

Evaluate the Multiple Breast Cancer Factors and Calculate the Risk by Software Tool Breast Cancer Risk Evaluator

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Abstract

Background: The encapsulation of multiple heterogeneous data sources from different departments provide all the details of the patients in which some are the data provided by the patient. It has to be grouped as unified schema and analyzed accurately to bring out the possible and permanent solutions for the patients. **Methods:** To calculate and analyze the breast cancer risk by providing data to the system through medical analysis, BIRAD Score, Medical History, Social History and Family History. **Results:** The software tool Breast Cancer Risk Evaluator has developed to calculate breast cancer risk by providing information through database, passed to the system for processing and generate a report to predict the current stage of breast cancer in the patient. **Application:** It will help the doctor and patient to know the current stage of cancer, based on that doctor can prescribe the medicines.

Keywords: Influence, equipped, encapsulation, heterogeneous, unified schema, survival time

1. Introduction

Breast Cancer Risk Evaluator is a software tool through which data can be passed and then evaluated to find out the possibility of breast cancer occurrence. Data source is nothing but collection of data from various departments in hospitals. The different departments pass the data to the unified system to gather all the information. The heterogeneous data should be grouped to ensure that the process is done correctly. The result is based on the kind of algorithm involved in the data processing. The analyzer can give useful information based on the data passed for processing. Normally when the patient approaches a hospital for check-up he or she has to provide general details which can be grouped along with the laboratory analysis. Whenever the patient meets the doctor in the hospital he or she has to give the following personal details which are:

- Name of the Person
- State / Country
- Reference

- Age (normally greater than 30 years)
- Sex
- Religion (which focuses on vegetarian or non-vegetarian)
- Marital Status (Contraceptives /Abortions/Breast feeding duration)
- Educational Status (Awareness about breast cancer)

In medical history there are several factors related to the patient health condition that leads to breast cancer. Medical history involves different tests that take place in the laboratories and different departments using medical machines and tools. In some cases treatments may bring breast cancer risk like excess radiation exposure and hormone intake. The medical history¹ includes:

- Age of the Person
- Being female (Risk is more compared to male)
- Benign breast conditions (benign breast disease)
- Blood androgen levels
- Blood estrogen levels (hormone level)

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- Bone density
- Breast density on a mammogram (image representation)
- BMI (Body Mass Index – body fitness)
- Lobular Carcinoma In Situ (LCIS)
- Usage of contraceptives (avoid conceive)
- Abortions (change of body condition)
- Late Marriage and delivery
- Less breast feeding duration
- Radiation exposure in youth
- Personal history of cancer (anybody affected in the family through breast cancer, lung cancer , DCIS etc.,)

The life style of the patient relates to social activities like excess consumption of drinking and smoking. Now a days both men and women are get addicted to smoking and consumption of alcohol. They think that they can overcome out of the stress but it leads to a lot of health issues. Some believe it give them a social status to drink and smoke. Today we live in the age of live-in relationship which creates lots of problem especially among younger women. The usage of contraceptives to avoid pregnancy which in turn creates disastrous effects in the long run because female body has to undergo lots of changes after attaining puberty. Excess consumption of alcohol is directly connected to increased risk of developing breast cancer because of reduction in body activity^{2,3}. It may develop other issues in the body by developing several other types of cancer that leads to abnormal condition in the body. In general a person with less or no physical activity leads in gaining weight over a period of time which also results in breast cancer^{4,5}. In rural India, women from specific groups are drink excessively. Even though there is no direct connection between smoking and breast cancer, recent research shows a strong connection between the two. When women started smoking early the consumption rate is more when years pass by, which leads to increased risk of breast cancer⁶⁻⁸. Studies shows the gradual increase in smoking and how people get addicted to smoking.

2. Breast Cancer and Heredity

Gene transfer takes place from one generation to the next through parents to the new born child. The gene travels further to successive generations. There is a possibility of 5–10% of breast cancers based on inherited breast cancer

gene. Every one of us derive biological information from our parents. The first degree relatives can be from either side like paternal or maternal side. Even though there are multiple reasons, two main genes most commonly linked to an increased risk of breast cancer are BRCA1 and BRCA2⁹. There are other genes participating but the risk is low. If somebody's relatives diagnosed with breast cancer at an older age, it is not true to conclude because of inherited breast cancer gene. The reason may be a genetic change (mutation) that increases the risk of breast cancer. Our body lymphatic system is referred as the secondary circulatory system. The fundamental work of the lymphatic system is to collect excess fluid from the body tissues and circulates to the main bloodstream¹⁰. Sometime this system can play a very destructive and worrisome role in the spread of breast cancer. Components of the lymphatic system called lymph nodes are distributed at specific locations throughout the body. Breast tissues which includes an extensive network of lymphatic vessels plays a very important role to regulate the local fluid balance as well as in filtering out harmful and useless substances. Normal test like regular Breast Self Examination (BSE) can help find tumors during the initial stage of growth, hopefully before they spread quickly or metastasize to other parts¹¹. The person can easily sense changes in the breast, color change, change of shape, itching, irritation etc.

In anatomy, the genitourinary system or urogenital system is the system of the reproductive organs and the urinary system. Normally these are grouped together because of their close existence to each other and the usage of common outlets for passing urine and for sexual intercourse. For Breast Cancer details of genitourinary system that are usually extracted from the patient are Pregnancy Age, Number of Delivery (number of children born), Delivery age (Frequency of delivery based on number of children born), Usage of contraceptives (to avoid pregnancy), Miscarriages, Menarche (Attaining puberty – getting the first menstruation period) and Menopause (last menstruation). All these ages play a very important role and it can be used for further analysis. There is a possibility that even unmarried women can be affected by breast cancer because of the inherited genes like BRCA1 and BRCA2^{12,13} (Figure 1).

3. System Architecture

System Architecture provides a link between different modules in the system. Each module have multiple

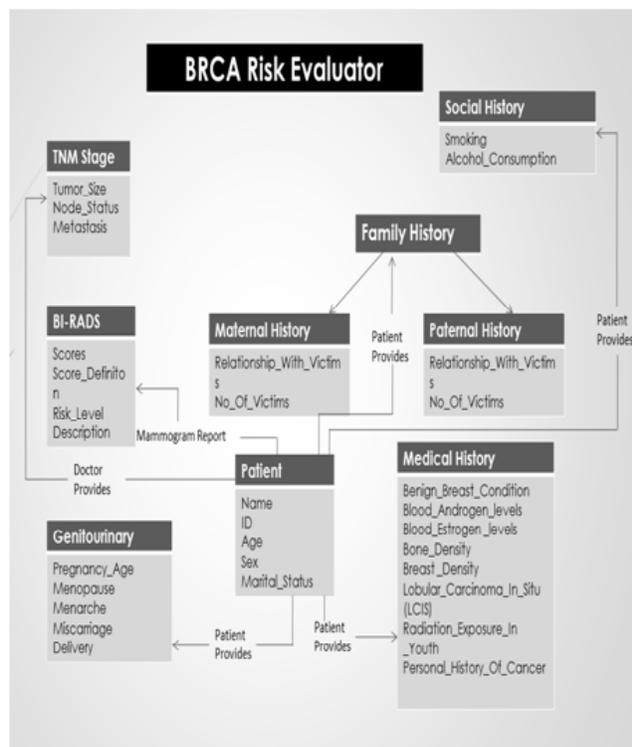


Figure 1. Breast Cancer Factors.

parameters and have the values Yes or No (1 or 0), based on the values, the result can be derived. Some of the values are directly given by patients and the remaining values be derived through medical tests. The medical results available from the laboratories and family history, Social history and Genitourinary system should be provided by the patients. When the doctor provides the information such as TNM Stage and BI-RADS score from the mammogram, medical reports along with patient information, the system encapsulates all the data into a unified schema and then process the inputs to show the result based on procedural steps implemented in the software tool. BI-RADS (Breast Imaging-Reporting and Data System), is a quality assurance tool originally designed and developed, through which the mammographic image can be analyzed but sometimes it does not show clear result when it is based on dense breast tissue. TNM which defines the Tumor size, Node status and Metastasis. The tumor size shows how long the cancer has been developed and the aggressiveness of the cancer to spread to other areas of the patient’s body. The diagrammatic representation which shows the connection between different parameters and the ways through which the information is provided.

4. Module Design

Breast Cancer Risk Evaluator consists of four modules. Each module has its specific operations which happen simultaneously and the final result can be calculated based on the inputs passed from each module to the final operations. The software has been developed in such a way that it collects the intermediate result from each module and further process for the final result. Each module has been created with multiple parameters, having close relationship with each other. The modules and the front-end are linked through the database connectivity (normally the primary key nothing but the patient ID or Number) and with the effective use of different normalization techniques. The four modules which have been implemented are: Personal Details module, Family History module, BIRADS Score module, TNM Staging module. Each of these modules are very basic but important in Breast Cancer Analysis. These modules will help us produce more effective results in terms of final outcome.

5. The E-R Diagram

The Entity-Relationship diagram is nothing but the relationship between different entities. The diagrammatic representation explains the entity attributes and relationship between different entities. In general, all the human body parts are related to each other. The functioning of the body parts depend on other parts, likewise breast cancer are also be based on various factors. Each entity has direct influence on other entity. Each patient has multiple details like patient name, age, ethnicity, gender, etc. As we know that being a female has higher chances of causing breast cancer compared to male. Age also is a main factor and have related details like puberty, age of marriage, age of pregnancy, etc. These details can be properly designated by using different symbols to make the Entity-Relationship diagram which gives the common idea about breast cancer (Figure 2).

6. Code Design

The data can be retrieved from the back end database but the front end software program should be ready to interact with the database. The software code is nothing but programming instruction which deals with input,

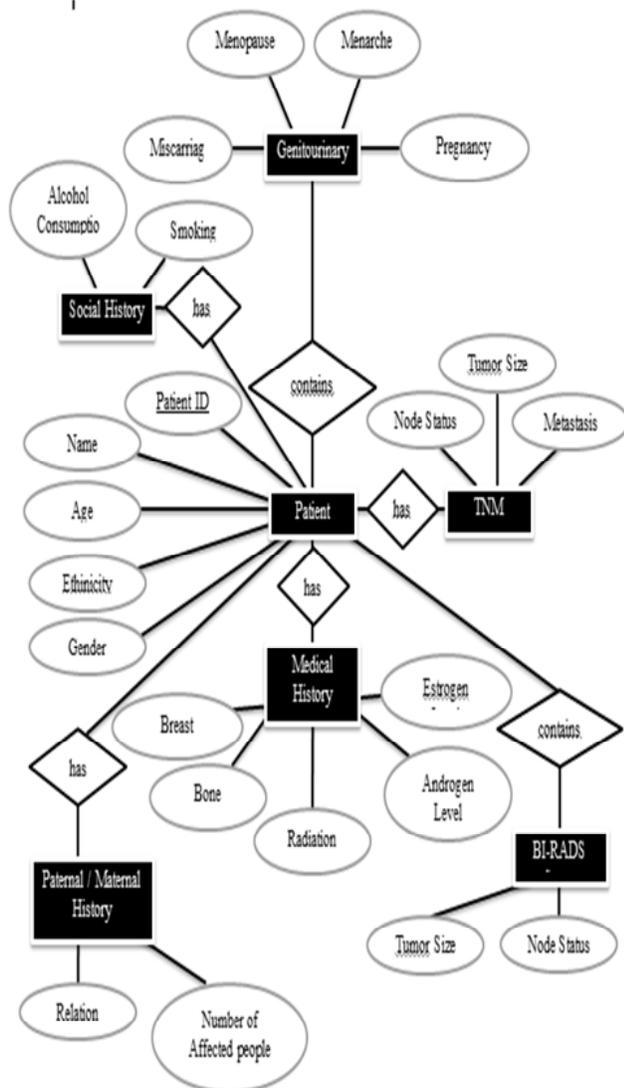


Figure 2. Entity-Relationship Diagram.

process and output delivery. The working principle based on client – server architecture is nothing but the client requesting the server to operate the input passed by the client, the server responds accordingly by processing the input and passes the output result to the client. .Net, HTML, CSS3, JavaScript are used as front end and MySQL Server as back end. There are different tables designed based on the module. When the patient and the doctor gives the data, all reach the centralized database and are stored. The process starts by collecting the information from the database and process as per the software code implementation. There are seven forms created, based on Personal details, Family details, Medical history, Social history, Genitourinary, BI-RADS scoring

and TNM-Staging. While processing it will connect all the data and show the result. The sample code is as follows:

Medical Page

```

package com.project.DAO;
import org.springframework.beans.factory.annotation.
    Autowired;
import org.springframework.orm.hibernate3.
    HibernateTemplate;
import com.project.persistence.Medical;
import com.project.to.MedicalTo;
public class HibernateMedicalDao implements
    MedicalDao{
    @Autowired
    HibernateTemplate hibernateTemplate;
    public void addInfo(MedicalTo medicalTo) {
        System.out.println(" addInfo in HibernateMedicalDao ");
        Medical medical=new Medical( medicalTo.
            getPatient(),medicalTo.getBreastDensity(),medicalTo.
            getBoneDensity() , medicalTo.getAdrogen(),
            medicalTo.getEstrogen(), medicalTo.getBenign(),
            medicalTo.getRadiation(), medicalTo.getLcis());
        hibernateTemplate.save(medical);}}
package com.project.mvc;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import org.springframework.beans.factory.annotation.
    Autowired;
import org.springframework.stereotype.Controller;
import org.springframework.web.bind.annotation.
    RequestMapping;
import org.springframework.web.bind.annotation.
    SessionAttributes;
import com.project.Service.MedicalService;
import com.project.to.MedicalTo;
@Controller
@SessionAttributes
public class Medicalcontroller {
    @Autowired
    @RequestMapping("/medical")
    public String addInfo(HttpServletRequest request,Http
        Servlet response)
    {
        System.out.println("RegisterController class use-
            InitialReg()");
        String breastdensity=request.
            getParameter("breastdensity");
    }
}

```

```
String bonedensity=request.
getParameter("bonedensity");
String adrogen=request.getParameter("adrogen");
String estrogen=request.getParameter("estrogen");
String benign =request.getParameter("benign");
String radiation =request.
getParameter("radiation");
String lcis =request.getParameter("lcis");
MedicalTo medicalTo=new MedicalTo();
medicalTo.setBreastDensity(breastdensity);
medicalTo.setBoneDensity(bonedensity);
medicalTo.setAdrogen(adrogen);
medicalTo.setEstrogen(estrogen);
medicalTo.setBenign(benign);
medicalTo.setRadiation(radiation);
medicalTo.setLcis(lcis);
medicalService.addInfo(medicalTo);
System.out.println("Operation Completed");
return "Genitourinary";}
```

7. User Interface Screen Design

The User Interface design is user-friendly and clearly shows how the user enters the data into the system (Figure 3). It has been designed as per the end-user convenience. The end-user easily enters the data to process the data in the system. The interface of Breast Cancer Risk Evaluator system is very user-friendly and quite easy for anyone to use it in their day-to-day operations.

E.g. Personal and family details (Figure 4), Medical history (Figure 5) and TNM –Staging

Three to four decades ago people affected by cancers were not common. But in the present world mostly in developed countries people affected by cancers are common. It is the increasing trend, also in the developing countries like India. It is increasing in urban India compare to rural



Figure 3. Login-EntryForm.

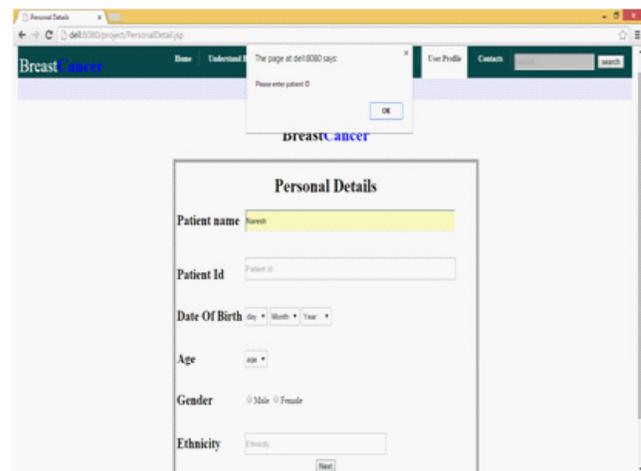


Figure 4. Personal Details Form.



Figure 5. Medical History Form.

India. The main reason for this is changing lifestyle, food habits and lack of exercise¹⁴. The period of Breast feeding is gradually falling because women are beauty conscious. Only a small percentage of breast cancer occurs through gene transfer by successive generations, but various other reasons involved. Everyone has to maintain a correct Body Mass Index (BMI) throughout their life time. Naturally female have to undergo many changes after menarche, marriage, pregnancy and delivery¹⁵. It has been noticed that the sudden increase of body weight and breast size leads to chance of getting breast cancer after some years in their life time.

8. Conclusion

This paper gives an idea of how the breast cancer affects an individual, different factors, the relationship between different modules, how the data can be passed, how the

data processing happens in the system and based on all these the risk can be evaluated. The final result is calculated based on values accessed from different modules. Each module has its importance based on input received from patients and through medical analysis report. The amalgamation of this information goes into the software which analyses based on the importance given in the level of different points system. Whatever tables are created can be combined and analyzed through the different normalization mechanism. The values combined and computed accordingly based on the conditions passed in the software tool. The output level varies from 1 to 10. If the final value is 1 means risk is very low, when the value increases accordingly the risk also increases. Value 10 depicts the patient in critical and in high risk. Based on the output the doctor can understand the situation and accordingly suggests various medical options and procedures.

In general Breast Self Examination (BSE) and Clinical Breast Examination (CBE) are commonly administered to women, to analyze and check their breasts periodically and it can be done through clinical expert or on their own. Whenever the any woman comes across changes in the breast such as color change, irritation, nipple discharge and lump, they should meet the doctor immediately. Not only breast cancer but any type of cancer is curable if it is detected early. Breast Cancer treatment costs more and not affordable to the major portion of patients in India. Only 38% people can afford to meet the treatment cost, remaining 62% people do not turn up for further treatment because of increasing treatment cost. The early detection of Breast Cancer is completely curable by consulting a doctor and medical treatment. Even during the advanced stage, it is possible to extend patient's survival time.

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