

Telemedicine-cloud: Tomosynthesis - Breast Cancer Screening in Rural Areas

Introduction:

America's land mass in rural areas is 97% and only 19.3% of the population lives there (approximately 60 million people). In rural areas 11.3% of the residents have no medical insurance.

In America breast cancer is the most common cancer in women and is the second leading cause of cancer deaths. The National Cancer Institute (NCI) in 2016 projected that 12.4 % of women will develop breast cancer in their lifetime. NCI estimated that 246,660 women will be diagnosed in 2016 with breast cancer and 40,450 women shall die of the disease.¹ Recent study by the Center for Disease Control and Prevention, Atlanta, GA indicated that deaths from cancer are higher in rural America.^{2,3}

A significant number of rural women fail to undergo breast cancer screening for several reasons beyond their control, e.g., lack of medical facilities in their area of residency, inadequate and infrequent outreach programs by the clinicians, long travel distances to a clinic, proper training to implement the self-examination of their breasts, lack of knowledge about mammogram, etc.⁴

Breast cancer is typically detected in women by clinical breast examination by a clinician, mammogram, additional tests, e.g. ultrasound, Magnetic Resonance Imaging, and biopsy. Elizabeth Krupinski, PhD was the first radiologist in America to provide access to 2-dimensional mammography in rural areas, but it was limited to few areas in the State of Arizona.⁵

We have provided the state-of-the-art technology and service to all the women in the rural areas by employing telemedicine-cloud based Digital Breast Tomosynthesis

(DBT) for the screening of breast cancer. The physical examination is done in a van equipped with “General Electric Senographe Pristina mammography system.” The major advantage of DBT technology over 2-dimensional mammography is that it allows radiologists to view breast tissue using a 3-dimensional dataset that improves diagnostic accuracy by facilitating differentiation of potentially malignant lesions from overlap of normal tissue. The mammography is done on real time basis under the supervision of an especially trained radiologist on 3-D tomosynthesis and the women is provided the interpretation within few minutes.⁶

The Solution:

Fortutec developed a solution that collects the **Tomosynthesis** data from a test performed on women and sends it to radiology department of a hospital. The data is then analyzed for any breast cancer symptoms and records the notes. The patient gets a notification with the results and asked to schedule a follow-up appointment as needed.

Technology:

This web-based solution is developed using C#, open source Dicom, Zoom for video integration.

Women seeking a breast cancer screening test launches the online portal and request for a screening. A schedule is then displayed based on the Telemed-Zone which is assigned based on her zip/postal code. The Telemedicine-Van follows its schedule and visits a central location of the zone. The patient drives to the location of the van and the Registered Nurse takes care of the rest of the process of collecting the vitals and readings using the portable devices and record them in the system. The results are then sent to EMR of the clinic/hospital. If the Nurse has a question, they can have a conversation via telemedicine platform with Physician and get the questions/concerns/issues addressed. If needed, the patient is asked to visit hospital.

Value proposition of the solution:

- 1.) Very helpful to women living in rural areas
- 2.) At home service and can avoid stressful journey to clinics
- 3.) Physicians time is effectively used
- 4.) Cost savings to Health care system

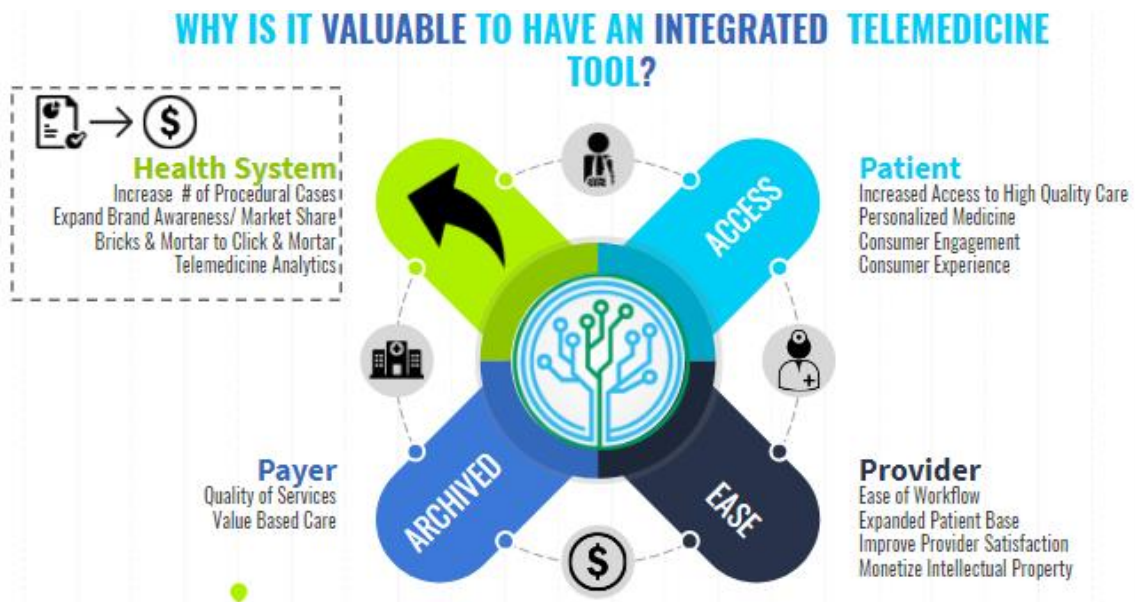


Figure 1

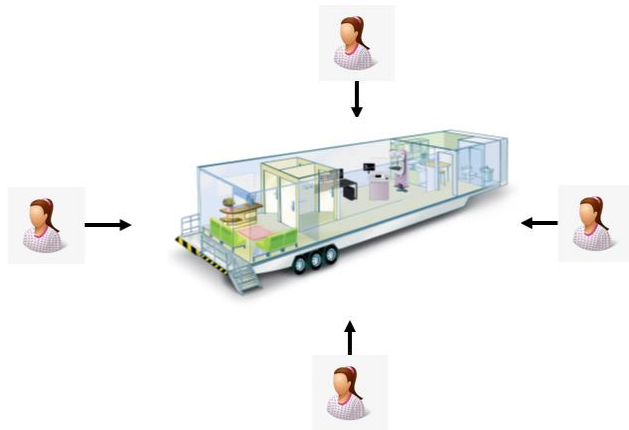


Figure 2

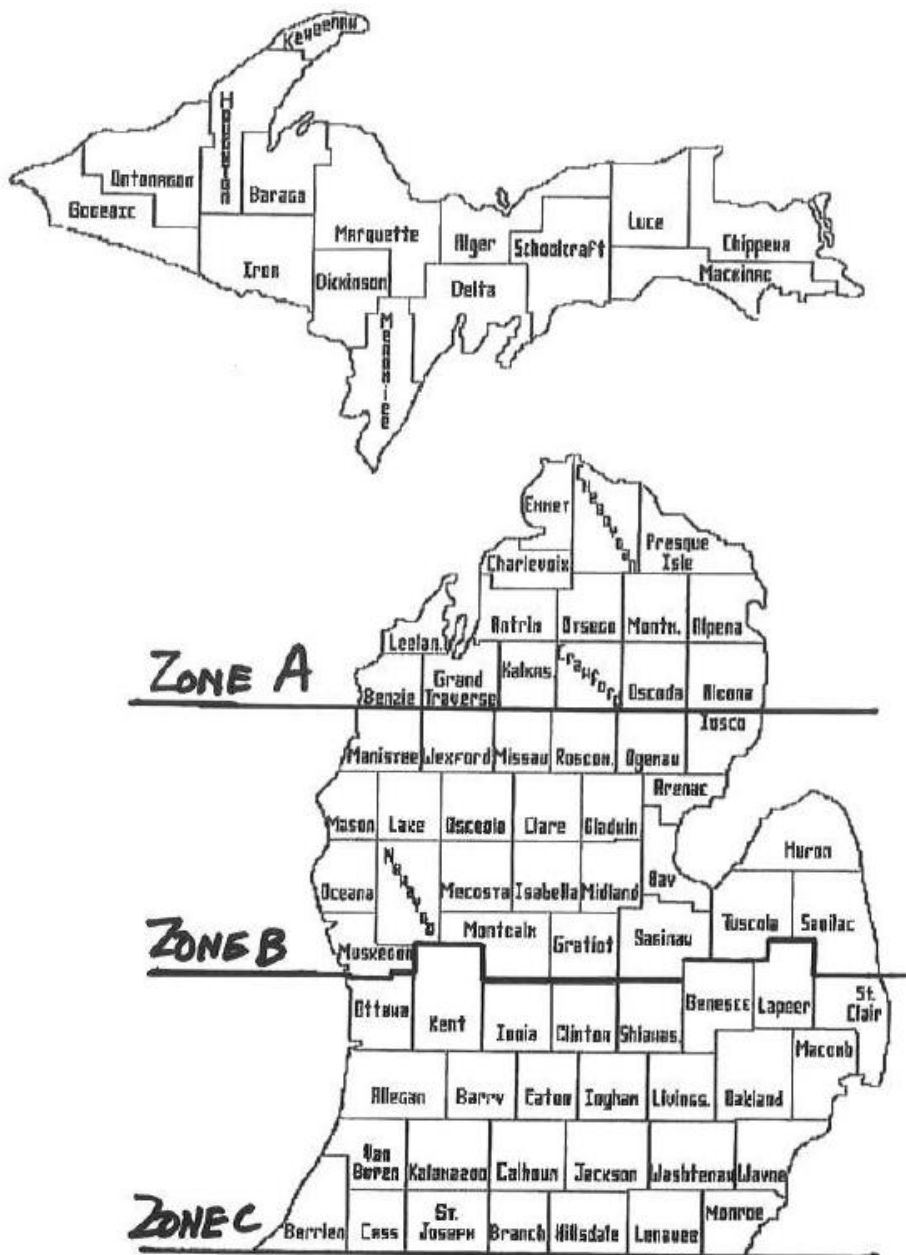


Figure 3

Discussion:

The selection of the three zones (A, B and C) in the State of Michigan (Figure 3) was done arbitrarily without any consideration of the demographics of the state.

The “Zone A” has twenty-nine (29) counties and twenty-seven (27) of them consist of small towns, villages and farms. In view of the scattered population of the residents and absence of a nearby community hospital, the women have to travel long distance for the breast cancer screening. Our logistical analysis suggests that two (2) “Mobile Medical Telemedicine” vans shall be required to serve the entire women population of “Zone A”.

The “Zone B” has twenty-four (24) counties and eight (8) counties of them are representative of industrial towns and large cities. These eight (8) counties provide easy access to breast cancer screening. Some women living in the remaining sixteen (16) counties reside at the cusp of the community hospitals in these largely populated eight (8) counties, and thus do not need breast cancer screening via telemedicine-cloud technology. According to our logistical analysis two “Mobile Medical Telemedicine” vans shall be sufficient to provide breast cancer screening in the small towns, villages and farms of the sixteen (16) counties of the “Zone B” with scattered population.

We are studying the financial aspects of telemedicine-cloud based breast cancer screening for both the rural and urban areas of the State of Michigan.

Summary:

Telemedicine-cloud computing using Zoom and DICOM technology shall provide the quality analysis of Tomosynthesis data collected from women patients in small towns, villages and farms similar to that currently available in urban areas of America by conventional methods. The costs of medical care employing telemedicine-cloud technology shall be lesser than the currently prevailing medical care in America.

References:

1. Breast Cancer by the Numbers: Survival Rates by Stage, Age, and Country.
<https://www.healthline.com/health/breast-cancer/survival=facts-statistics#1>
2. New CDC Report shows deaths from cancer higher in rural America.
<https://www.cdc.gov/cancer/ncccp>.
3. Davis TC, Connie LA, Rademaker A, Baily SC, Platt DJ, Reynolds C, Esparaza J, Liu D, Wolf MS. Differences in Barriers to Mammography Between Rural and Urban Women. *J Women Health* 21(7):748-755.
4. Peppercorn JM, Houck K, Wogu AF, Villagra V, Lyman GH, Wheeler SB. National survey of breast cancer screening in rural America. *J Clin Oncology* 31, no.26_suppl (September 10, 2013), pp13. DOI: 10.1200/jc.2013.31.26_suppl 1
5. Krupinski EA. Improving Access to Mammography in Rural Areas. Susan M. Astley et al. (Eds.): *IWSM 2006, LNCS 4046*, pp111-117, 2006, Springer- Verlag Berlin Heidelberg 2006.
6. Sujana PS, Mahesh M, Vedantham S, Harvey SC, Mullen LA, Woods RVW. Digital breast tomosynthesis image acquisition principles and artifacts (Review). *Clinical Imaging* 2019; 55: 188-195.