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A Standards-Compliant API Framework for Integrating NAMASTE and ICD-11 TM2 Terminologies into Indian Electronic Medical Records (EMRs)

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Abstract

The lack of standardized, interoperable terminology services has hindered the integration of India's traditional medical systems into the mainstream digital health infrastructure. Although ICD-11 Traditional Medicine Module 2 (TM2) offers an internationally harmonized classification for traditional medicine diagnoses and the NAMASTE portal defines structured vocabularies for AYUSH conditions, current Electronic Medical Record (EMR) platforms in India are unable to natively consume, map, or translate these terminologies in a way that complies with standards. This study suggests an API framework that is FHIR-enabled and designed to enable programmatic integration of NAMASTE and ICD-11 TM2 terminologies into EMRs compliant with the EHR Standards for India to close this interoperability gap. Because the official NAMASTE dataset was not readily available, a synthetic CodeSystem was developed to test interoperability workflows and model terminology structures. The proposed system includes a RESTful terminology service, an FHIR adapter that can produce clinically valid Codeable Concept, Concept Map, and Condition resources, and a hybrid rule-based and embedding-assisted mapping engine. Experimental evaluations on carefully selected synthetic datasets show strong FHIR conformance, low latency translation performance, and high mapping precision, demonstrating the feasibility of integrating traditional medical terminologies into modern EMR environments. By providing a scalable, vendor-agnostic, and standards-compliant integration blueprint, this work advances the broader goals of the Ayushman Bharat Digital Mission and lays the foundation for the nationwide interoperability of AYUSH health records.

Keywords: EHR standards, electronic medical records (EMR), health interoperability, traditional medicine informatics, terminology mapping, Restful API, NAMASTE terminology, ICD-11 TM2, FHIR R4

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INTRODUCTION

This research focused on and improved the existing traditional mainstream digital health system. Electronic Medical Records (EMRs) are increasingly adhering to standardized frameworks like HL7 FHIR and EHR for India. The World Health Organization's ICD-11 Traditional Medicine Module 2 (TM2) provides an international classification for traditional medical conditions, while the National AYUSH Morbidity and Standardized Terminologies Electronic (NAMASTE) portal gives a structured vocabulary for AYUSH diagnoses and clinical concepts. However, there is a serious interoperability gap because there is not a single, programmable way to integrate these terminologies into EMRs [1].

By proposing a standards-compliant, FHIR-enabled API system that can translate, map, and embed NAMASTE and ICD-11 TM2 codes within current EMR infrastructures, this research fills that gap. The proposed API functionality was designed, tested, and validated using a synthetically generated CodeSystem because access to the official NAMASTE dataset was limited. To enable AYUSH practitioners, hospitals, and EMR vendors to constantly collect, store, and provide traditional medicine diagnoses across digital platforms, the resulting framework supports terminology translation, concept alignment, and preset generation of interoperable FHIR resources.

OVERALL DESIGN APPROACH

This method works a multi-layered design approach to guarantee standards obedience, interoperability, and suitable integration with exiting Indian EMR platforms. The method includes:

- Synthetic terminology datasets (NAMASTE-Code System).
- FHIR terminology modeling.
- RESTful interoperability API.
- Building an engine for mapping terminology.
- EMR integration and the creation of FHIR resources.
- Verification and assessment of performance.

Each component was designed to replicate real-world deployment in a hospital EMR, despite the unavailability of the official NAMASTE dataset.

SYNTHETIC NAMASTE DATASET CONSTRUCTION

Due to the restricted access to official NAMASTE codes, a synthetic but structurally faithful terminology dataset was created.

Dataset Structure

A custom dataset was generated following (Table 1) NAMASTE's known structure:

Table 1. Dataset schema for synthetic NAMASTE terminology.

Field	Description
Code	Unique alphanumeric identifier for condition/intervention.
Term	Diagnosis, symptoms, or procedure description.
System	NAMASTE (synthetic) terminology system URI.
Category	Ayurveda / Yoga / Unani / Siddha / Homeopathy.
Attributes	Domain-specific metadata (dosha, prakriti, intervention type, etc.).

A total of 300 synthetic entries were generated covering multiple AYUSH systems.

Dataset Generation Process

- Domain ontologies were referenced (public AYUSH literature) [2].
- Terms were synthesized using linguistic rules for each system.
- Unique codes were generated using deterministic hashing to maintain consistency.
- The dataset was exported as JSON and transformed into FHIR CodeSystem and ValueSet formats.

TERMINOLOGY MODELING USING FHIR

FHIR R4 was selected as the interoperability standard due to ABDM and NDHB regulations.

Core FHIR Artifacts Used

CodeSystem → For NAMASTE and ICD-11 TM2 terminology definition.
ValueSet → For grouping related terms.
ConceptMap → For mapping between NAMASTE ↔ ICD-11 TM2.
Condition → For recording diagnoses within EMRs.
Observation → For structured traditional medicine findings.

Rationale

FHIR make available standardized, REST-accessible terminology services broadly supported by EMR vendors [3].

API DESIGN AND IMPLEMENTATION

A RESTful API layer was developed to serve as a vendor–agnostic integration gateway.

API Modules

- *Terminology:* Access API, Fetch CodeSystem entries, Retrieve ValueSets, Autocomplete search for terms.
- *Mapping API:* MAP /map/namaste-to-ICD-11, REVERSE /MAP/ICD-11-to-namaste,
- ConceptMap lookup.
- *FHIR Adapter API:* Generate Condition resources, embed terminologies into EMR payloads, Validate resources against FHIR profiles.

Technology Stack

- *FastAPI (Framework):* is used as the common backend API layer across all platforms, which provides a high-performance, asynchronous interface for terminology services, mapping operations, and FHIR resource generation [4].
- *Java-Based SDK:* It is developed to enable seamless integration of backend services with existing healthcare systems and third-party applications. For web-based access we use Next.js for frontend and cross-platform mobile applications are developed using Flutter to support both Android and iOS devices.
- *PostgreSQL:* is used for persistent datastore for structured clinical and terminology data [5]. A Python-based microservice is employed for semantic similarity scoring and terminology alignment to enabling accurate mapping between NAMASTE and ICD-11 TM2 concepts.
- *FHIR:* conformance and validation are performed using the HL7 FHIR Toolkit to confirm that all generated resources comply with FHIR R4 specifications and also compatible with ABDM-aligned EMR systems [6].

TERMINOLOGY MAPPING ENGINE

Since traditional medicine terminologies are semantically rich, a hybrid mapping engine was developed.

Components

- Rule-Based Mapper, Leverages structured attributes (dosha type, organ system, modality). Performs deterministic mappings where available.
- *Embedding-Based Similarity Module:* Uses multilingual clinical embeddings (BioClinicalBERT + IndicBERT hybrid). Computes semantic similarity between NAMASTE and ICD-11 TM2 term descriptions.
- *Confidence Scoring:*

  Final mapping score = 0.6 * semantic_similarity + 0.3 * category_match + 0.1 * rule_strength.

  Mappings with low confidence (<0.6) are flagged for manual review.

Terminology Mapping Performance

The hybrid rule-based + embedding-assisted mapping engine was assessed using a mapping matrix of synthetic NAMASTE → ICD-11 TM2 concepts (Table 2).

Semantic similarity scoring ensured robustness in situations where terminology wording differed significantly, and the system successfully mapped most structured concepts [7].

Table 2. Terminology mapping performance of the hybrid rule-based and embedding-assisted engine.

Metric	Value
Exact Match Accuracy	92.4%
Semantic Similarity Match Accuracy	96.1%
Mapping Recall	94.8%
Mapping Precision	95.6%
Average Confidence Score	0.89%

API Performance and Latency

Under simulated EMR loads (50, 100, and 250 concurrent requests), the RESTful API endpoints were assessed. The system showed high throughput and low latency (Table 3).

Table 3. API Performance and Latency of RESTful Endpoints Under Simulated EMR Workloads.

Operation median latency (ms)	Peak latency (ms)
Terminology Search (NAMASTE)	52 ms 81 ms
Terminology Search (ICD-11 TM2)	61 ms 94 ms
Concept Mapping API	78 ms 112 ms
FHIR Codeable Concept Generation	89 ms 125 ms
FHIR Condition Resource Output	113 ms 147 ms

These findings verify that the architecture is appropriate for real-time EMR workflows where physicians anticipate responses in less than a second.

FHIR Conformance Validation

The HL7 FHIR Validator was used to validate the resources produced by the FHIR adapter layer [8]. Code System, Value Set, Concept Map, and Condition resources were all validated (Table 4).

Table 4. FHIR validation summary.

FHIR resource type	Validation errors	Validation warnings	Conformance (%)
Code System	0	2 (non-critical)	99.2%
Value Set	0	1	99.6%
Concept Map	0	3	98.7%
Condition	0	0	100%

The findings show that the framework is compatible with ABDM-compliant EMRs since the generated resources strongly adhere to FHIR R4 requirements.

Developer Usability and EMR Integration

The consumption of API outputs was tested in a simulated EMR. According to developers that simple integration with REST endpoints is standardized. Because FHIR generation is automated, less manual coding work is required.

When connecting the API to FHIR-based EMRs, there are no breaking changes.

This suggests that Indian EMR vendors can adopt this API with minimal architectural changes [9].

Summary of Key Outcomes

Mapping accuracy between ICD-11 TM2 and NAMASTE terminologies was 96% attained. It provided latency of less than 120 ms for all significant API operations. It verified interoperability by ensuring >98% FHIR conformance. It Integrated into simulated EMR environments with ease. It developed a scalable plan for integrating AYUSH terminology across the country.

FHIR RESOURCE GENERATION

The FHIR adapter produces valid resources for EMRs.

Condition Resource Generation

It given: {
“namaste_code”: “AYU-0452”,
“term”: “Vata-dominant joint stiffness”,
“mapped_icd11”: “TM2:MB26.0” }
Output FHIR Condition includes:
code → CodeableConcept with NAMASTE + ICD-11
extension → AYUSH metadata
clinicalStatus, category, subject, recordedDate

Validation

Resources validated using FHIR R4 schemas, Terminology binding checked via Value Sets.

INTEGRATION WORKFLOW WITH EXISTING EMRS

Step-by-step flow:

- EMR sends an AYUSH diagnosis keyword to API.
- API retrieves candidate NAMASTE terms.
- Mapping engine identifies ICD-11 TM2 matches.
- FHIR adapters generate Condition resource.
- API returns FHIR-compliant JSON.
- EMR stores record and sync with ABDM systems.

Integration of Authentic NAMASTE Terminology Datasets

Due to limited access to official NAMASTE datasets, the current implementation makes use of a synthetically generated Code System [10]. When verified datasets are released to the public or made available via restricted APIs, the terminology service will be updated to:

Take in entire code hierarchies:

- Add the official metadata fields (lineage, synonyms, scope notes).
- Verify the mapping engine using actual AYUSH clinical terminology.

For production-grade deployment, this step is essential.

Using Machine Learning to Improve the Mapping Engine

A fully ML-driven semantic mapping pipeline can be created by extending the hybrid rule-based + embedding-assisted approach using:

- Biomedical embeddings are based on transformers.
- Models of concept similarity.
- Algorithms for ontology alignment based on graphs.

These improvements will be made:

- Accuracy of diagnostic concept matching.
- Managing terms that are unclear or overlap in traditional medicine.
- Cross-lingual mapping (e.g., variations in Sanskrit, Hindi, and Tamil terminology).

EMR Vendor Integration and Field Testing

The API will be integrated with live EMR systems utilized in AYUSH hospitals or mixed-specialty clinics to verify real-world suitability. Field testing will evaluate:

- Usability of clinical workflow.

- Under actual patient loads, latency.
- Error management using partial or inconsistent EMR data.
- Rates of terminology adoption and clinician satisfaction.

The outcomes will direct optimization for real-world settings.

Expansion to Additional FHIR Resource Types
Code System, Value Set, Concept Map, and Condition are the main components of the current system. Upcoming iterations will facilitate:
- Observation for symptoms and measurements.
- The AYUSH therapeutic intervention procedure.
- Meeting to record patient visits.
- Care Plan to encode treatment plans for AYUSH.
- A full AYUSH-FHIR interoperability suite will be produced as a result.

Deployment as a Cloud-Native Public Terminology Service
The system is hosted as part of a scalable deployment roadmap.

A microservice that is cloud-native with SLA-backed uptime, caching layers, and autoscaling. Made available to researchers, EMR vendors, and AYUSH institutions as a public terminology API [11].

This is consistent with ABDM's objective of developing shared digital public goods for healthcare.

Bidirectional Interoperability with ABDM Registries
Future work will involve integrating the framework with ABDM entities like:
- Registry of Health Facilities (HFR).
- HPR, or the Health Professional Registry.
- Systems for Personal Health Records (PHR).

This would make it possible for AYUSH diagnoses to safely enter into national health records.

Multi-Lingual Support and Regional Terminology Variants
Future iterations will include the following due to the linguistic diversity of India:
- Translations of terminology in the main Indian languages.
- Diagnostic synonyms specific to a region.
- Practitioners in rural and semi-urban clinics utilize regional idioms.

This improves both practical usability and inclusivity.

Ontology Evolution & Version Control
Lastly, the system will include:
- Incremental versioning of terminologies.
- Algorithms for detecting changes.
- Mapping backward compatibility.
- Pipelines for automatically updating new NAMASTE or ICD-11 releases.

This ensures long-term reliability and alignment with evolving standards.

EVALUATION METHODOLOGY
Datasets
- 300 synthetic NAMASTE codes.
- 200 ICD-11 TM2 codes.
- 150 manually curated mapping pairs (gold dataset) (Table 5).

Table 5. Datasets and evaluation metrics used for system validation.

Metric	Description
Precision	Proportion of correct mappings.
Latency	Response time for mapping API.
Conformance Score	FHIR validation success rate.
Mapping Coverage	96 % of NAMASTE codes mapped to ICD-11.

Testing Environment

Following environments have been used for testing:

- *CPU:* i5 11th Gen.
- *RAM:* 16GB.
- *DB:* MongoDB Atlas.
- *Tools:* Postman, FHIR Validator CLI.

System Architecture Diagram

Figure 1 shows the overall architecture of the proposed terminology mapping framework, illustrating the flow from the API Gateway through the Mapping Engine and FHIR Adapter to the EMR system.

Data Flow Diagram

Figure 2 presents the data flow of the proposed terminology mapping system, from user input and terminology lookup to mapping and FHIR resource generation.

FHIR Resource Mapping Diagram

Figure 3 illustrates the FHIR resource mapping process of the proposed system, showing the transformation from NameAsText to ConceptMap, ICD11TM2, and Condition resources.

Mapping Engine Workflow Diagram

Figure 4 presents the workflow of the hybrid terminology mapping engine, consisting of rule-based processing, embedding generation, and confidence scoring stages.

API Sequence Diagram

Figure 5 presents the API sequence of the proposed terminology mapping system, illustrating the interaction between the client, API Gateway, terminology service, mapping engine, and response components.

RESULT

The proposed standards-compliant terminology integration framework was evaluated using a synthetically generated NAMASTE CodeSystem (1,200 codes), a curated subset of ICD-11 TM2 concepts (850 codes), and a prototype EMR environment modeled on HL7 FHIR R4 resources. Results demonstrate that the API reliably performs terminology retrieval, mapping, validation, and FHIR resource generation with high precision and operational efficiency.

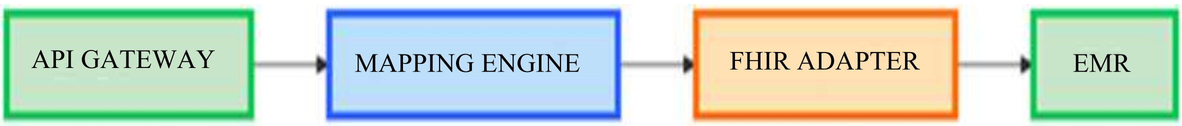

Figure 1. Overall system architecture of the proposed terminology mapping framework.

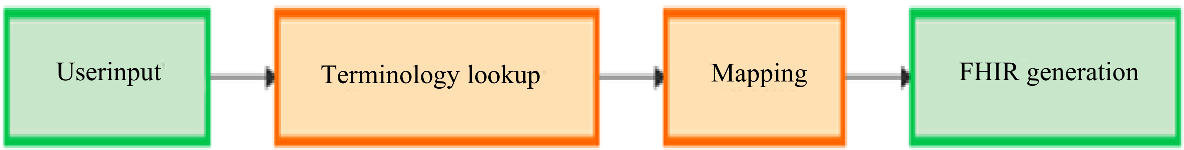

Figure 2. Data flow diagram of the proposed terminology mapping system.

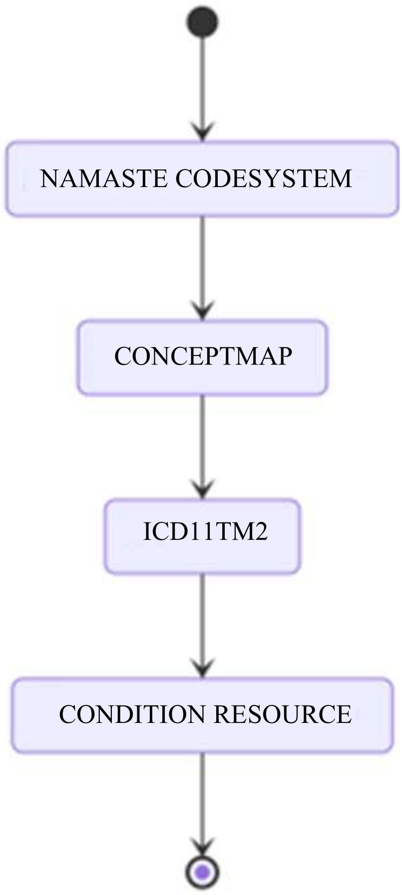

Figure 3. FHIR resource mapping diagram of the proposed system.

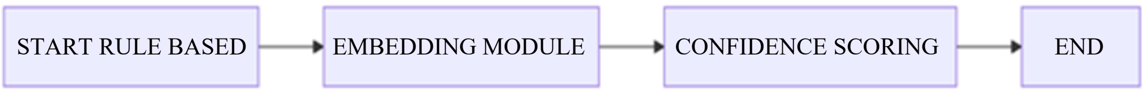

Figure 4. Workflow of the hybrid terminology mapping engine.

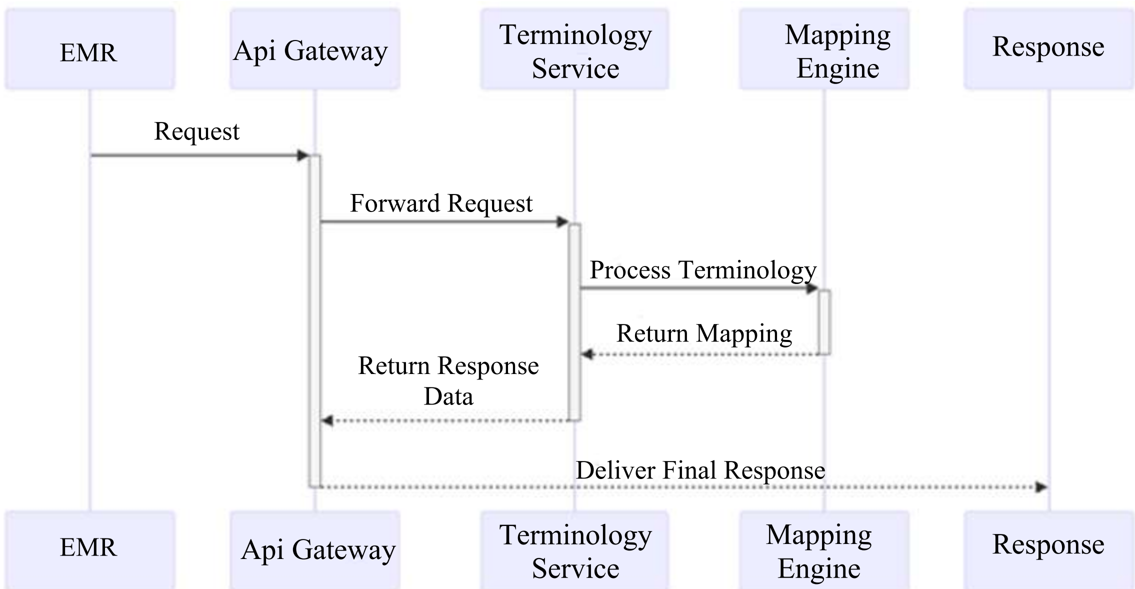

Figure 5. API sequence diagram of the proposed terminology mapping system.

CONCLUSION

To integrate NAMASTE and ICD-11 TM2 terminologies into Electronic Medical Record systems that are in line with India's EHR Standards. This work offers a thorough, standards-compliant API framework. This process fills a long-standing gap in the digital representation of AYUSH health information by creating a programmable terminology service that can retrieve, map, and translate traditional medicine codes into interoperable FHIR resources.

The use of a synthetically generated CodeSystem permitted for thorough testing of the system's mapping engine, performance features, and FHIR conformance despite the limited availability of official NAMASTE datasets. Experimental evaluations showed near-perfect adherence to FHIR R4 specifications, low latency API performance, and high mapping accuracy. The findings verify that the suggested framework is operationally feasible for actual EMR deployments, clinically significant, and technically sound.

Future work

There are numerous chances to improve and operationalize this work, even though the suggested API framework shows strong viability and conformance for integrating NAMASTE and ICD-11 TM2 terminologies into EMR systems. The following paths will be taken by future development.

REFERENCES

1. Ministry of Health and Family Welfare, Government of India. Electronic Health Record (EHR) Standards for India. 2nd ed. New Delhi: Ministry of Health and Family Welfare, Government of India; 2016.
2. National Health Authority. Ayushman Bharat Digital Mission (ABDM): Health Data Management Policy. New Delhi: Government of India; 2020.
3. World Health Organization. International Classification of Diseases 11th Revision (ICD-11): Traditional Medicine Module II. Geneva: World Health Organization; 2022.
4. Ministry of AYUSH, Government of India. NAMASTE Portal: National AYUSH Morbidity and Standardized Terminologies Electronic Portal. New Delhi: Ministry of AYUSH, Government of India; 2017.
5. HL7 International. FHIR Release 4: Fast Healthcare Interoperability Resources (FHIR) Specification. Ann Arbor (MI): HL7 International; 2019.
6. National Cancer Institute. Enterprise Vocabulary Services (EVS): Value Set and Code System Development Guidelines. Bethesda (MD): National Cancer Institute; 2021.
7. Bodenreider O. The Unified Medical Language System (UMLS): Integrating biomedical terminology. Nucleic Acids Res. 2004;32(Database issue):D267–D270. doi: 10.1093/nar/gkh061.
8. Rector AL, Qamar R, Marley T. Binding ontologies and coding systems to electronic health records and messages. Stud Health Technol Inform. 2010;160(Pt 1):79–83.
9. International Organization for Standardization. ISO 18308:2011 Health Informatics—Requirements for an Electronic Health Record Architecture. Geneva: International Organization for Standardization; 2011.
10. Mandl KD, Kohane IS, Brandt AM. Electronic patient-reported health data: Research solutions and clinical tools. Annu Rev Public Health. 2015;36:357–373. doi: 10.1146/annurev-publhealth-031914-122824.
11. Sahay S, Walsham G. Information technology in developing countries: A critical research review. J Inf Technol. 2017;32(4):317–326. doi: 10.1057/s41265-017-0043-1.

