Chapter 2

Literature Survey

This chapter represents the concept of clinical decision support system, early timeline, architecture, methodology, selection & implementation guidelines and its application in Oncology. It also portrays the existing clinical decision support system in practice with respect to breast and cervix cancer. The limitations of the system are being addressed to look for various approaches in overcoming these issues.

2.1 Introduction

Clinical Decision making is an essential component of healthcare service today. It involves the clinical reasoning, clinical judgment, clinical inference and diagnostic reasoning [33] and this depends on accurate data, pertinent knowledge and appropriate problem-solving skills [34] and to do this healthcare professionals always expect to have patient related information and the domain knowledge within a limited time range for quality decision making during the patient encounter.

During the last few decades, Information and Communication Technology (I&CT) has supported the healthcare professionals in managing the informa-
tion related to patient care, research and education.

2.2 Decision Support System

A Decision Support System is a computer based information system that supports the personnel and organization with internal and external data to aid decision making [35]. Earlier the systems were only used for the business industry but with the increased awareness of the potential of the information technology system, health care professionals have found the necessity of using the system for a number of purpose like gathering patient information, diagnosis, monitoring treatment steps, research retrieval of data, providing most effective support in decision making in critical situations etc. thus offering a comprehensive support system in healthcare practice.

2.3 Clinical Decision Support System

2.3.1 Introduction

Clinical Decision Support System (CDSS) provides healthcare professionals with patient-specific information and domain knowledge intelligently filtered and presented at appropriate times in an appropriate manner to enhance patient care [36]. It forms an integral part of healthcare system typically designed to integrate knowledge base, patient related information and inference engine to generate case-specific advice [37].

Musen defined the clinical decision support system as any software that takes the clinical situation of as an input and inferences as output that assist clinicians in quality decision making [38].

Wyatt j, Spiegelhalter [39], described Clinical Decision Support Systems as
an active knowledge system that accepts patient information, matches it with the specified rule, and executes case specific suggestion for quality decision making.

Miller and Geissbuhler [40] defined the Clinical Decision Support System as a computer-based algorithm that assists a clinician with one or more component steps of the diagnostic process.

Sim et al. [41] describes it as software meant for direct aid in clinical decision making where the characteristics of a particular patient are compared to a domain knowledge base and patient assessments data or recommendations and then are presented to the clinician for the quality decision making.

2.3.2 Historical Timeline in Clinical Decision Support System

During the last few decades, the utilization of Information & Communication Technology applications has been increased among healthcare professionals for patient care, research and education. Table 2.1 shows the early timeline in design & development of clinical decision support system.

<table>
<thead>
<tr>
<th>CDSS</th>
<th>Description</th>
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<tbody>
<tr>
<td>Mycin [42]</td>
<td>It uses a simple inference engine and knowledge base with 600 rules where clinicians have to answer a long series of Yes/No questions and that can lead to a probable diagnosis in each case.</td>
</tr>
<tr>
<td>Caduceus [43]</td>
<td>It supports the clinician in the diagnosis of 100 different diseases.</td>
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Health Information Management 12 MCOAHS, Manipal
<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
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<tbody>
<tr>
<td>Internist-1 [44]</td>
<td>It is a computer based diagnostic tool for internal medicine where the clinician has to pass the sign and symptoms, lab results and patient history into the system and in turn the system provides the possible diagnosis using the ranking algorithm.</td>
</tr>
<tr>
<td>DxPlain [45]</td>
<td>It is available through World Wide Web and contains 4,900 clinical manifestations dealing with over 2,200 unique diseases generating 230,000 unique disease interconnections. It supports the physicians by generating stratified diagnoses based on signs and symptoms, lab results and findings of patients.</td>
</tr>
<tr>
<td>Diagnosis Pro [46]</td>
<td>It covers 15,000 disease manifestations covering emergency medicine, internal medicine, pediatrics, OB-GYN etc. With having disease information for more than 7000 diseases, it is designed to support the physician in improving patient care and preventing diagnostic errors.</td>
</tr>
<tr>
<td>VisualDx [47]</td>
<td>It supports the clinicians with visual differential diagnoses based on the patient’s history of illness, signs and symptoms, where the clinicians can access more than 17,000 images and also the details of expert review for about 1,000 visually identifiable cases of disease, infection and drug reaction.</td>
</tr>
<tr>
<td>RODIA [48]</td>
<td>Relative Optical Density Image Analysis performs quantitative evaluation of medical images and fracture healing monitoring and is used in medical imaging, diagnostic, orthopedics and other healthcare disciplines.</td>
</tr>
<tr>
<td>System</td>
<td>Description</td>
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<tr>
<td>Leeds Abdominal Pain System [49]</td>
<td>It supports the physicians in clinical assessment based on Bayesian probability theory where the program accepts the patients related information and provides an assumption of conditional probability of various diagnoses and mutual exclusivity of the seven possible diagnosis.</td>
</tr>
<tr>
<td>HELP [50]</td>
<td>It is a knowledge base hospital information system with robust decision making functions through data interpretation, alerts, reminders, treatment management and suggestions using clinical protocols.</td>
</tr>
<tr>
<td>CASNET/ Glaucoma [51]</td>
<td>This expert system is used for the diagnosis and treatment of Glaucoma where the knowledge is represented in a casual associational network for describing the disease process.</td>
</tr>
<tr>
<td>ABEL [52]</td>
<td>ABEL [52] It is an expert system which employs the casual reasoning for the management of electrolyte and acid base derangement.</td>
</tr>
<tr>
<td>QMR [53]</td>
<td>It supports the clinicians with the knowledge base of disease conditions, findings and diagnosis. The system consists of information about 700 diseases and over 5000 signs, symptoms and laboratory details.</td>
</tr>
</tbody>
</table>

Table 2.1: Early Time in Development of Clinical Decision Support System
2.3.3 Phase model in architecture of Clinical Decision Support System

Wright A, Sittig DF [54] (Figure 2.1) has represented a four phase model in architecture of clinical decision support system since 1959. This timeline also shows the integration of clinical decision support system in clinical practice and healthcare systems.

![Figure 2.1: Four Phase Model of Clinical Decision Support System](image)

The above historical landmark represents the development of clinical decision support system in healthcare practice where the researchers have supported the healthcare team with various solutions in making quality decisions during the patient encounter. Many approaches are being used during each phase of implementation where the researchers have attempted to ease integrating clinical decision support system into clinical workflow and other information systems.
2.3.4 Clinical Decision Support System Architecture

A Clinical Decision Support System is designed and developed using various components. Figure 2.2 represents the architectural representation of a Clinical Decision Support System with the basic and essential components such as dialogue management, knowledge management, model management and data management.

![Figure 2.2: Conceptual Model of Clinical Decision Support System [55]](image)

The dialogue management builds the user interface to CDSS whereas data management builds connection for database and data warehouse to accessed and store patient related information received from other information system. The model management assists the user in analyzing the case at hand. The knowledge management supports with the easy retrieval, storage and dissemination of domain knowledge receives from internal and external sources.
2.3.5 Methodology for Clinical Decision Support System

There are many methodologies that can be used for the development of a clinical decision support system to support the clinicians in quality decision making. Some of the important methodologies are [56]:

2.3.5.1 Bayesian Network

Bayesian Network (BN) in Clinical Decision Support System supports the clinicians with a knowledge base graphical representation that shows the set of variables and their probabilistic relationship with the disease and symptoms. The system gives input interpretation of expert in the form of probability of disease and assists in decision making but it also represents the disadvantages where the system finds it difficult to get the possible diagnoses. The DxPlain is one of the good examples of CDSS with Bayesian methodologies where the diagnosis are being ranked with associated symptoms.

2.3.5.2 Neural Network

Artificial Neural Network (ANN) represents the non-knowledge-based adaptive Clinical Decision Support System. It uses artificial intelligence to allow the system to learn by itself from the disease pattern and past experiences / examples. It forms three layers; the Input (data receiver), Output (the result) and the Hidden (Process data) to supports quality decision making. The adaptive learning capability of the system processes incomplete data through informed guesses of the end user without any input. A large database is not required to store the outcome with its associated probabilities and due to this reason training the end user becomes more time consuming which leads to less acceptability of the system among the end users.
2.3.5.3 Genetic Algorithm

The Genetic Algorithm (GA) is based on Darvin’s theory of survival of the fittest. It derives the information from the patient data which process iteratively and produces result but the lack of transparency in reasoning and defining the fitness criteria makes it undesirable for clinicians to adopt it in their practice. In diagnosis of urinary incontinence the GA has proved to be very useful.

2.3.5.4 Rule-based system

A rule-based expert system represents If-Then conditions where the user has to answer the condition to get the probable outcome. As for example, there is a risk of stroke, if the patient’s blood pressure is high. The system evaluates the knowledge based on the rules compiled by the user during the designing phase and once they match the system draws the conclusion of the case in hand. It is easy to store a large amount of information coming up with the rules to clarify the logic in decision making process but the user may find it difficult to transfer domain knowledge into the rules as the system require many rules to execute the command and show the result. As for example, Mycin is based on 600 rules to help the end users in identifying the cause of bacterial infection.

2.3.5.5 Logical Condition

In a healthcare setup the logical conditions are used to alert and reminder to the healthcare team. As for example, they may alert the ICU nurses that the patient heart rate or respiration rate is low. The methodology in Logical condition is very simple where the system accepts the data and checks whether it is within or outside the bounds. Alerting and Reminding assist the healthcare team in complying with guidelines but too many alert sometimes may over-
whelm them and cause them to ignore them and sometimes that may lead to suffering of the patient.

2.3.5.6 Casual Probability Network

Casual Probability Network work with the cause and effect methodology where the system attempts to trace a path from the patients symptoms to disease classification and determine the best possible knowledge model to the end users in relation to the disease and its condition. CASNET is the first clinical decision support system that uses the casual probability network to assist in the diagnosis of glaucoma. It represents a hierarchical representation of knowledge in terms of symptoms state and disease.

2.4 Selection and Implementation Guidelines for Clinical Decision Support System

The following steps are considered to be the minimum and essential in selecting and implementing decision support system in healthcare practice [57].

2.4.1 Assure that the end users understand the strength and limitation of the system

2.4.2 Assure that the knowledge is from a rich knowledge source, as the end users always expect to be told about the rules, evidence behind the rules, testing of the system and validation process.

2.4.3 Assure that the system is appropriate for the local site and vendors should have the answers of the end user’s query.

2.4.4 Assure that the end users are properly trained to understand and use the system.

2.4.5 Regular monitoring of the proper utilization of the installed clinical de-
cison support system should be done at a regular intervals.

2.4.6 The knowledge base should be regularly monitored and maintained to support the end users with up-to-date domain knowledge.

2.5 Impact of Clinical Decision Support System

It is widely known that clinical decision support system is being used as a tool by healthcare professions for improving the diagnostic and treatment performance in a large scale. It has been proved from the study conducted by Eta et.al where the performances of the physician and internist were assessed after the implementation of Quick Medical Reference (QMR) diagnostic decision support system. The result indicated that the physicians diagnostic performance was higher in those cases where the QMR had provided the quality information [58].

The impact of clinical decision support system was also observed in the studies conducted by Rogers et.al [59–61], Gonzalez et.al [62], Rodman et.al [63], White R H et.al [64], Chase et.al [65], McDonald et.al [66–69], McDowell et.al [70, 71], Tierney et.al [72, 73], Young et.al [74], White K H et.al [75] where the clinical decision support system showed a significant difference in improving the clinical performance of the clinicians as well as the patient outcome. The Implementation of a clinical reminder system by Anitha & Rajagopalan [76] showed a remarkable improvement in clinician performance in diagnosis and treatment of chronic illness and preventive care.

Dereck et.al [77] on their systemic review found that the clinical decision support system is effective in drug dosing, preventive care, performance improvement of clinicians, and other aspects of healthcare practice but not for
2.6 Related Work and Findings

A literature survey [33]- [99] was conducted to identify the available clinical decision support systems in cancer care and with specific reference breast and cervix cancer. The data collected from the literature survey showed that there are several studies that have been done in the field of clinical decision support system in cancer care but there are only a few available in the domain of Breast cancer and very few in Cervical cancer care. Works of interest in this research domain are:

2.6.1 Oncocin [78]

This decision support system is designed to provide treatment advice for cancer chemotherapy. It uses artificial intelligence to provide the recommendation to the physician on medicine, dosage and testing. The drug doses are determined on the basis of time schedule, toxicity and blood count. The system was designed by combining the Chemotherapy Protocol guidelines and knowledge provided by expert oncologists. The system consists of Interviewer i.e. a rule based expert consultant to preview the previous information and enter the present complaints of the patient and Reasoner to get the recommendation for appropriate therapy and test in the form of representing the knowledge in four main types of data structures i.e. Context, Parameter, Rules and Control Blocks. The typical users of ONCOCIN were residents and clinical assistant rather than certified physicians. The system is only restricted to cancer chemotherapy but does not extended to the entire domain of oncology.
2.6.2 Oncosifter [79]

Oncosifter is a search engine developed to support the clinicians in accessing related diagnosis and treatment, medical news and publication. The system is implemented using Perl-CGI and support with Keyboard Search where the query matches the metadata and the corresponding results are retrieved; Directory Interface to provide the overview of cancer by categorizing into three sections such as body location/systems, Common cancer and Childhood cancer; Hierarchical Visualization Interface to display the structural relationship of the data and the Personalization Interface where the user can create a profile to include the information of his/her interest. The system is linked and mainly provides information from Medline Plus and Cancer.gov.

2.6.3 Computer Aided Medical Diagnosis Tool [80]

This integrated system is designed by Electronics, Informatics and Systems at the University of Calabria in Italy. This has been embedded into the Telemedicine to allow the clinicians to provide remote consultation. This is an automatic classifier which discriminates between benign and malignant cells from a breast cancer. Firstly the graphical computer program analyzes the cytological features of Fine Needle Aspiration samples based on digital scanning and a frame-grabber board and gets it saved for further determination of each nucleus and its boundary. The second stage consists of the creation of a 30-dimensional features vector by performing the analysis for each individual on a large set of patients for which the actual diagnostic outcome is known. An automatic classifier using a Linear Programming model is used to discriminate the benign from the malignant cells of breast cancer. The system works on a client - server platform with common gateway interface and Java based
2.6.4 OWCH [81]

The Oncology WorkbenCH (OWCH) is designed to support the oncologist in multi-drug chemotherapy regime where the treatment editor accepts the planned treatment regimes data from the user and send it simultaneously to the Simulation and Optimization Engine. Once received, both engines interact with the Information Repository for information in relation to effectiveness and toxicity of the anti-cancer drug. The simulation engine evaluates the newly composed treatment and sends the result to the result viewer whereas optimization engine determines and advises the best possible treatment strategy via Treatment Editor. This result may be stored in the Information repository for future reference. The interfaces are delivered to the user Java applets via the WWW so that minimal set-up is required at the user end and the simulation and optimization is done on a fast server dedicated to the purpose.

2.6.5 KON3 [82, 83]

Knowledge and Ontology on ONcology (KON3) is an electronic guideline for the management of hepatocellular carcinoma. It consists of Knowledge Base to represent the knowledge at semantic level using virtual medical records, vocabulary and expression; Guideline Engine to execute the guidelines using process and rule engine whereas Guideline editor helps the user to design the guidelines associated with heptocellular carcinoma.
2.6.6 OncoTheraper [84]

OncoTheraper is a Clinical Decision Support System designed and supported by a Service Oriented Architecture for the therapy planning in pediatric oncology. The technology is based on Artificial Intelligence and consists of Oncology Protocol Server to store the computerized oncology protocol in the Representation Language whereas Intelligent Monitoring Server to interpret and execute the therapy plan generated by Therapy Planning Server.

2.6.7 Clinical Decision and Economic Analysis Model of Cancer Pain Management [85]

This evidence based decision analytical model was designed to assist the healthcare decision makers in comparing the different strategies of cancer pain management based on guideline based care, oncology-based care and usual care. This model is constructed to facilitate the estimate of cancer pain prevalence based on demographics, epidemiology of cancer and cancer pain and evaluate the impact of cancer pain and its management in a default or user-defined healthcare population. The result is evident that the guideline-based cancer pain management was lead to improve the pain control but it increases the utilization of resources.

2.6.8 LISA [86]

The system is designed with an aim to support the clinician in quality decision making the care of Childhood and Lymphoblastic Leukemia. The system integrates the patient data and clinical information to provide patient specific recommendation for the treatment plan processes. This Oracle database allows the clinicians to captures, view and modify the patient information at each
stage of treatment for individual children and provides decision support on
dosing and scheduling of the therapy.

2.6.9 OncoDoc [87–89]

The system is designed to support the oncologist in providing therapeutic
recommendation for breast cancer patient using decision tree and hypertext.
OncoDoc allows the clinician to control the operationalization of guideline
knowledge through hyper-textual reading of a knowledge base encoded as a
decision tree. The system can also be used in eligibility screening system in
breast cancer clinical trials.

2.6.10 Knowledge Based Approach for Diagnosis of Breast
Cancer [90]

This knowledge based system uses the soft computing tool such as Artificial
Neural Network and Neuro Fuzzy Systems to assist the clinicians in diagnos-
ing breast cancer. The Back Propagation Algorithm, Radial Basis Function,
Learning Vector Quantization and Adaptive Neuro Fuzzy Inference Engine
were used to evaluate the dataset where the sources of data were Wincon-
sin Breast cancer Diagnosis. The simulator was developed using MATLAB
and the performance was compared in terms of accuracy of diagnosis, training
time, number of neurons etc. The comparison showed that the knowledge base
approach can be effectively used by the oncologist in detection of breast cancer
and to enhance the survival rate.
2.6.11  Retrospect [91]

Retrospect is a prototype decision support system designed to support the clinician in predicting the treatment outcome and recommending optimal treatment plan for the patient with breast cancer. It supports the hybrid architecture i.e. the prediction engine is based on neural network whereas the recommendation component of it is based on genetic algorithm. The evidence showed the availability of Retrospect in two forms; local that runs on 32-bits window environment and distributed consists of a thing window client and an internet server application.

2.6.12  A knowledge-based approach to assign breast cancer treatments in oncology units [92]

This knowledge based decision support system uses a multiple classification ripple down rules (MCRDR) for the incremental knowledge acquisition and a knowledge base for the treatment of breast cancer. The knowledge base was built using National Comprehensive Cancer Network (NCCN) clinical protocol and the knowledge was represented with six fractions i.e. clinical stage, evaluation, findings, primary treatment, post-surgical treatment and surveillance/follow-up. The system was designed using JAVA and MySQL and connected to JBDC interface. The system consists of three important module MCRDR engine for the extraction of knowledge, Inference Engine for Inferring clinical treatment and the third module to format the explanation of inferred treatment.
2.6.13 Breast Cancer Decision Support System for Rural People [93]

This decision algorithm system assesses the values of decision variables and recommends the line of treatment based on the size of the tumor, the size of the breast, number of masses, radiation to chest wall, collagen vascular disease, and hormonal receptor. The decision algorithm used in this system is the modification of National Cancer Control Network guidelines for breast cancer that assist the users in classifying the cancer stage in order to form the method of treatment and storing the information related to the survivability rate of the patient after treatment.

2.6.14 Decision Support System for Breast Cancer Chemotherapy [94]

The database is designed to support the oncologist in post-operative adjuvant chemotherapy of operable breast cancer. The system is implemented in Visual Basic 4 under Windows 3.x and Windows 95. The system consists of production rules and is grouped into frames invoked in a goal-driven fashion. One frame manages the rules and decides whether the patient is eligible for chemotherapy or not, whereas another manages the patient pathology prior to the chemotherapy. The system provides the recommendation in tree structure where the sub-frames represent the stage of the treatment, the possible presence of pathologies, and recommend the drugs to be administered with their quantities and the date of the next drug administration.
2.6.15 Computer Aided Medical Diagnostic (CAMD) System [95]

CAMD assists the oncologist with well-defined set of data, such as sign and symptoms and pathology result, pertaining to patient with breast cancer. These data are identified, collected and introduced into the database to form the classification for the detection of breast cancer. The measurements of these data were assessed based on the physicians’ clinical experience, which is result in knowledge base or training set where a mathematical programming method was used. These classification and pattern recognition support the end user in making correct diagnosis and also to distinguish between benign and malignant cells for early detection of breast cancer using image processing tools based on cellular morphometry and an automatic classifier. Here the image input is from a microscope and the Web facility allows remote diagnosis from any location through the use of java-applets.

2.6.16 Decision Support System for Breast Cancer patient [96]

This Web based clinical decision supports system support the oncologist in making prognostic assessment using the characteristics of the patient through three different prognostic modeling methodologies such as Nottingham prognostic index, Cox regression modeling and a partial logistic artificial neural network with automatic relevance determination. These three models were used to obtain a more accurate prognostic assessment of the patient. The multiple imputation technique was used to overcome the issues associated with the missing data.
2.6.17  Clinical Practice Guidelines Based Ontology Driven  
Clinical Decision Support System for Breast Cancer [97]

This decision support system was developed with an intention to support and 
guide the family physician in conducting breast cancer follow-up. The system  
provides tools for the decision, makes recommendations and offers referral 
services regarding the treatment of a breast cancer patient based on Clinical  
Practice Guidelines (CPG). The guideline element model was used to convert 
the CPG in electronic format and the Protg was used to develop domain  
ontology and finally the execution engine was used to develop IF and THEN  
forward rule. The system provides the recommendation by passing decision  
variable using IF part and the result in which the THEN part executes the  
result using action variable.

2.6.18  Staging of Cervical Cancer with Soft Computing  
[98]

This soft computing hybrid decision support system was designed to assist the  
clinicians in detecting the different stages of uterine cervical cancer. The sys-
tem extracts the knowledge from the knowledge base with Genetic Algorithm  
using Rough set theories concept and Interactive Dichotomizer Algorithm.

2.6.19  Uterine Cervical Computer Aided Diagnosis [99]

This Computer-Aided-Diagnosis (CAD) was designed to aid the oncologist  
in diagnosis of cervical cancer. The core processing system automatically  
analyses the gathered patient data and suggests the appropriate examination 
depending on diagnosis. The system captured not only the text data but
also the images and videos of various forms and medium. It was built on open, modular and featured based architecture that is designed to process for is multi-featured to process multiple-data and sensors. The embedded CAD systems make it more interactive and automate the clinical workflow to generate the patient diagnosis and recommendation automatically.

## 2.6.20 Limitation Observed with the existing system

The literature survey shows certain evident limitation in the existing clinical decision support systems in breast and cervix cancer care. These limitations were addressed during the design, development and implementation of the proposed system.

Patient information plays a vital role in decision making but the existing system [58]- [79] fails to provide any evidence of capturing the complete demographic and clinical details of the outpatients and inpatients during the continuity of care.

Automated Staging and classification of cancer sites helps the clinicians in getting accurate results about the type of cancer where an oncologist can find it easy to plan the treatment and care. The existing systems [58,79] reviewed do not provide any evidence of having automated provision to classify the TNM staging system and ICD-O-3rd Version for classifying the Topographical and Morphological codes.

It is evident that some of the systems are restricted to cancer chemotherapy [29, 58, 74, 77] Hepatocellular carcinoma [82, 83] but not the entire oncology domain where the clinicians have to depend on another application to extract patient information and other domain knowledge.

Some of the systems uses IF and THEN rules where a user has to answer a series of questions to get the accurate result. . The system requires regular
updation in terms of rules and algorithm because if the query passed by the user does not match with the rule no result will be displayed. It has also been found out that the system does not have any electronic medical records module to capture and manage the patient information as this forms the basis of any quality decision making [46, 58].

This search engine does not provide any evidence related to the online search of the knowledge as it only provides the information to the user when the required search matches with the metadata. There are many other research databases to which the system could have been linked instead of restricting it to Medline and cancer.gov [79]. The literature indicated the issues related with the insufficient speed of Java application which leads to a low satisfaction rate among end users [59].

The review indicates that the system provides information related to the oncology protocol and any changes in protocol require the system to reconfigure and addition of new protocol leads to the burden of the user as well as the administrator [64, 72, 73] As and when the CPG is getting updated, systems knowledge base also requires to be reconfigured and updated to support the clinician with updated protocol and guideline.

The system still shows a low practical compliance rate despite the dissemination of computer-based ‘clinical practice guidelines’ as decision support systems because the recommendations provided by the system were suited to average patients but not to all [66–68]. The system fails to provide any evidence in provision of online knowledge to the end users [70, 78].

The oncologists always looks for a system where they can keep a track of the patients who have undergone any treatment under him/her. Most of the systems [58]- [79] have features to support the functions.

Statistical Analysis results are considered to be an important element in
quality decision making for cancer control and prevention program. Literature
survey results fails to provide any evidence of clinical decision support system
with a feature of statistical analysis module within it [58]- [79].

Most of the systems were found to be Windows-based applications which
restricts the user to have access to the system within the Local Area Networking
but does not provide global access.

2.7 Conclusion

Clinical decision support system is always expected to assist the healthcare
professionals in quality decision making during patient encounter. Cancer care
is always challenging for the oncologists where the clinical decision support sys-
tem helps them in getting instant access to the domain knowledge and health
information. The result of literature survey with respect to clinical decision
support system in cancer care showed that very few clinical decision support
systems are available with respect to breast and rarely in case of cervical can-
cer care. Each system represents a unique set of features but only limited to a
certain class of treatment or therapy and also based on many models such as
Perl-CGI, Linear programming, Artificial Neural Network, Neuro Fuzzy, Cox
regression model, Artificial Engine etc. Most of the systems were found to
be Window Based Applications built on Java, MsSQL, Visual Basic program-
ming languages. As a window based application, the systems were also found
to have restriction in terms of global access where it is restricting the access to
the user within the Local Area networking. CDSS should be designed in such
a way that leads to high end user satisfaction and showed result in maximum
acceptability and sustainability of the system among practitioners.