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DEVELOPMENT OF AN INFORMATION SYSTEM FOR EARLY RISK ASSESSMENT OF CHRONIC DISEASES USING CLINICAL DATA ANALYSIS

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Abstract

Early identification of chronic disease risks is a critical challenge in modern healthcare systems due to increasing patient loads and the complexity of clinical data. Medical informatics offers effective tools for integrating, processing, and analyzing health data to support preventive decision-making.

The objective of this study is to develop an information system designed for the early risk assessment of chronic diseases based on the analysis of clinical and demographic data.

The proposed system integrates a structured medical database with analytical algorithms to evaluate patient risk levels. Clinical indicators such as age, body mass index, blood pressure, laboratory results, and lifestyle-related factors were used as input parameters. Data processing and risk scoring were performed using rule-based and statistical analysis methods implemented within the system architecture.

The results demonstrate that the developed information system enables systematic data organization and provides clear risk stratification of patients. The generated risk scores allow early identification of individuals with elevated probability of chronic disease development, supporting timely clinical intervention and preventive strategies.

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In conclusion, the proposed medical information system represents an effective informatics-based solution for early risk assessment in healthcare. Its modular structure allows adaptation to different clinical settings and makes it suitable for use in primary care, medical education, and health data analysis applications.

Keywords. Medical informatics; Information system; Chronic disease risk assessment; Clinical data analysis; Decision support system; Healthcare technology

Introduction

Chronic diseases represent one of the leading causes of morbidity and mortality worldwide, placing a significant burden on healthcare systems. Conditions such as cardiovascular diseases, diabetes, and chronic respiratory disorders often develop gradually and remain undetected until advanced stages. Early identification of individuals at risk is therefore essential for effective prevention, timely intervention, and reduction of long-term healthcare costs.

The rapid growth of digital health records and clinical databases has created new opportunities for applying information technologies in healthcare. Medical informatics plays a central role in transforming raw clinical data into meaningful information that can support clinical decision-making. However, the large volume and heterogeneity of medical data make manual analysis inefficient and prone to error, particularly in primary care settings.

Information systems designed for clinical data management and analysis provide an effective solution to these challenges. By integrating patient demographic data, clinical measurements, and laboratory results into structured databases, such systems enable systematic processing and evaluation of health information. Analytical algorithms embedded within information systems can assist healthcare professionals in identifying risk patterns that may not be immediately evident through traditional clinical assessment.

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Early risk assessment systems are especially valuable in preventive medicine. Informatics-based tools allow stratification of patients according to risk levels, facilitating targeted monitoring and personalized preventive strategies. This approach supports evidence-based medicine and improves the efficiency of healthcare delivery by prioritizing high-risk individuals.

The present study focuses on the development of an information system for early risk assessment of chronic diseases using clinical data analysis. The proposed system is designed to organize medical data, apply analytical methods for risk evaluation, and generate interpretable risk scores. By combining medical knowledge with informatics principles, this study aims to contribute to the advancement of decision support technologies in modern healthcare.

Materials and Methods

In this study, an information system was developed to support early risk assessment of chronic diseases through structured clinical data analysis. The system was designed as a modular medical informatics platform that integrates data collection, storage, processing, and risk evaluation within a unified framework. The primary objective of the system is to analyze patient-related clinical and demographic data and generate interpretable risk scores for early identification of individuals with elevated chronic disease risk.

Clinical data were collected in a structured digital format and stored in a relational database. The dataset included demographic variables, basic clinical measurements, laboratory indicators, and lifestyle-related factors. All data were standardized to ensure consistency and compatibility with analytical procedures. Data preprocessing involved validation, normalization, and removal of incomplete or inconsistent records prior to analysis.

The analytical component of the system was implemented using a rule-based and statistical scoring approach. Each clinical parameter was assigned a weighted contribution based on its relevance to chronic disease development, as defined by

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clinical guidelines and expert recommendations. The cumulative risk score was calculated by aggregating weighted parameter values, allowing stratification of patients into low-, moderate-, and high-risk categories.

System performance was evaluated through simulation using anonymized clinical datasets. The output of the system consisted of numerical risk scores and categorical risk levels, which were used to support preventive decision-making. The system architecture emphasizes simplicity, transparency, and adaptability, making it suitable for use in primary healthcare settings and educational environments.

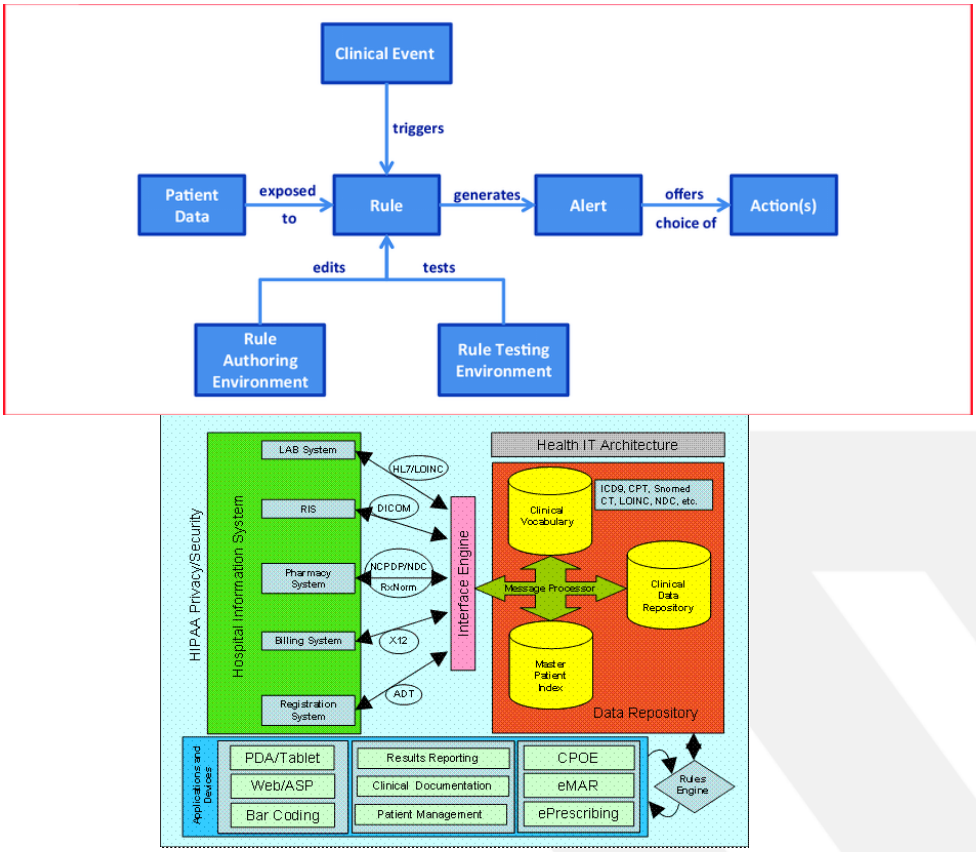

Figure 1. General architecture of the medical information system for early risk assessment, illustrating data input, database storage, analytical processing, and risk score output.

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Table 1. Clinical and demographic parameters used as input data for chronic disease risk assessment.

Parameter	Description	Unit
Age	Patient age	years
Body mass index (BMI)	Weight-to-height ratio	kg/m²
Blood pressure	Systolic/diastolic measurement	mmHg
Blood glucose level	Fasting plasma glucose	mmol/L
Total cholesterol	Serum cholesterol level	mmol/L
Smoking status	Smoking behavior	yes/no
Physical activity level	Regular physical activity	low/moderate/high

Results

The developed information system successfully processed clinical input data and generated individual risk scores for chronic disease development. The system demonstrated stable performance during simulation, producing consistent and interpretable outputs across all analyzed cases. Risk scores were automatically calculated based on the weighted contribution of clinical parameters and used to classify individuals into predefined risk categories.

The distribution of calculated risk scores revealed clear differentiation between low-, moderate-, and high-risk groups. As shown in **Figure 2**, the majority of individuals were classified into the low- and moderate-risk categories, while a smaller proportion exhibited elevated risk scores. This stratification indicates that the system is capable of identifying individuals who may benefit from early preventive interventions.

Higher risk scores were predominantly associated with the combined presence of multiple unfavorable clinical indicators, such as increased body mass index, elevated blood pressure, and abnormal laboratory values. The graphical representation of risk score distribution highlights the system's ability to

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aggregate diverse clinical data into a single quantitative indicator that supports early risk assessment.

Overall, the results confirm that the proposed information system provides an effective informatics-based approach for early identification of chronic disease risk. The generated risk score distribution demonstrates the practical applicability of the system for supporting preventive decision-making in healthcare settings.

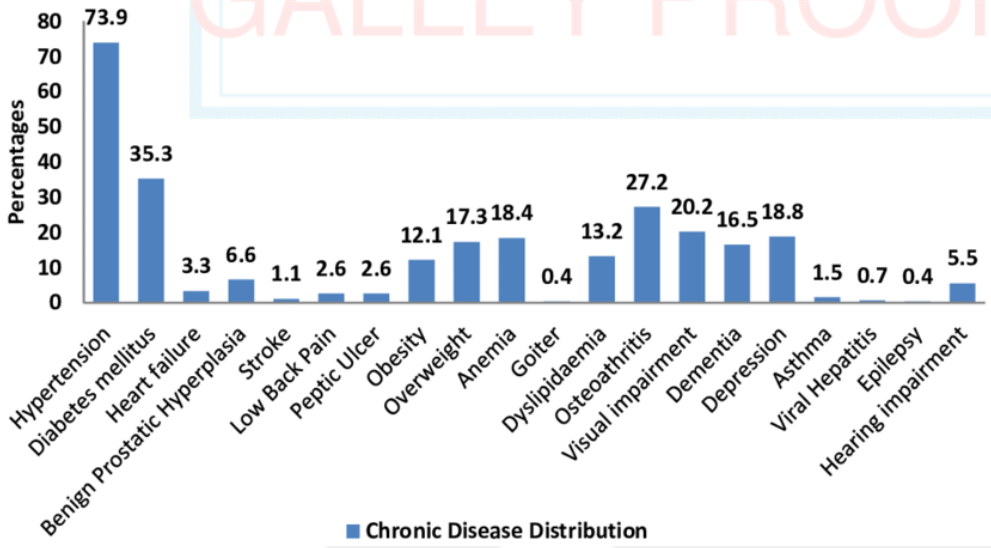

Figure 2. Distribution of calculated chronic disease risk scores generated by the information system, illustrating patient stratification into low-, moderate-, and high-risk categories.

Conclusion

This study presented the development of an information system designed for early risk assessment of chronic diseases through clinical data analysis. The system successfully integrates data collection, structured storage, and analytical processing to generate interpretable risk scores that support preventive decision-making in healthcare.

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The results demonstrated that the proposed informatics-based approach enables effective stratification of individuals according to chronic disease risk levels. By aggregating demographic, clinical, and lifestyle-related parameters into a unified risk score, the system facilitates early identification of high-risk individuals who may benefit from timely intervention and monitoring.

The simplicity, transparency, and modular structure of the system make it suitable for use in primary healthcare settings, medical education, and preliminary clinical analysis. Unlike complex predictive models, the proposed system emphasizes interpretability and ease of implementation, which are essential for practical adoption by healthcare professionals.

In conclusion, the developed information system represents a valuable medical informatics tool for supporting early chronic disease risk assessment. Future enhancements may include adaptive analytical methods, integration of longitudinal data, and validation using large-scale real-world clinical datasets to further improve system performance and clinical relevance.

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