ISSN 2348-9928
Doi:10.46532/ijaict-202108020 Published on 05 (07) 2021

# An Analysis of Medical Informatics and Application of Computer-Aided Decision Support Framework

**[1]Yun Chen and [2]Ernst Ginell**
[1,2] Division of Biology & Biomedical Sciences, Washington University in St.Louis, USA
[1]yunchen36@aol.com

**ArticleInfo**
International Journal of Advanced Information and Communication Technology
(https://www.ijaict.com/journals/ijaict/ijaict_home.html)
https://doi.org/10.46532/ijaict-202108020
Received 12 March 2021; Revised form 05 April 2021; Accepted 20 May 2021; Available online 05 July 2021.


**Abstract** - Due to the advent of technology in the medical sector, the future of the Computer-Aided Decision (CAD) is promising as a support system for the processing of images. Since there is significant results reported due to the application of diagnostic radiology in the healthcare facility, radiologists are looking forward to enhancing medical and bioinformatics using CAD. Medical evaluations and trials have been done over the past few decades to aid in the optimization of accurate programs and evaluate the real contributions of CAD in the medical informatics interpretation procedures. Health experts and radiologists utilizing patient outputs from fundamental application of CAD are placed in the best position to focus on the final decisions concerning the performance of patients and diagnosis. However, researches have shown that the computer outputs require not projecting significant general accuracy compared to a certain radiologist to enhance patients' performance. The volume and measure of the present patient data including their complexity to enhance the process of making proper healthcare decisions while making it problematic for healthcare practitioners and physicians to facilitate the management of patients. This condition calls for the usage of biomedical informatics methodologies to effectively process information, create biomedical implementations and informatics frameworks for CAD support systems. With that regard, this paper evaluates the medical and bioinformatics based on the application of CAD systems. It further projects on the applications of the systems, their application guidelines and techniques. The paper ends with the analysis of the future problems and directions of the CAD support framework.

**Keyword** - Computer-Aided Diagnosis (CAD), Bioinformatics (BI, Medical Informatics (MI)

## 1. Introduction

The application and usage of medical and bioinformatics for the Computer-Aided Diagnosis (CAD), medical systems have been considered ubiquitous in the medical sector. An adaptation of these decision support framework in relation to the medical and bioinformatics have been applied in both simple and complex medical system over the past few decades. According to a medical survey done in the late 1950s, a gradual and systematic advent of CAD system is essential for use in radiological departments which means that radiologists in the modern age by now have familiarised themselves with the weaknesses and strengths of a wide-range CAD systems and programs. Hence, it makes it possible for them to avoid excessive dependency or dismissive aspect on computer outputs. This has to ensure the acknowledgement of the CAD system and optimized diagnosis, evaluation of healthcare practitioners and radiologists. In that case, effective tasks for every CAD system will be analysed and implemented for every healthcare practitioner and radiologist in reference to their personal observation and training competency. As a result, this helps to minimize and control intra-observations variation and enhance the performance of diagnosis.

With the evident enhancements in medical technologies for image processing and segmentation, it now seems to be an escalation of image complexities especially in the gathering of medical information. Other than the medical information measured from simple to complex CAD it allows massive volumes of patient data to be collected. Since this patient data screen is constantly advancing presently, medical applications and high-throughput medical measurement systems project a wide-range image and big data for patients every minute, hence making it challenging for healthcare practitioners to look into the data while attending prognoses and diagnoses at the same time. At the moment, it is essential to improve and develop the CAD system in the sector of medicine which reflects on the advancement to be projected in the future. Medical processing and implementation of bioinformatics in the segment of CAD systems has been in existence since 1970s when researchers focussed on the automation of medical diagnosis of an Acute Abdominal pain. In the same decade, Internist was created to represent a protocol-based professional system meant to help in the diagnosis of both simple and complex medical issues in internalized medicine. These signified the most prominent and essential

enhancement in the sector of bioinformatics systems in the many CAD support systems [1]. From their onset, substantial enhancement has been reported with wide-range comprehension and acknowledgement of healthcare practitioners assessing patient data and assuring prompt release of patient results.

With significant research done in this medical field, there has been significant literature analysed concerning the topic. Researches outline the various concepts and upcoming research practices for medical decision support framework which categorically evaluates the fundamental research enhancements in CAD systems for the purpose of predicting the outcomes of patients after diagnosis of such multi-modal and multi-scaled data. Researchers in early 1990s projected a more comprehensive analysis of the fundamental works done on decision support frameworks and diagnosis practices. In the same research, a more advanced research focuses on the systematic evaluation of computer medical decision support framework that is applicable over a series of decades. This paper considers essential research analysis on CAD systems utilized in the analysis of therapy processes and computer-based patient monitoring during the process of undertaking therapy. According to the research [2], CAD systems are useful for fine-tuning therapies and enhancing the safety of patients, prescribing their drugs and enhancing the process of lab testing following therapy practices.

There are other research evaluations that project an insight to more categorical subgenres of medical and bioinformatics techniques and their application in CAD systems. Researchers have critically evaluated and provided insight on the specific sub-genres of medical informatics and CAD systems based on image textual evaluation. Apart from that there are plenty of research practices that are focused on the implication of CAD frameworks in medical radiological practices. In this paper, we will provide a generalized analysis of techniques in biomedical informatics which have critically been applied as CAD support frameworks. Apart from that we will evaluate the issues such as the validation of this framework and the level of adoption for the end users.

## 2. Background Analysis

In reference to Human Genome Projects (HGPs), which was published as a draft, novel issue in functional genomes have been evaluated critically hence, opening up an incredible measure of healthcare application [3]. A number of research attempts have been focussed on the requirements of genomic-centred techniques in the healthcare sectors such as evaluating the genome-connected risk elements for the integration and categorization of medical information and genetics in the medical practice field. Both the Medical Informatics (MI) and Bioinformatics (BI) are globally projected to play a significant role in the support of healthcare efforts. However, there are still research evaluations on whether the two can operate together or not.

### *2.1 Bioinformatics (BI)*

BI incorporates the enhancement and implementation of new informatics methods in genomic and biological sciences. This aspect is a young successful disciplines and incorporates scientific journals, meetings and research societies that are interested in the development of genomes and other essential human projects. Contrary to that MI is essentially established as a field that has incredibly channelled the advent and enhancement of informatics methods in healthcare and biomedical analyses. However, over the past few years it has faced challenges following the advent of BI [4].

Novel approaches in MI have facilitated the connections with BI in the enhancement of new methods of connecting joint segments of Biomedical Informatics (BMI. As such, this projects a number of issues for MI and BI concentrated on the query of whether it is effective for BI to fundamentally concentrate on enhancement methodologies and equipment for advancing the communication of genomic findings in clinical analysis using MI techniques.

### *2.2 Evaluation of BI and MI: Genome Medicine Complementarities*

The contrast between MI and BI might possibly yield significant insight that potentially allows for the planning for future disciplines. In BI, many experts have recommended that analysts and medical practitioners from fields such as statisticians and physicists have to add value on BI jobs as long as their expertise in handling big experimental information is proved. The most fundamental collaboration in this is dependent on proximal disciplines of MI that has been handling the issues of building both large and complexities amount of patient data that represents the knowledge collected within a period of three decades. In the end, this paper provides an evaluation and comparison of the various disciplines based on a number of various medical perspectives. In table 1, an analysis of the general weaknesses and strengths of the present CAD support frameworks and fundamental research analyses has been evaluated.

### *2.3 Enhancement of BI and MI as an Educational Informatics Segment*

Even before the advent of PC systems into the healthcare setting and bioinformatics labs, it was possible to identify the variations between BI and MI in various research fields such as automated theories, data theories and cybernetics in the early 1940s and late 1950s [5]. This as a result projected the idea of developing the expansive knowledge of computer science and bioinformatics that typically focused heavily on data libraries and information technology. The Pioneers such as Von Neumann, Shannon and Wiener has included in the research practices for biological problems that added to the breakage of genetic codes [6]. During this timeframe, cryptographers were incorporated in the research practice using PC systems that were meant to handle complex mathematical problems to determine the feasibility of the various theoretical frameworks for the genetic codes. As such, this facilitated the introduction of a wide-range metaphors and concepts into the genetic measure of information. In turn, this was decisive in the establishment of data system in genetics via the centralized dogma of the biological molecules. The activity and



Corresponding author at: Yun Chen, Washington University in St.Louis, USA.

practice of medicine included a number of connections with the pre-informatics aspects such as linguistics, statistics and mathematics which also incorporated mathematical models in immunology and neurology in the evaluation of radiological images.

## 3. Methodology

There are various essential elements of computational techniques utilized in the evaluation and development of biomedical informatics and the CAD support frameworks. The forms of methods and techniques are critically centred on the areas of application and the essential performance measures. Some of the essential aspects of these frameworks are evaluated below.

### *3.1 Professional Systems: Case-centred Reasoning and Protocol-centred Framework*

The techniques such as the protocol-centred framework (crisp and fuzzy), professional systems and the case-centred reasons have been built on the skills and expertise accumulated from the professionals in a specific field of research. The progresses, diagnoses and opinions are collected to create the protocol-based evaluation structures in reference to the certain key concepts of medical diagnosis remedies which are definitely created. Researchers, over the past few decades have presented a hybrid decision-making support framework that is formulated centred on the case-centred and protocol-centred reasoning framework that is applicable in the ICU facility for assisting medical practitioners and physicians to make proper decisions in the projection of patient data. In another study, researchers have described the techniques of CAD frameworks for medical contexts based on the application of fuzzy logic [8]. In the framework, the skill set from professionals is collected into the fuzzy logic maps and the cognitive structures to effectively evaluate the various stages of illnesses based on the application of temporary data throughout the infection timeframe.

### *3.2 Image Procession and Signal Determination*

A number of CAD frameworks utilized a collection of patient information in the process of evaluating diagnosis evaluations. These frameworks evaluates raw images and signals from patients to effectively extract fundamental sets of information, trends and features centred on the kind of diagnostic support system being computed by physicians. For example, the signal evaluation framework is utilized to evaluate ECG and to categorize arrhythmia illnesses and cases from patients. The signal evaluation framework determines the actual timeframe to effectively defibrillate patients that are affected by cardiac arrests and the ventricular fibrillations. Plenty of researches have projected the image processing frameworks that utilize CT images from the patients with Pelvic illnesses to effectively produce both qualitative and quantitative evaluation of haemorrhaging. In the same case, a number of computer-aided fracture identification frameworks have been structured to effectively process a number of CT pelvic slices injuries from patients which quantify and identify potential fractures.

### *3.3 Machine Learning (ML)*

As a result of continued development in the sector of Machine Learning (ML), more sophisticated and complex biomedical information frameworks have been formulated. Frameworks which have the capacity to classify and predict illnesses critically depend on a number of ML techniques. However, there is no premium or supreme ML method which can be applied to entire learning issues. Instead, the most effective technique is dependent on the application forms. For instance, researchers have provided a systematic evaluation of the neural networks in the CAD system for the treatment and diagnosis of cancer. Apart from that the research described the customized ML methodologies that outperform the standardized methods such as Artificial Neural Framework and the linear discrimination evaluation framework based on the application of cancer datasets.

### *3.4 Scientific Contents and Informatics Tasks of BI and MI*

Whereas this theme has already been projected above in comparison to academic disciplines, it requires more specific evaluation following a number of essential observations. Biology has incredibly been transformed from the significantly descriptive sciences channelled to a number of principles and theories such as the evolution theory by Charles Darwin, protocols of Mendel, centralized molecular dogmas of biology and the structural DNA in the human cells and the ecological or organismal contexts. BI has significantly emerged as a computational framework that drives the insight behind the evaluation of big data supporting the identification of genomics, metabolomics and proteomics [9]. As such, BI is considered predominantly connected to a number of research practices.

The sector of medicine is said to be more of an art and a science. Even though this sector has witnessed drastic transition in scientific measure over the past few decades, it concentrates mostly on the management and evaluation of patients which means that more scientific systems have to be launched to interpret more practical medical data. The massive numbers of projected paradigms for the healthcare sector which include molecular medicine, evidence-based medicine, economic medicine, telemedicine and the technological-centred care show the heterogeneity of the science merits and assumptions that underpin various technological advancements. These advances graduate increasingly according to the opportunities meant to enhance the quality of personal patient care services that also relates to the costs of services. The absence of unified theoretical frameworks in the medical sector might have significantly contributed in the diversified directions in MI with minimal subfields focusing on research, education and medical practice applications. The sector of informatics critically deals with a wide-range diversity application of scientific approaches and technologies on the manner in which data is managed, represented and modelled. At the moment, there is no prevailing scientific theory apart from the ones describing medicine [10]. MI concentrates on the comprehension and enhancement of practical healthcare data systems hence accessing doses for medical diversity and breath.



Corresponding author at: Yun Chen, Washington University in St.Louis, USA.

### *3.5 Information Analysis and Quality: Uncertainty and Noise*

Healthcare datasets normally are difficult, noisy and partial to restructure due to the factor of individual subjectivity and variability status of majority of medical observations. The underlying healthcare knowledge is typically uncertain as proved in many MI studies of analysis and decision-making. Whereas biological share of information to a massive scale is considered a prevailing issue, they normally collect under certain governed conditions after critical experiments centred on certain frameworks of controllable, observation and instrumental replication.

In the field of medicine, elements beyond the physiologic i.e. environmental, geographical, ethical, socioeconomic and cognitive have incredibly introduced key variables that are challenging to define and evaluate in a clinical perspective. The massive range variation factors incorporating essentially various reasoning issues included in the caring of patients might provide useful explanation as to why most MI normally faces issues when generating a particular laboratory outcome other than their individual areas of origin [11]. Analyses in biology and BI have been focused based on lab assumption with various sources, but have been varied with vitro and vivo which are known for projecting various data qualities and varied forms of experimental data controls.

### *3.6 Knowledge and Data Integration : Data Retrieval, Interoperability, Databases, and Network*

The medical informatics have shown fundamental contribution to the networking, integration and documentation of data via the enhancement of coding frameworks, healthcare terminologies and enhancement of medical standards. As a result, this has created the foundation of research practices on information models which enhances the program and data interoperability over heterogeneous computing systems and platforms. Nonetheless, a number of clinical datasets typically are known to bear specialized purposes, encrypted to privacy or accessibility, typically not linked with the Web or database. Patient information is mostly not entirely exchanged and has to be protected through confidentiality, security protocols and technologies. Other than this advancement a segment of pioneered medical informatics projects have been evaluated significantly based on massive medical datasets which are utilized to study the longitudinal pattern treatments, tests and manifestation. As such, this has added on the knowledge about medical information structures and analytical techniques. More recently, healthcare informatics have been considered as a forefront in the enhancement of ontological-development tools such as computerising the essential text on the genetic elements of illnesses, ontological enhancement of frameworks like Protégé and the facilitation of significantly-detailed computing frameworks for healthcare skillset required for the interpretation of significantly informative and complex imaging modality.

## 4. Application of Computer-Aided Decision (CAD) Support Framework

There is a wide-range application sector of CAD in medicine. These are:

### *4.1 Radiology*

In this sector, the computer-based image analysis and process have been a common phenomenon. Connecting image processing, ML and image visualization to enhance the process of decision-making, various medical benefits have been seen over the past few decades. With a number of advances for medical images such as Functional MRI, X-rays and Magnetic Resonance Imaging various biomedical informatics techniques have been formulated for the application-based remedies. A number of researches have surveyed more than 150 publications before 2002 concerning CAD in the radiography of chests [12]. This analysis concentrates on the progressive assumption in CAD for the radiography of chests. Apart from that there are other researches on the enhancement of decision-making frameworks based on the application of automatic evaluation of CT scans.

These incorporate the literature assumptions on the enhancement of CAD frameworks which evaluate the CT scanner for the patients' brain system, especially for those with traumatic brain injuries. The framework potentially evaluates the degree of Intracranial Pressure in the brain system. In another research evaluation, discussions on the enhancement of CAD frameworks have been done in relation to pelvic disorders. The research also focusses on the fractures and their detection in traumatic pelvic injuries and evaluates an automated technique for quantifying the fracture sizes with reference to CT images of patients with a pelvic disorder. There is an underlying functionality and design of the radiological decision support framework which significantly supports the samples of evolutions and developments of CAD frameworks over the past four decades.

### *4.2 The Intensive Care Unit (ICU) and Emergency Medicine*

One of the most prevailing sectors of medical research and bioinformatics and CAD is the emergency medicine. For the patients in the ICU and the emergency sector, it is vital that treatment and diagnosis are given in a timelier manner. Due to the fact that ICTs normally face a massive shortage of medical resources, it is becoming essential to dispense and manage the medical resources to critically-ill patients who require it significantly. CAD frameworks play a significant obligation in the reduction of diagnosis timeframe, enhancing the allocation of resources and diminishing the patient mortality. A number of literature sources have provided a comprehensive evaluation of CAD frameworks for the traumatic problems. Frameworks have proved to show the case-centred reasoning methodology that enhance the estimation of patient resources and outcome utilization which enhances patient care significantly in the ICU.

Researches project a medical decision support framework that links both the protocol-centred and case-



Corresponding author at: Yun Chen, Washington University in St.Louis, USA. 

centred aspects of reasoning which includes an evaluation of the ones that perform effectively with actual and simulated ICU information. In the research, a computer alert framework that is formulated to identify an Averse drug scenario in hospitals has been recommended. This framework has been projected to generate alerts for those with more risks to Averse drug scenarios. This research indicates that in the 6-month medical trial, about 44% of the participants were reported to bear positive alerts and unidentified by physicians following alert notification. As a result, this indicates a significant promise for the application process in continued monitoring process of patients [13].

*4.3 Cardiovascular Medicine*

Having interventional or continuous monitoring of the cardiovascular signals for diagnosing diseases and projecting impeding cardiac scenarios might be a fundamental medical tool to consider. Presently, there are a number of researches done in the sector of bioinformatics in the process of developing CAD remedies for different elements of cardiovascular medicines. The CAD frameworks classify and identify arrhythmia from the evaluation of individuals' Electrocardiography signals. In the research, accurate categorization in the dataset has been considered. There are a lot of students that utilize auscultation frameworks in the analysis and diagnostic evaluation of CAD essential for application by physicians. In the evaluation, non-linear techniques have been used. ECG signals are used in ventricular fibrillation to project the highly-yielded accuracy for the success of defibrillation. The evaluation also define the incorporation of PetCO2 signals to effectively increase the predictable frameworks and their robustness.

*4.4 Dental Application*

Computerized medical decision-making framework and medical diagnosis framework have shown significant success in the sector of dentistry. A number of research practices in clinical decision support framework have been done based on the observer performance that was knowledge-based framework of image, evaluation of radiographic pictures. This research included more than 100 approximate surface radiographic pictures and 16 generalized practitioners meant to identify the availability of caries and the restoration required. In the analysis, it is argued that dental practitioners who utilized the framework to project their diagnoses indicated significant increment in their capacity to treat and diagnose caries effectively. This was done with a more generalized form of accuracy and projection for the amendment of the cavitated surface. In the same case, healthcare practitioners over the years have projected the computer-assisted detection framework utilizing image evaluation of information from the intraoral camera. In the projection, a feasible evaluation based on the application of sophisticated image segmentation and ML methodologies have been identified to determine the carriers from digitalized images.

*4.5 Cancer*

The bioinformatics have played a fundamental role in the detection and treatment of cancer. In an analysis done by researchers, most treatment cases of cancer involved decision-making systems. Particularly, the research concentrated in the application of Artificial Neural Networks (ANN). Based on the research practice, there are advantages of diagnosing and treating cancer using CAD. It is also discussed that CAD is optimized to diagnose the illness based on the combination of heterogeneous data from various forms of modalities. The researchers focus that the projected methodology in most cases is capable of outperforming the most popular ML methodologies: ANN and Linear Discriminant Analysis. There are a number of evaluations that focus on CAD frameworks for the prognosis and diagnosis of cancer. The initial system is image-centred risks score algorithms for the outcome projection of oestrogen receptors markers for patients suffering from breast cancer. The second system deals with the determination and segmentation of the lymphocytic infiltration extent based on digitalized histopathology [14]. The third methodology is focused on the distinguished cancer patients with varied Biopsy specimen grade and Gleason prostate cancer grade.

*4.6 Paediatric Medicine*

CAD and decision-making support frameworks are now considered popular for handling various applications in paediatric and neonatal care units. At the moment, there are potentials of diagnostic and decision-making support frameworks in the paediatric setting which effectively focus on the web-based paediatric frameworks. As such, there are various utilities of these diagnostic assisted systems and more research practices have been recommended to project the future for the CAD framework. Artificial intelligence-centred framework applies the case-centred reasoning aspect to estimate the medical assumptions and the utilization of resources. As such, medical practitioners have explained the manner in which systems have been intended for the patients' ICU units and created to operate in neonatal ICUs. In this research, it is projected that the research from the close-range clinical pilot evaluation considered the evaluation of neonatal ICU which is considered significant and captured with interests of the physicians for the potential medical application. There main purpose for this is to identify where the application of medical decision support frameworks have any influence on the morbidity and mortality rate of newly-born babies and to determine if any forms of transitions in the evaluation of physicians and their treatment practices can be detected for the diagnosis of these babies. The factors involved in the segmentation and application of CAD systems in the practical paediatric include alert fatigue, engineering, audit trials, human factors and liability. Implementation and selection of these systems in clinical application necessitate significant deal of caution. When this is done with care, it has significant benefits and enhances medical practices in the paediatric intensive care unit.



Corresponding author at: Yun Chen, Washington University in St.Louis, USA.

## 5. Implication of the Computer-Assisted Decision Framework in Biomedical Informatics

Over the past few decades, biomedical informatics has to be more vibrant as a constantly growing segment in the medical field. Nonetheless, as discussed in this paper the most of the CAD frameworks are implemented in the field of biomedical informatics frameworks. In that case, minor frameworks of CAD are centred on biomedical informatics that has widely been appreciated in the field. There are a lot of researches that have defined and compared the foundation and scientific approaches of essential complementariness in the medical field i.e. bioinformatics and medical informatics. The inclusion of CAD knowledge can significantly strengthened the future assumptions in the formulation of critical informatics disciplines which are essential for boosting the medical practices in the healthcare facility. These efforts link up the multimodal information and link up the bioinformatics and biomedical informatics to enhance patient outcome in future.

Computer-assisted diagnosis and prognosis is done using multiple fusion of data which incorporate both the digital patient data and computerized image evaluation aspects such genomic and tissue data in the process of predicting the results of patients. These tasks apply the protein expression and other fundamental sets of data projected by normal biomedical informatics techniques in the process of developing and diagnosing prognoses for cancer problems.

A time series microarray genome expression has been recommended to profile the sets of data to project the manner in which patients respond to the pegylated interferon cure. The computer-assisted decision framework in reference to biomedical informatics knowledge has presently begun to prove positive results when it comes to virological medical research. For example, medical practitioners have described computational techniques to be effective when identifying the prevailing techniques for HIV-1 resistance in dealing with the expression of gene profiles and the evaluation of virus-host interaction. In the same case, another research evaluation showcase the novel aspect in the process of diagnosing hepatocellular and liver cirrhosis illnesses based on the application of a network-centred system.

### *5.1 Criteria for Validation of CAD Successful Application*

With a lot of research practices in clinical application of decision support frameworks for various clinical operations, it is fundamental to incorporate a systematic framework to compare, validate and verify various frameworks and their medical applications. A number of researchers have compared the various CAD frameworks applicable in internal clinical operation: QMR, Meditel, lliad and Dxplain [15]. These frameworks have been structured in different publication throughout their stages of development, application and evaluation. These researchers have effectively conducted a test of frameworks on various identical diagnostics and the challenges measuring their performance in every system on the different medical measurement scales. The evaluation of performance has been given the prospective assessment of a number of medical test specification applying a wide-range cases and difficulties. Another research evaluation performance of CAD is pertinent to the oral anticoagulant diagnosis and treatment of patients over a wide-range clinical test whether the CAD framework is effective for patients' stabilization based on oral anticoagulant through the maintenance and initiation of medical therapy. With the statistical evaluation of medical performance measures, it is reported that decision support frameworks enhance the quality of these anticoagulant treatments during both short-term and long-term treatment of illnesses.

A number of publications have also focussed on different criteria which are essential for the effective application and development of computer-aided decision support framework. Alongside these publications, medical practitioners in the modern age have reviewed the medical decision support frameworks with the focus on a specific success criterion. Physicians are enthusiastic to apply the computerized medical decision support framework to enhance the quality of medical frameworks. However, there is deficiency in theoretical comprehension mostly from non-physical perspectives like systems and the manner in which certain diagnostic frameworks can be deemed effective. There are effects of these decision support frameworks on medical practitioners.

The physicians and medical practitioners are susceptible in acknowledging recommendations of these decision support frameworks, facilitating quality assurance and validating paramount relevance of medical facilities. A number of researches have also highlighted the relevance of launching a valid and reliable composite scoring framework that measures the implication of diagnostic decision support framework concerning the quality of medical services. In this research, it is claimed that the scoring framework is fundamentally used to assess and evaluate the potential outcomes of research types that apply the CAD frameworks. To facilitate the success of the framework, we have conducted an analysis of the strengths and weaknesses of the present CAD framework and its areas of application.

### *5.2 Analysis of the Strengths and Weaknesses of the Present CAD Framework in Various Areas of Application*

Considering the sheer cases of biomedical informatics techniques implemented in the computer-aided diagnosis and the CAD support frameworks, including the wide-range researches in the medical field, these frameworks are significantly becoming an inherent segment in the medical department.

The frameworks are gradually becoming potentially capable of dealing with sophisticated and complex medical issues. By effectively establishing systematic procedures for verification and validation, these CAD frameworks can potentially become more dependable hence increasing the quality of diagnostic measures while also minimizing the variance of physician opinions. The novel capacities of the frameworks permit the researchers and care givers to provide more insight on the present clinical problems in a manner which is impossible as compared over the past few decades.



Corresponding author at: Yun Chen, Washington University in St.Louis, USA.

**Table 1:** Strengths and weaknesses of the present CAD framework

| Areas of Application | Strength | Weaknesses |
|---|---|---|
| Cancer | • Incorporate significant measure of molecular assays and information is typically present in most cancer cases. These are applied in the enhancement of firm decision support frameworks. | • A lot has to be planned on the integration of skills from the molecular-centred and image-centred sources present in the detection of cancer treatment.<br>• There should the development of more effective methods and schemes meant to validate the efficiency of the present and future systems in cancer diagnosis and treatment. |
| Radiology | • Considered as the most effective method of computation that can be applicable to typically various radiology cases.<br>• Considered as one of the most advancing sector of computer-assisted decision framework | • A number of researches in this sector risk the lack of more comprehend datasets<br>• A number of these researches lack knowledge of complications, injuries and illnesses into the process of making decisions |
| ICU and emergency medicine | • Even though there less frameworks launched in the clinical sector, the present system have proved to be essential to enhancing the quality of services in the healthcare facility<br>• There are potential CAD frameworks in the field of medicine and the trauma that are considered resource and time constraints in the healthcare sector | • Accurate assumption of the present frameworks might not be enough for medical application<br>• Various injuries and diseases have not been focused by CAD support frameworks<br>• There is absence of more comprehensive long-term and short-term implications of these frameworks based on the application of significant amounts of datasets |
| Cardiovascular medicine | • Due the fact that heart illness is considered as one of the leading factor of death, CAD frameworks have been seen to bear significant advantages in the clinical world<br>• Whereas cardiovascular-centred smart decision frameworks are affected by high-false positives, this significantly aids in the detection of illnesses in their initial stages | • These frameworks typically incorporate a small portion of patient data. A variety of data sources might be required to enhance the process of decision-making to minimize false positives<br>• There is absence of more comprehensive validation processes. The present literature arguments have to be reviewed in a more applicable context. |
| Dental application | • The present frameworks have indicated the capacity for detecting dental issues at their initial stages<br>• More medical practices are seen as a result of the potential detection by such frameworks | • A number of such technologies are utilized to the capture data for CAD frameworks that are relatively significant and thus prevent the wide-range practical application |

## 6. Conclusion and Future Research

In conclusion, the application of Computer-Aided Decision (CAD) support frameworks is gradually considered as a prevailing computing aspect in the medical field. At the moment, it is becoming significant to fuse data retrieved from the healthcare dataset with



Corresponding author at: Yun Chen, Washington University in St.Louis, USA. 

significant modality measures to effectively project more robust treatment and diagnoses. The present fusion of bioinformatics and biomedical informatics methods will potentially boost the creation of a novel generation of framework-biological CAD framework which combines and processes data in molecular images, signals and demographics. With these and other sources of patient information it will potentially permit systems to undertake more personalized and specific application in the medical sector. Applying these advances in computing techniques and methods on the medical systems might potentially aid in mitigating issues such as overfitting the outputs over certain forms of data or handling missing and incomplete data. These technologies in computational techniques should focus more on enhancing the quality of data accessed from feature selection and extraction. This enhancement is typically a significant step following the clustering or classification of data. Whereas computerized prognostic and diagnostic decision support frameworks have significantly proved to be fundamental in the sector of medicine, more contributions should be focussed on enhancing the quality of services using the CAD frameworks. This will potentially evolve the medical process and incorporate novel and broader techniques to assess and process patient data.

## References

[1]. H. Jing, Y. Yang and R. Nishikawa, "Retrieval boosted computer-aided diagnosis of clustered microcalcifications for breast cancer", Medical Physics, vol. 39, no. 2, pp. 676-685, 2012.

[2]. "Computer diagnosis system for thermal analysis by BEM aided with simple CAD", Computer-Aided Design, vol. 19, no. 7, p. 385, 1987.

[3]. S. Nagaraj, G. Rao and K. Koteswararao, "The Role of Pattern Recognition in Computer-Aided Diagnosis and Computer-Aided Detection in Medical Imaging: A Clinical Validation", International Journal of Computer Applications, vol. 8, no. 5, pp. 18-22, 2010.

[4]. P. Bois, J. Hermanus and F. Cantraine, "A system for computer-aided diagnosis", Medical Informatics, vol. 14, no. 1, pp. 13-23, 1989.

[5]. E. Kim, "Artificial Intelligence and Computer-aided Diagnosis in Medicine", Current Medical Imaging Formerly Current Medical Imaging Reviews, vol. 16, no. 1, pp. 1-1, 2020.

[6]. Q. Li and K. Doi, "Reduction of bias and variance for evaluation of computer-aided diagnostic schemes", Medical Physics, vol. 33, no. 4, pp. 868-875, 2006.

[7]. "Medical plotter", Computer-Aided Design, vol. 12, no. 6, p. 334, 1980. Doi: 10.1016/0010-4485(80)90144-x.

[8]. J. Toriwaki, "Annual Joint Conference: 6th Conference of Japan Society of Computer Aided Diagnosis of Medical Images (CADM), Shinji Yamamoto, Professor, Toyohashi University of Technology, Conference Chair and 5th Conference of Japan Society of Computer Aided Surgery (CAS-Japan), Jun-ichiro Toriwaki, Professor, Nagoya University, Conference Chair", Computer Aided Surgery, vol. 2, no. 5, pp. 315-315, 1997.

[9]. S. Farooq and Z. Khan, "A Survey of Computer Aided Diagnosis (Cad) of Liver in Medical Diagnosis", VAWKUM Transactions on Computer Sciences, vol. 15, no. 3, p. 130, 2018.

[10]. N. De Silva and D. Jayamanne, "Computer-Aided Medical Diagnosis Using Bayesian Classifier - Decision Support System for Medical Diagnosis", International Journal of Multidisciplinary Studies, vol. 3, no. 2, p. 91, 2017.

[11]. T. Chang, "The Role of Computer-aided Detection and Diagnosis System in the Differential Diagnosis of Thyroid Lesions in Ultrasonography", Journal of Medical Ultrasound, vol. 23, no. 4, pp. 177-184, 2015.

[12]. K. Drukker, L. Pesce and M. Giger, "Repeatability in computer-aided diagnosis: Application to breast cancer diagnosis on sonography", Medical Physics, vol. 37, no. 61, pp. 2659-2669, 2010.

[13]. M. Juan, M. Alcañiz, C. Monserrat, V. Grau and C. Knoll, "Computer-aided periodontal disease diagnosis using computer vision", Computerized Medical Imaging and Graphics, vol. 23, no. 4, pp. 209-217, 1999.

[14]. "A machine learning approach to expert systems for fault diagnosis in communications equipment", Computer-Aided Design, vol. 20, no. 1, p. 45, 1988.

[15]. H. Yoshida and B. Keserci, "Bayesian wavelet snake for computer-aided diagnosis of lung nodules", Integrated Computer-Aided Engineering, vol. 7, no. 3, pp. 253-269, 2000.



Corresponding author at: Yun Chen, Washington University in St.Louis, USA.