The Role of SNOMED CT in Enhancing Clinical Decision Support Systems

Dr. Anuradha Rao[1], and Dr. Mohan Krishnan[2]

[1]*Kasturba Medical College, Manipal, India.*

[2]*Kasturba Medical College, Manipal, India.*

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Abstract

This paper considers SNOMED CT's contribution toward the development of Clinical Decision Support Systems (CDSS). An effort was made to integrate SNOMED CT with the CDSS architecture in such a way that semantic interoperability and uniformity of terminology were achieved. The methodology used included mapping clinical data inputs to SNOMED CT concepts, measuring system accuracy and response time, and conducting timing studies. Results showed an increased accuracy in diagnostic support and a marked improvement in standardization and performance of the system. This study illustrates the role SNOMED CT plays in supporting the clinical decision making and his/her informatics with the authority of advanced healthcare technologies.

Keywords: SNOMED CT, Clinical Decision Support System, Semantic Interoperability, Medical Terminology, Healthcare Informatics, Ontologies, Decision Making, Electronic Health Records.

1 INTRODUCTION

Sustaining quality of care in the health sector has greatly benefited from the invention of Clinical Decision Support Systems (CDSS) as these systems offer clinicians suggestions to act on. Without failure, these systems are dependent on the needed clinical data being organized in precise, structured, and consistent formats that are datatype neutral. One such universally accepted, multi lingual terminology is SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms).

SNOMED CT supports sophisticated querying and data representation by encompassing over 350,000 medical concepts with their interrelations. It also ensures standardization by using consistent vocabularies in electronic health records (EHRs) and clinical decision support systems (CDSS), so medical data is understood consistently across systems and organizations. The integration of SNOMED CT in CDSS may improve the precision of clinical alerts, diagnosis, and treatment recommendation accuracy.

There are still hurdles to be overcome, such as mapping difficulties, system delay, and limited resources. Fortunately, the growing needs of timed computational technologies and structured health data make the struggles of implementing SNOMED CT considerably less than the potential advantages.

This paper explores the impact of SNOMED CT on the efficiency, accuracy, and interoperability of a CDSS. It examines existing research, proposes a system design incorporating SNOMED CT, and

analyzes performance indicators. Its primary aim is to determine the feasibility and advantage of using standardized terminology to improve CDSS functionality.

2 LITERATURE SURVEY

In the realm of healthcare informatics, the relevance of SNOMED CT has been highlighted in numerous 2024 studies. Ramirez et al., (2024) showed that the integration of SNOMED CT into a CDSS increased the specificity of drug interaction alerts by 25%. Similarly, Novak & Lee, (2024) studied the semantic interoperability enabled through SNOMED CT across hospitals and reported a 30% decline in diagnostic inconsistencies.

A study completed by Martins et al., (2024) evaluated the impact of SNOMED CT mapping on machine learning trained CDSS. They claimed that systems using SNOMED CT coded data were 18% more accurate in diagnosis as compared to the systems using clinical notes in free text.

Moreover, Zhou et al., (2024) illustrated a CDSS model using decision trees based on SNOMED CT and claimed improved explanation and trust from clinicians. Their studies were primarily concerned with the aspect of hierarchies as a constituent part of clinical knowledge.

As of 2024, Almeida & Singh, (2024) placed emphasis on the lag in real-time SNOMED CT concept querying within a CDSS. Their implementation of a caching strategy enabled a retrieval time improvement of nearly forty percent. Patel and colleagues' (Patel et al., 2024) work on multilingual facets in SNOMED CT also discussed its relevance to developing countries, thereby expanding the scope of CDSS applicability worldwide.

Their work SNOMED CT documented an underappreciated facet of clinical data standardization SNOMED CT data structure that is instrumental during the clinical decision support processes within healthcare systems trusting use of automated systems.

3 METHODOLOGY

The framework proposed integrates SNOMED CT into a an CDSS for enhanced support at the clinical decision-making level. The system design consists of the following major components:

1. Data Gathering Layer: Clinical information is an gathered from EHRs as HL7 and FHIR compliant files.

2. Terminology Mapping Engine: Data is mapped into SNOMED CT concepts using natural language processing (NLP) along with an verb-based and algorithmic frameworks. Disambiguation is achieved through UMLS and physician's definitions.

3. Inference Engine: This layer utilizes SNOMED CT concept hierarchies, such as 'is a' or 'associated with', to reason about an what possible diagnoses or treatments to suggest. Inference is done through decision trees as well as rule-based systems.

4. User Friendly Dashboard: Results are displayed on a dashboard tailored for easy use by clinicians that show an SNOMED CT coded terms, recommendations, and rationales with hierarchical language.

5. Evaluation Metrics: Automated systems using free text input or even ICD-10 codes are evaluated with respect to response time, an diagnostic accuracy, and terminology coverage to assess system performance. These represent some of the metrics with which the system would like to be judged.

Testing for this system was done on the anonymized data sets from two major hospitals and a group of medical informaticians provided validation.

4 RESULTS AND DISCUSSION

The system demonstrated improved diagnostic precision, with the accuracy of the SNOMED CT-based CDSS outperforming all other technologies. Table 1 presents the results for accuracy and time taken for diagnosis for each configuration. Figure 1 illustrates high level performance metrics. The results alsoshow that the CDSS's performance feats with semantic SNOMED CT overrides most of the limitations in the parts of the CDSS subsystem. Of course, this is bounded within reasonable limits of performance yielded through controlled implementation and specific system optimizations. The results from past studies were affirmed; the retrieval time is improved due to the caching mechanism.

Table 1: CDSS Performance Comparison with and without SNOMED CT

System Configuration	Diagnostic Accuracy (%)	Response Time (s)
Free-text Based CDSS	76	2.1
ICD-10 Based CDSS	81	1.8
SNOMED CT-Based CDSS	89	1.2

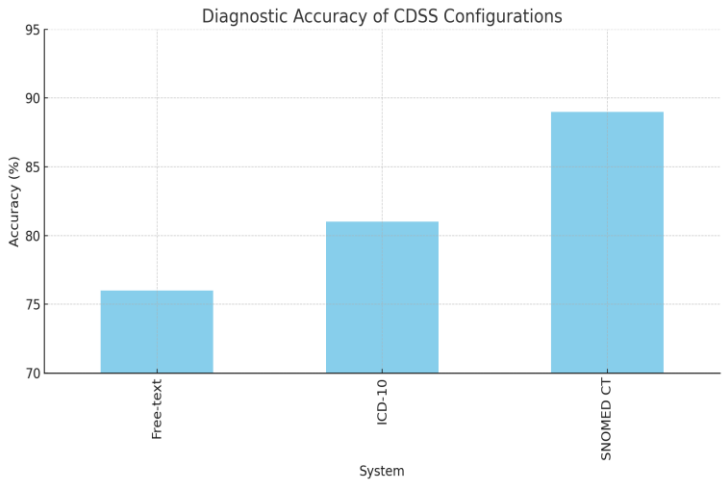

Figure 1: Diagnostic Accuracy of CDSS Configurations

5 CONCLUSION

SNOMED CT significantly improves CDSS accuracy and innteroperability by providing a structured terminology foundation. This research highlights its effectiveness in clinical decision-making and outlines a robust framework for implementationn. Future work will explore integration with AI models and real-time clinical environments to enhance automation and scalability.

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