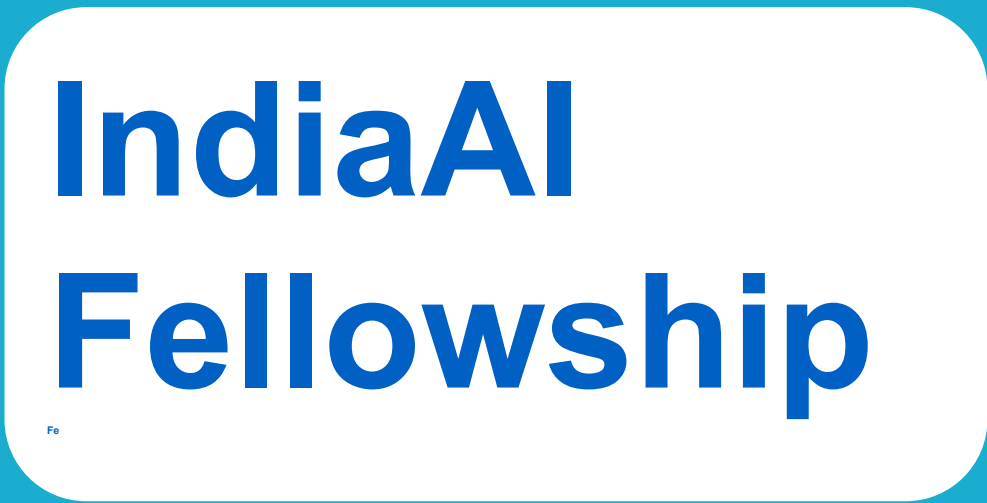




# Optimizing Clinical Decision-Making: Text-to-SQL For Enhanced EHRs



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## Project Description

- To develop an automated text-to-SQL system for querying Electronic Health Records (EHR) databases using natural language.
- To enable clinicians without SQL expertise to retrieve patient information efficiently through intuitive questioning.
- To bridge the gap between clinical expertise and database management in healthcare settings.

## Objectives

- To convert natural language queries into accurate SQL statements for EHR databases.
- To handle complex multi-table queries involving patient demographics, diagnoses, prescriptions, and lab results.
- To achieve high query accuracy and minimize errors in SQL generation.
- To implement robust error handling mechanisms for unanswerable or ambiguous queries.

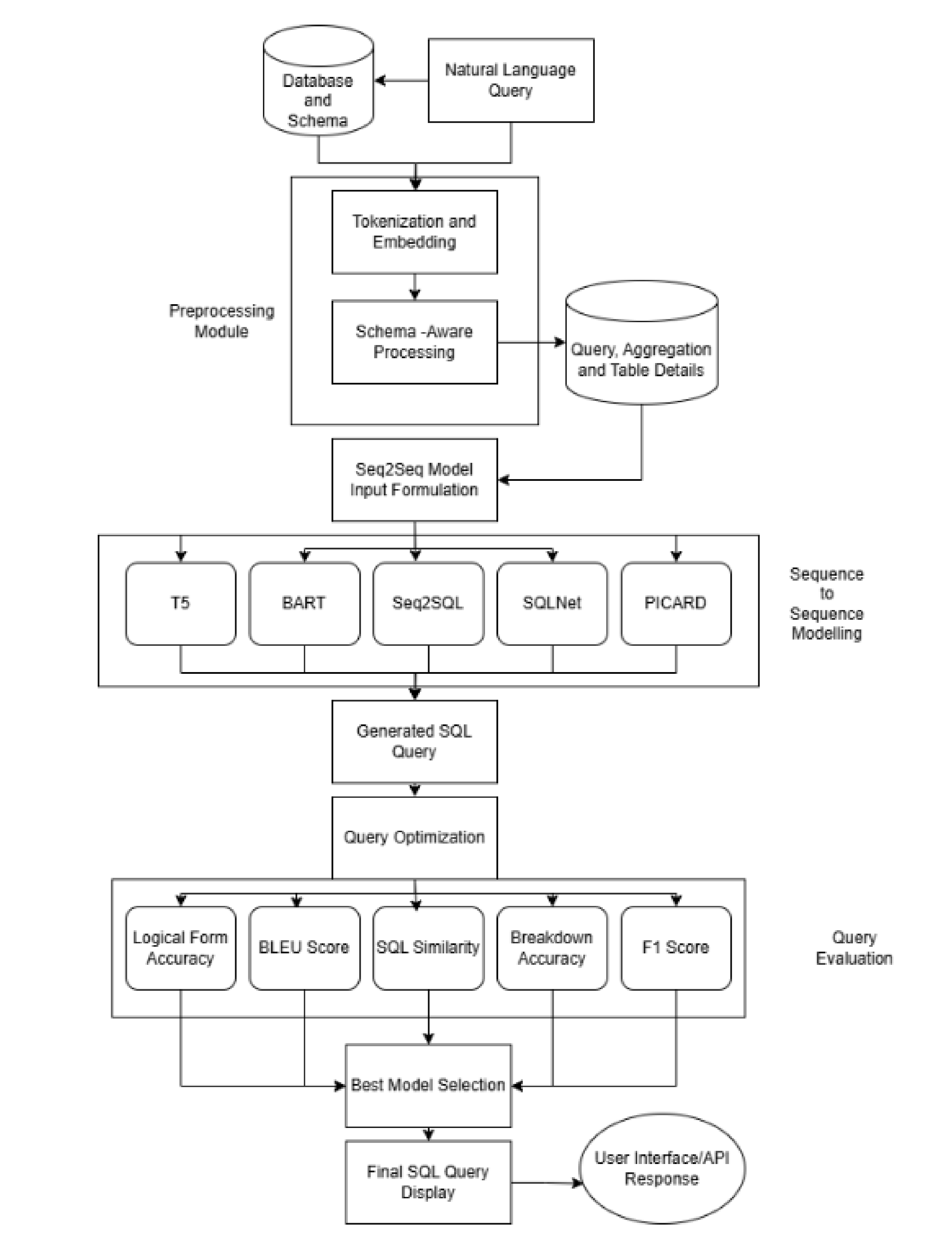
## Novelty

- Integration of constrained decoding techniques to ensure syntactically valid and executable SQL queries.
- Schema-aware processing that adapts to complex medical database structures with multiple relational tables.

## Deliverables

- Web-based user interface for intuitive query input and result visualization.
- Comprehensive evaluation framework with multiple metrics (BLEU, F1-Score, Component Accuracy).

## System Architecture



## Results

Metric	T5	BART	Seq2SQL	SQLNet	PICARD
Logical Form Accuracy (%)	72.4	74.8	68.2	70.1	79.3
BLEU Score	0.54	0.56	0.50	0.52	0.59
SQL Similarity Score	0.74	0.76	0.70	0.72	0.80
Aggregation Operator Accuracy (%)	69.5	71.2	65.3	67.8	74.6
Aggregation Column Accuracy (%)	66.8	69.1	62.7	65.2	72.5
Table Selection Accuracy (%)	75.1	77.3	71.9	74.0	81.4
Condition Column and Operator Accuracy (%)	64.2	66.7	60.4	62.9	70.1
Condition Value Accuracy (%)	61.5	64.0	58.3	60.8	68.5
Average Breakdown Accuracy (%)	67.2	69.8	63.8	66.2	73.0
Precision	0.68	0.70	0.64	0.66	0.74
Recall	0.65	0.68	0.62	0.64	0.71
F1-Score	0.67	0.69	0.63	0.65	0.73

## Future Development

- Integration with real-time EHR systems (Epic, Cerner, Allscripts) through standardized API interfaces.
- Expansion to support voice-based queries for hands-free clinical workflows.

## Outcome of the Project Impact on Industry/Society

- **Increased Efficiency:** Reduces query formulation time from minutes to seconds, allowing clinicians to focus on patient care rather than database navigation.
- **Democratized Data Access:** Enables nurses, residents, and non-technical staff to access critical patient information without SQL training.
- **Cost Reduction:** Eliminates need for dedicated database specialists for routine queries.
- **Improved Clinical Decision-Making:** Faster access to patient histories, lab results, and treatment outcomes leads to more informed clinical decisions.
- **Enhanced Patient Safety:** Quick access to medication histories, allergies, and past diagnoses reduces risk of adverse events and medical errors.

## Conclusion and Outcomes

- Successfully developed an automated text-to-SQL system achieving 79.3% accuracy on medical EHR queries using the PICARD architecture.
- Demonstrated significant performance improvements through schema-aware processing and constrained decoding techniques.
- Comprehensive evaluation across five models established PICARD as the optimal choice for medical database querying.