2.1. Breast Cancer Domain

2.1.1. Introduction

Day by day breast cancer, a global problem, is intensified except some developed countries. According to the American Cancer Society, the estimated new breast cancer cases are 229,060 (both sexes) in United States only in the year 2012 [1]. The estimated deaths are 39,920 (both sexes); 410 (men) and 39,510 (female). In women after lung cancer, breast cancer ranks second as a cause of death. From different angles global efforts are on to manage the menace. Clinical and medical research, diagnostic procedures and equipments are some of the major areas of exploration.

2.1.2. Mortality Rate

Cancer is a group of diseases which cause abnormal change and grow of cells in the body. Cancer cells form a tumor and are named after the originating body part. Breast tissues are made up of lobules, glands producing milk, and ducts which links the lobules to the nipple. The remaining part is fatty, connective and lymphatic tissues. Two types of breast cancer are 1) Non-invasive and 2) Invasive.

In situ type breast cancers are considered as non-invasive as it do not grow beyond the layers of cells where the abnormal cells are generated. In DCIS (Ductal carcinoma in situ) normal epithelial cells of the cells are replaced by abnormal cells which may greatly expand the ducts and lobules. In LCIS (Lobular carcinoma in situ) cancer cells grow within lobules of the breast. Other in situ type breast cancers possess the properties of both DCIS and LCIS.

Most of the breast cancers are infiltrating or invasive. In invasive type the cancer spreads and grows through the walls of the glands or ducts where the abnormal cells are originated. The classification of tumors assign a stage of 0, I, II, III, or IV to breast cancer. Stage 0 means the breast cancer is in situ. Stage I stands for early stage of breast cancer. Stage IV is the most advanced stage.

The Table 2.1 shows the estimated new female breast cancer cases and deaths by age in United States in the year 2015. Total numbers of new cases of invasive breast
cancer are approximately 231,840, out of which 40,290 deaths are expected among US women in 2015 and total number of in situ breast cancers are about 60,290 in US women in the year 2015. The median age at diagnosis for female breast cancer is 61 years [2].

Table 2.1. Estimated New Female Breast Cancer Cases and Deaths by Age, United States [2]

<table>
<thead>
<tr>
<th>AGES</th>
<th>IN SITU CASES</th>
<th>INVASIVE CASES</th>
<th>DEATHS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NUMBER</td>
<td>%</td>
<td>NUMBER</td>
</tr>
<tr>
<td>&lt;40</td>
<td>1,650</td>
<td>3%</td>
<td>10,500</td>
</tr>
<tr>
<td>40-49</td>
<td>12,310</td>
<td>20%</td>
<td>35,850</td>
</tr>
<tr>
<td>50-59</td>
<td>16,970</td>
<td>28%</td>
<td>54,060</td>
</tr>
<tr>
<td>60-69</td>
<td>15,850</td>
<td>26%</td>
<td>59,990</td>
</tr>
<tr>
<td>70-79</td>
<td>9,650</td>
<td>16%</td>
<td>42,480</td>
</tr>
<tr>
<td>80+</td>
<td>3,860</td>
<td>6%</td>
<td>28,960</td>
</tr>
<tr>
<td>All ages</td>
<td>60,290</td>
<td></td>
<td>231,840</td>
</tr>
</tbody>
</table>

*Rounded to the nearest 10 cases. Percentages may not sum to 100% due to rounding.

Figure 2.1 [3] represent incidence rates and mortality rates for female breast cancers by age in United States from 1975 to 2012. From the figure it is evident that in the year 1980s for women aged 40 years and older the incidence rates increased rapidly. In 1990s incidence rates stabilized for women aged 40, but increased for women aged 50 and above due to some reasons like obesity and the use of menopausal hormones. Incidence rates for women aged 20 to 39 years increased only 0.6% from 1994 to 2012. For women aged 40 years incidence rates remained stable since 1986 and so also for women aged 50 from 2006 to 2012. Incidence rates for women aged 60 increased 1.0% per year since 2004 and for women aged 70 and more the
incidence rates of breast cancer increased 1.2% per year since 2005. From Figure 2.1 it is also evident that in United States mortality rates for women of all ages decrease gradually since 1990.

Figure 2.1. Incidence and Mortality Rates of Female Breast Cancer by Age, United States, 1975 to 2012 [3]

2.1.3. Mortality rate in India and Global Comparison

Recently in most cities of India breast cancer is the most common cancer and second most common in rural areas. Presently, out of every 100 breast cancer patients 4% are aged 20 to 30 years, 16% are of 30 years old and 40.28% are aged 40 to 50 years group. In India, of all female cancers, breast cancer accounts for 25% to 32% [4].

One third of the global breast cancer patients are collectively in United States of
America, India and China. Table 2.2 [4] reflects breast cancer incidence and mortality in USA, India and China in the year 2012 according to International Agency for Research on Cancer (WHO). From the table it can be said that in USA one female for every five or six women newly diagnosed with breast cancer is dying of it. In China one lady for every four female diagnosed with breast cancer is dying of it. Whereas in India one for every two women diagnosed with breast cancer is dying. In India the breast cancer growth rate should be controlled immediately to prevent major shock.

<table>
<thead>
<tr>
<th>Breast Cancer</th>
<th>Country</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence - Female</td>
<td>USA</td>
<td>2,32,714</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>1,87,213</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>1,44,937</td>
</tr>
<tr>
<td>Mortality - Female</td>
<td>USA</td>
<td>43,909</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>47,984</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>70,218</td>
</tr>
</tbody>
</table>

Figure 2.2 [5] show the distribution of new cases of breast cancer along with deaths due to this reason and survivals. 59.69% of total world populations belong to Asian countries which represent 39% of the total new breast cancer cases, 44% of deaths, and 37% of survivors in world context. Northern America representing only 5% of global population has the burden of breast cancer with 15% of new cases, 9% of deaths and 17% of survivors showing high incidence and survival rates. African countries represent 15% of global population accounts for 8% of the new breast cancer cases, but 12% of deaths due to this reason indicating poor survivals because of late diagnosis and limited treatment.
2.1.4. Reasons of Breast Cancer

Most of the breast cancer cases occur in women aged over 50 [2]. Number of factors are responsible for increasing risk of developing breast cancer in women:

i) Genetic history: Women having family history of breast cancer are at a high risk of developing breast cancer.

ii) Medical history: Women suffered with benign breast cancer earlier are at a high risk of growing breast cancer in future.

Figure 2.2. Distribution of Estimated New Breast Cancer Cases, Deaths, and Survivors [5].
iii) Late age at first pregnancy: Older age at first live birth increases the risk for developing breast cancer.

iv) Long term hormonal therapy: Prolonged effect on sex hormone levels in premenopausal women increases the risk of developing breast cancer [6]. Hormone replacement therapy after menopause also increases the risk of breast cancer.

v) Life style: Consumption of high fat diet like red meat, processed meat, animal fat and alcohol can cause breast cancer. Obesity or overweight cause hyperinsulinemia and insulin resistance, which in turn reported to be high risk factors for breast cancer [7].

vi) Breast feeding: Long duration breast feeding reduces the risk factor for breast cancer for a woman.

2.1.5. Issues Related to Breast Cancer Diagnosis and Strategies to Overcome

Early diagnosis of breast cancer is highly solicited for augmenting survivability. Some of the issues related to delayed diagnosis of breast cancer are discussed below:

- **Breast cancer diagnosis procedure**

  Three methods to diagnose breast cancer are: surgical biopsy, mammography and FNAC (Fine Needle Aspiration Cytology).

  ➢ **Surgical biopsy**: Local anesthesia is necessary for the patient undergoing surgical biopsy. In this case a surgeon produces 1 to 2 inch cut on the breast to remove all or part of the abnormal mass and often normal like tissues. These tissues are examined in pathological laboratory under microscope to check for malignancy. Surgical biopsy is the only test by which one can detect definitely whether the suspicious area is benign or malignant. At the end of the surgical biopsy procedure, a marking is placed in the infected area. Laboratory tests required 2 weak to issue report. Reports of biopsy include:

    ▪ The cells in the lump are benign or non-cancerous.
- The cells in the lump are malignant or cancerous.

- Grade and type of cancerous cells if present. It also points out margin, where positive margin indicates cancerous cells are present at the margin of the tumor, negative margin stands for cancerous cells are absent at the margin of the tumor, and close margin means cancerous cells are very much closed to the margin. In case of positive margin the cancer spreads beyond the infected area. In case of negative margin the cancer is confined inside the tumor. In case of close margin the distance between cancer cells and normal cells is less than 3 millimeter.

The accuracy of surgical biopsy is nearly 100%, but it is costly, invasive, time consuming and also painful [8].

- **Mammography**: It is an X-ray of the breast. Two types of mammogram are: diagnostic mammogram and screening mammogram. Diagnostic mammogram takes more time than screening mammogram as it takes more X-ray photography of the breast from different vantage points. In this process of mammography image of breast has been taken by a specialist using X-ray for investigation. The images are called mammogram. Lump, cyst, fatty cells and even microcalcifications can be detected in mammogram. For any abnormality of cells further tests may be advised for confirmation. If any area in breast is found suspicious, specialist suggests more tests like ultrasound or MRI for clearer or more precise image of the suspicious area. If these tests detect any solid mass, the observant is recommended for other test like surgical biopsy or fine needle aspiration cytology for detection of malignancy. Findings on mammogram are as follows:

  - Oval or round patches with distinct borders on mammogram indicate benign lump or tumor or cyst or fibroadenomas.
  
  - Bright white spots indicate calcifications.
  
  - Cluster of microcalcifications indicate chance of noninvasive breast cancer as it is very difficult to be confirmed about it from the image.
- White patch or mass is an indication of invasive breast cancer in which clear border around the tumor cells disappeared.

In some centres reports can be obtained at the time of screening or investigation. Other centres, where the facilities are not available may take 2 weak to issue report. Accuracy of mammography varies from 68% to 79% only [9].

**FNAC**

- Fine needle aspiration cytology is a quick and simple procedure in which aspiration of a syringe is continued by in and out movement of a hollow fine needle which is protruded from the syringe and inserted into the tumor. As a result small amount of tissues from the lump or cyst or the suspicious area in the breast are collected and has been sent to pathological laboratory. This procedure of collecting sample is nearly same as blood sample collection procedure. In pathological laboratory a specialist or cytologist investigate the sample under the microscope for cancer cells. The total procedure of collecting sample and examining it called FNAC in together. No special prior preparation for performing this test is necessary. Sometimes the test may be uncomfortable or painful for the patient. Local anesthesia can be suggested in some cases if required to avoid pain. Some of the effects after performing FNA are:
  - pain
  - minimal bleeding or bruising and swelling

Doctor or nurse advised the procedure of taking care of the investigating site. Total procedure of FNAC can be done quickly. Time required to collect sample is 10 to 20 seconds. Sample may be collected more than once as directed by doctor. This is due to the reason of ensuring good sample collection. Examination procedure takes only 20 to 30 minutes.

Some risk factors of FNA are:
  - post effect bleeding and bruising.
  - if the position of lump is deep inside a small breast, complications of Pneumothorax may happen.
  - FNA is not 100% accurate.
Accuracy of FNAC with visual interpretation varies from 65% to 98% [10] depending on the experience of the doctor.

2.2. Cardiac Arrhythmia Domain

2.2.1. Introduction

At present cardiac arrhythmia has become one of the major problems world-wide. It affects not only male and female of older ages, but young people of ages 20s and 30s are also diagnosed with this disease nowadays. Growing obesity among young adults is one of the reasons behind it. Figure 2.3 shows normal heart and heart with cardiac arrhythmia.

![Cardiac arrhythmia](image)

**Figure 2.3. Normal Heart and heart with Cardiac Arrhythmia**

There are four chambers in our heart — two upper chambers known as atria and two lower chambers known as ventricles. The sinus node, a natural pacemaker, normally controls the rhythm of heart. The sinus node is located in the right atrium. Normally each heart beat initiated by the electrical impulses, which is produced by sinus node.
The electrical impulses from the sinus node move across the atria, which causes the muscles of atria to contract and as a result blood is pumped into the ventricles. When the signal reach atrioventricular node (AV node), generally the only pathway of electrical impulse from atria to the ventricles, it slows down the electrical signal, which in turn helps the ventricles to fill with blood due to this slight delay. The contraction of muscles of the ventricles due to electric impulses causes the muscles to pump blood to lungs or to the rest of the body. In a normal and healthy heart, this process of pumping blood usually goes smoothly, causing normal heart rate of 60 to 100 beats a minute. If the electrical impulses, which cause heart to beat, are not working properly, results in cardiac arrhythmia. Due to this reason the heart beat may be too slow or too fast or in irregular fashion.

Early management of this disease and proper medication can save lives in case of sudden deaths [11]. ECG or EKG (Electrocardiogram) is one of the main diagnostic tools to detect heart function which produces a graphical diagram of heart’s electrical impulses. Cardiac arrhythmia means irregular heart beat: either heart beat rate is too slow (less than 60 beats per minute) referred to as Bradycardia or heart beat rate is too fast (more than 100 beats per minute) referred to as Tachycardia [Figure 2.4]. Heart’s ability to pump blood may be reduced due to severe cardiac arrhythmia, which can cause pain in chest, dizziness, fainting, shortness of breath etc.
2.2.2 Mortality Rate

A life threatening situation can arise when heart’s ability to do work reduced greatly for a prolonged time. Recently cardiovascular diseases have become one of the major causes of death in both developed and developing countries. Sudden losses of ability of heart to work in an individual may or may not have previously identified with cardiac diseases can cause unexpected death. Patients with Coronary Artery disease (CAD) have the complications of Ventricular Tachycardia which causes majority of fatal cases that occurs in the acute stage of ischemia. According to American Heart Association 81.1 million adults of America are suffering from one or more types of cardiovascular diseases (CVDs) and among them 34.3% death cases are reported due to this cause in 2009 [12]. Year-wise statistics of cardiac arrests due to heart diseases and stroke from 2012 to 2016 are given in Table 2.3 [13] as published by American Heart Association.
<table>
<thead>
<tr>
<th>Year</th>
<th>Out of hospital cardiac arrest</th>
<th>In – hospital cardiac arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Incidence: more than 350,000</td>
<td>Incidence: 209,000</td>
</tr>
<tr>
<td></td>
<td>Survival rate: 12%</td>
<td>Survival rate (Adult): 24.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival rate (Children): not available</td>
</tr>
<tr>
<td>2015</td>
<td>Incidence: 326,000</td>
<td>Incidence: 209,000</td>
</tr>
<tr>
<td></td>
<td>Survival rate: 10.6%</td>
<td>Survival rate (Adult): 25.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival rate (Children): not available</td>
</tr>
<tr>
<td>2014</td>
<td>Incidence: 424,000</td>
<td>Incidence: 209,000</td>
</tr>
<tr>
<td></td>
<td>Survival rate: 10.4%</td>
<td>Survival rate (Adult): 22.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival rate (Children): 36.8%</td>
</tr>
<tr>
<td>2013</td>
<td>Incidence: 359,400</td>
<td>Incidence: 209,000</td>
</tr>
<tr>
<td></td>
<td>Survival rate: 9.5%</td>
<td>Survival rate (Adult): 23.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival rate (Children): 40.2%</td>
</tr>
<tr>
<td>2012</td>
<td>Incidence: 382,000</td>
<td>Incidence: 209,000</td>
</tr>
<tr>
<td></td>
<td>Survival rate: 11.4%</td>
<td>Survival rate (Adult): 23.1%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Survival rate (Children): 35%</td>
</tr>
</tbody>
</table>
2.2.3. Mortality Rate in India

Most of the literatures used sudden cardiac death (SCD) statistics as obtained from different studies made on data available for North America and Western Europe. Very few Asian countries conducted studies to estimate incidence of SCD. Recently Coronary Artery Disease (CAD) in India is increasing which causes an increase in sudden cardiac death. A study based on verbal autopsy by Rao et. al. in 2012 reported that 10.3% of overall mortality are due to SCD [14].

Incidence of SCD is high at infancy and beyond the age of 45 years irrespective of sex and race as the risk of CAD increases with increasing age. Arrhythmogenic disorder is one of the common causes of SCD in young population. Ventricular Tachycardia is one of the main reasons of SCD occurrence. In a study 70% of SCD patients are identified with Ventricular Tachycardia if detected within five minutes of cardiac arrest, which reduced to 43% if detected later in the incident [15].

2.2.4. Reasons of Cardiac Arrhythmia

Some internal and external factors are responsible for Cardiac Arrhythmia. Fever, a temporary internal factor disorders heart rhythm temporarily. Some other factors are responsible for permanent disorder of heart rhythm. These factors are discussed below:

**External Factors:**
- Anxiety, fear, mental stress, nervousness.
- Alcohol, Caffeine (from coffee), toxins, drugs.
- Hormonal medication such as thyroid hormones.

**Internal Factors:**
- Temporary factors like infections, fever, electrolyte imbalance such as Potassium disorder.
- Heart attack or stroke or Coronary Artery Disease.
- Hypertension.
- Inflammation of muscle of heart.
- Structural problems of heart.
- Thyroid diseases.
- Problems in electrical impulse generation and propagation system.

2.2.5. Issues Related to Cardiac Arrhythmia Diagnosis

Specialists used to review symptoms, family history, health habits such as physical activity, smoking etc. and then conducted some physical examinations like listen to rate and rhythm of heartbeat, check pulse to detect how fast heart is beating etc. Doctors also used to perform some tests to monitor heart which may include:

- **Electrocardiogram (ECG)**: Using this test abnormal rhythm of heartbeat can be detected by measuring timings and duration of each electrical phase of heartbeat.

- **Echocardiogram**: This test is performed to produce an image of heart’s size, structure and motion.

- **Holter monitor**: In this case a portable ECG device is attached to the body of the patient for a day or more to record activity of heart.

- **Event monitor**: In this case also patients are used to wear a portable ECG device and by pressing a switch activity of heart can be recorded during an incidence of symptoms.

- **Stress test**: In this case activity of heart is monitored while patients are exercised on treadmill or on bicycle.

- **Tilt table test**: This test is used to record heart rate and blood pressure during different positions of the body.

- **Electrophysiological testing and mapping**: In this case electrodes are placed at different spots within heart to map spread of electrical impulses within heart to detect the location of arrhythmia and the cause.
Automated ECG classification techniques attempt to diagnose cardiac arrhythmia using known data set. Recently, it has become an emerging tool for specialists to diagnose cardiac arrhythmia due to following reasons:

- Analyzing ECG reports visually is complex and also time consuming. Expertise is required to detect problems in ECG [16].
- Moreover most of the above tests are not available in all health centres especially in rural areas.
- In India health services and health personnel are not sufficient in comparison to population and also not distributed equally across and within states. People in rural areas are suffering from poor health related services.
- Early diagnosis is needed to prevent major damages.

2.3. Hepatitis Disease Domain

2.3.1. Introduction

Hepatitis disease is a systematic infection related to liver which is very vital organ. It causes an inflammation of the liver without pinpointing any specific reason [17]. There are five viruses known as hepatotropic viruses, which are responsible for causing hepatitis: A-virus (HAV), B-virus (HBV), C-virus (HCV), D-virus (HDV) and E-virus (HEV). In the recent years it has become one of the major diseases worldwide. More casualties are reported due to this reason. At present there are 2 million people infected with Hepatitis-B virus, and 200,000 to 300,000 people infected with Hepatitis-C virus [18]. Infection with HAV or HEV can cause sudden fever, jaundice and in some persons acute liver failure (ALF). Infection with HBV, HCV or HDV can cause liver cirrhosis or liver cancer.

2.3.2. Mortality Rate

According to WHO Global Hepatitis report 97% of all hepatitis mortality are caused by HBV and HCV in the Western Pacific region. Remaining 3% of deaths in the region are due to HEV and acute hepatitis B. In 2015, 1.34 million deaths are caused by viral hepatitis, which is increasing over time. In 2015, 720,000 people were died due to cirrhosis of liver and 470,000 people were died due to hepatocellular carcinoma. In
2015 there are 257 million people infected with HBV and 71 million people infected with HCV. Hepatitis disease related deaths are more in China followed by Philippines and Viet Nam. Figure 2.4 and Figure 2.5 show country-wise hepatitis disease mortality in 2015.

Year wise incidence of hepatitis A, hepatitis B and hepatitis C in United States from 1980 to 2014 are illustrated in Figure 2.6, Figure 2.7, and Figure 2.8 respectively [19].

Figure 2.6. Reported Cases of Hepatitis A: Na onally and by State or Jurisdiction – United States, 1980 – 2014 [19].
2.3.3. Mortality Rate in India

In India, viral hepatitis is one of the major health problems. The country has a burden of 40 million people, who are infected with HBV i.e. 11% of the global
burden. 3% to 4% of Indian population is infected with HBV. In India, the prevalence of viral hepatitis varies from region to region and the percentage of HBV infected people is recorded as the highest in native Andaman and Arunachal Pradesh. Tribal areas are suffering more from this disease in comparison to non-tribal areas as obtained from different statistical reports. Prevalence of population with HCV infection in India is around 1%. Prevalence of HCV is higher in Punjab, Haryana, Andhra Pradesh, Puducherry, Arunachal Pradesh and Mizoram. Acute viral hepatitis and acute liver failure are mainly caused by HAV and HEV. HAV causes 10% to 30% of acute hepatitis and HEV causes 10% to 40% of acute hepatitis in India. In India, 5% to 15% of acute liver failure and 15% to 45% of acute liver failure are caused by HAV and HEV respectively [20].

2.3.4. Reasons of Hepatitis

Three main viruses causing hepatitis are HAV, HBV and HCV. Hepatitis A, B and C may be acute and can last for not more than six months. Hepatitis B and C can be chronic and may last for long period of time. Each of these hepatitis transmits in different ways as described below:

- **Hepatitis A**
  
  HAV causing hepatitis – A is mainly transmitted to human body through food and water contaminated with this virus. Injection syringe and anal-oral contacts are also sources of this virus. Undeveloped areas having poor sanitation are at risk of spreading HAV.

- **Hepatitis B**
  
  Hepatitis – B is caused by contacting with body fluids like blood, saliva, semen etc. infected with HBV. It can transmit to an infant during breast feeding if the mother is infected with this virus.

- **Hepatitis C**
  
  This disease is mainly transmitted due to the poor health care system in terms of infection control. HCV, which causes this disease spreads through different injuries on the skin.
• Hepatitis – D

Like hepatitis – B, hepatitis – D also transmitted through contact with blood or blood products infected with HDV. In case of HDV there is a little possibility of vertical transmission.

• Hepatitis – E

HEV causing hepatitis – E is mainly transmitted through drinking water contaminated with faeces of infected people. Poor sanitation is the main cause of this type of contamination. Undercooked meat of infected animal and transfusion of blood products infected with HEV are other routes of this disease. Vertical transmission is also possible from an infected pregnant woman to her fetus.

2.3.5. Issues Related to Hepatitis Disease Diagnosis

Diagnosis of viral hepatitis can be done by examining physical conditions of patient and the reports of blood tests for hepatitis antibodies as prescribed by physicians. In addition some other tests are performed to detect liver functions. Different types of viral hepatitis causes similar symptoms to patients infected with the disease. For this reason laboratory testing must be needed to detect an individual is suffering from which type of hepatitis. Different blood tests which are performed to diagnose each type of hepatitis are given in Table 2.4.
<table>
<thead>
<tr>
<th>Test</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAV</td>
<td></td>
</tr>
<tr>
<td>HAV IgM</td>
<td>Positive indicates infection. Negative indicates no infection.</td>
</tr>
<tr>
<td>HAV total Ab</td>
<td>Positive indicates immunity against HAV infection.</td>
</tr>
<tr>
<td>HBV</td>
<td></td>
</tr>
<tr>
<td>HBs Ag</td>
<td>Positive result indicates infected with HBV.</td>
</tr>
<tr>
<td>HBc total Ab</td>
<td>Positive report indicates present or past infection with HBV.</td>
</tr>
<tr>
<td>HBc Ab IgM</td>
<td>Positive result determines age of infection (4 to 6 months).</td>
</tr>
<tr>
<td>HBe Ag</td>
<td>Positive result indicates high infectivity.</td>
</tr>
<tr>
<td>HBs Ab</td>
<td>Positive report represents immunity against HBV.</td>
</tr>
<tr>
<td>HCV</td>
<td></td>
</tr>
<tr>
<td>HCV Ab</td>
<td>Positive report with positive result of HCV RNA indicates infection with HCV.</td>
</tr>
<tr>
<td>HCV RNA</td>
<td>Positive result indicates HCV infection.</td>
</tr>
<tr>
<td>HDV</td>
<td></td>
</tr>
<tr>
<td>HDV total Ab</td>
<td>Positive report with the positive result of HBs Ag indicates HBV/HDV coinfection.</td>
</tr>
<tr>
<td>HDV IgM</td>
<td>Presence with the positive report of HBs Ag indicates coinfection with HBV/HDV.</td>
</tr>
</tbody>
</table>

### 2.4. Issues Related to Healthcare Service in India

In terms of population India is the second highest country in the world. Birth rates continue to be increasing in most of the states in India. Increasing population in India causes the present health care structure to become overburdened. Major problems
in this respect are discussed follows:

- **Poor health services in rural areas**

  Though 75% of total population are in rural areas, most of the hospitals are in urban areas and cities. Moreover doctors are not preferring to serve in rural health centres. This service is largely provided by urban hospitals. Health care service in rural areas should not be neglected.

- **Unavailability of modern health services**

  Modern health facilities are only available in urban areas and especially in metropolitan cities, while rural and remote areas are underserved. For this reason people from rural areas are suffering more to have modern health services. Unavailability of modern diagnostic methods at all parts of the country causes a delay in diagnosis and treatment. The growth of health services should be balanced at all parts throughout the country.

- **Shortage of manpower**

  Shortage of doctors, nurses and other staffs related to health care service is a real problem in India. In India there are only 0.9 doctors per 1000 people as per report published in 2010. For this reason doctors are overburdened. Availability of expert clinicians may help to reduce the delay in medical diagnosis. Care should be taken in this matter to avoid delay in proper diagnosis.

- **Need of improved health care system**

  Improved health care system should be provided in all areas to detect diseases at an early stage to reduce mortality and morbidity rates. Some programmes and policies should be implanted after collecting sufficient data. Awareness campaigning is required to prevent delayed diagnosis of different diseases as well as to increase survival rate.

- **Skill development programme**

  More programmes to improve knowledge and skill of technical staff associated with health care system are urgently needed to diagnose the disease correctly. In rural and remote areas most of the people visits general practitioners for treatment and guidance initially. Most of these practitioners in rural areas are not highly qualified and do not have expertise in all streams. Quality improvement programmes in national level for all of these practitioners are needed for better management of diseases.
2.5. Needs of Alternate Health Care Management

Providing better health care management in all parts of India, especially in rural and remote areas, is a great challenge. India spends only 4.2% of GDP on health care services, which is very low. Rural populations are suffering from acute scarcity of domain experts, modern diagnosing methods and poor health services. Doctors are also overburdened, which is a real problem indeed. Delayed diagnosis of diseases in underserved areas is a vital cause of mortality.

Sufficient numbers of experienced specialist from different domain are needed for providing better health care services. Unfortunately doctors are not willing to serve in rural and remote areas.

The reasons as stated above leading to consider of an alternative health care management system. An automated system such as Expert System (ES) or Decision Support System (DSS) might be useful. This may help to process information as collected from patients and diagnose the diseases. It might be capable of providing future treatment plan as well.

Health care service providers are processing huge data about various symptoms and diseases regularly due to increasing number of patients. Few of these data are uncertain and unrelated. Thus a proper way to classify data as well as proper data mining techniques is absolutely required, which are discussed on the next few chapters.

2.6. Conclusion

Early diagnosis of diseases and better treatment planning are absolutely needed for augmenting survivability from different diseases, especially in remote and rural areas. Acute scarcity of experienced domain experts and staffs related to health care services and proper infrastructure in rural areas are the main reasons for poor health care service in India, which demanding the need of automated expert system for early management of the diseases. This automated system may assist health personnel in diagnosing diseases and making decisions accurately.
References


