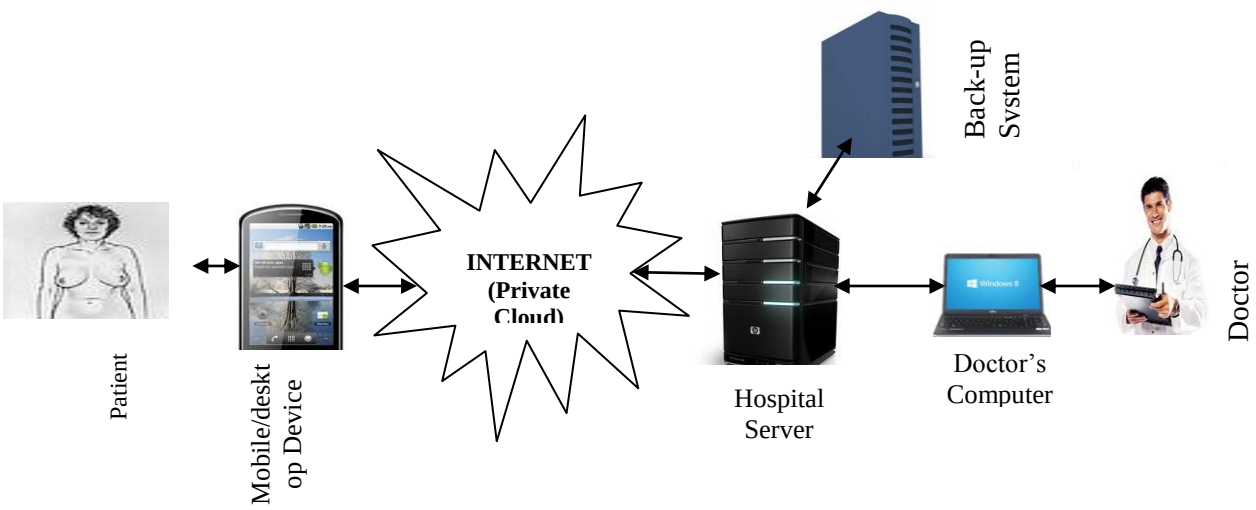

Figure 6: General System Architecture

IV. CONCLUSION

We observed that one of the main reasons why breast cancer treatment failure rate is on the high side is that the tumors and signs are not detected early. We have developed an eHealth Model that runs on both desktop and mobile device(s) to help women in conducting breast self-examination. This model is easy to use by both users (patient and medical professional) and possesses the following advantages:

a. It is installable and usable on both mobile and desktop device(s) meaning that the model can be used anywhere with internet connectivity.
b. It supports regular breast self-examination.
c. The system would improve the efficiency and quality of service provided by health worker/personnel.
d. Health professionals can track, access and advice patients from a distance.

V. REFERENCES

[1] M. Rizzi, M. D'Aloia, B. Castagnolo, "Review: Health Care CAD Systems for Breast Microcalcification Cluster Detection" Journal of Medical and Biological Engineering, 32(3): 147-156, 2012.

[2] A. A. Nasiripour, G. Mahmoudi, P. Raeissi, "A survey on explorating the dimensions of access to medical services," World Appl. Sci. J., 13: 424-430, 2011.

[3] C. Pagliari, D. Sloan, P. Gregor, F. Sullivan, D. Detmer, J. P. Kahan, W. Oortwijn, S. MacGillivray, "What is eHealth (4): A scoping exercise to map the field", Journal of Medical Internet Research, vol. 7, no. 1, 2005.

[4] T. R. Eng, "The eHealth landscape: a terrain map of emerging information and communication technologies in health and health care", The Robert Wood Johnson Foundation, Princeton, NJ, 2001.

[5] J. Marconi, "E-Health: Navigating the Internet for Health Information Healthcare", Advocacy White Paper. Healthcare Information and Management Systems Society, May, 2002.

[6] J. P. Kösters, P. C. Gøtzsche, "Regular self-examination or clinical examination for early detection of breast cancer". In Kösters, Jan Peter. Cochrane Database Syst Rev (2), 2003.

[7] D. Saslow, J. Hannan, J. Osuch, "Clinical breast examination: practical recommendations for optimizing performances and reporting". CA Cancer J Clin 54 (6): 327-44, 2004.

[8] J. M. Croswell, B. S. Kramer, A. R. Kreimer, "Cumulative incidence of false-positive results in repeated, multimodal cancer screening". Ann Fam Med 7 (3): 212-22, 2009.

[9] W. A. Berg, J. D. Blume, J. B. Cormack, E. B. Mendelson, D. Lehrer, M. Böhm-Vélez, "Combined screening with ultrasound and mammography vs mammography alone in women at elevated risk of breast cancer.". JAMA 299 (18): 2151 – 63, 2008

[10] W. A. Berg, Z. Zhang, D. Lehrer, R. A. Jong, E. D. Pisano, R. G. Barr. "Detection of breast cancer with addition of annual screening ultrasound or a single screening MRI to mammography in women with elevated breast cancer risk". JAMA 307 (13): 1394 – 404, 2012.

[11] J. Hrung, S. Sonnad, J. Schwartz, C. Langlotz, "Accuracy of MR imaging in the work-up of suspicious breast lesions: a diagnostic meta-analysis". Acad Radiol 6 (7): 387 – 97, 1999.

[12] M. O'Connor, D. Rhodes, C. Hruska, "Molecular breast imaging.". Expert review of anticancer therapy 9 (8): 1073 – 80, 2009.

[13] J. C. Eneremadu, "Lecture on Commonest Cancer in Women" page 17 – 22, 2012

[14] Breast Cancer Awareness Initiative's manual by The Rotary Foundation of Rotary International, 3H Grant No 65943, R. C. of Enugu City Layout, 2010.