Enhancing SNOMED CT Based Clinical Data Entry via Doctor Desk\textsuperscript{LITE}

A Case Study on Indian HMIS

(Proposal ID 201910)

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A Scientific Society Of the Ministry of Electronics & Information Technology, Government of India
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7. Voice-Based Prescription Generation System
8. Mobile/Tablet Interfaces with Voice Support
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About CDAC

- An autonomous Research and Development organization under the Ministry of Electronics and Information Technology (MeitY), Government of India.

Key Focus Areas of CDAC Noida

- Health Informatics
- Embedded Systems
- Speech and Natural Language Processing
- e-Governance
- Education and Training

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Health Informatics Solutions by CDAC

- **Hospital Information**
  - e-Sushrut

- **Supply Chain**
  - e-Aushadhi
  - e-MMS

- **Blood Bank Information**
  - e-Rakt Kosh

- **Citizen Centric**
  - Mobile Apps
  - Portal

- Available in Open Source Technology
- Configurable for multiple hospitals
- Unique Health ID for patients with patient profiling and EMR generation
- Interface with Medical Equipments, Biometrics, Tablets etc
- Integration with Aadhaar card and SMS Gateway
- Integration with “Mera Aspataal”, Online Registration System
- Supports Payment Gateway to enable Digital Payments

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Prior Scenario - Before Doctor Desk\textsuperscript{LITE}

- Doctor Desk (old) interface was available for data entry by clinicians for patient encounters.
- The interfaces were only available on desktops / PC terminals.
- User Interface was not responsive and complicated for use.

- SNOMED CT compliant fields were organized in a non-intuitive manner.
- As a consequence, clinical data entry was only around 10-15% in terms of number of patient encounters.
Doctor Desk LITE: Need & Motivation

- The primary challenges faced in large-scale adoption of clinical terminology in Hospital Management Information Systems (HMIS) include high patient loads and lack of adequate training to clinicians, particularly in developing countries.
- Clinicians are confounded by complex data entry interfaces present in systems, and often refrain from using them persistently.
- There is a need for simple and effective UI elements in design which is seamlessly accessible on multiple platforms (including mobiles and tablets).
- To this end, we present a case study which establishes the role of effective UI design in facilitating clinical data entry via SNOMED CT.
# Doctor Desk\textsuperscript{LITE} Web Interfaces

## Doctor Desk

<table>
<thead>
<tr>
<th>No.</th>
<th>Status</th>
<th>Name</th>
<th>Cr. No.</th>
<th>Gen/Age/Cat/Mobile</th>
<th>Dept/Unit</th>
<th>Room No.</th>
<th>Action</th>
<th>Prescription</th>
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<tbody>
<tr>
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<td>Waiting</td>
<td>Banna Kukamalla</td>
<td>379131900148860</td>
<td>F/33 Yr/General</td>
<td>C F M/C F M Unit 1</td>
<td>02</td>
<td>Rx</td>
<td>Vitals/GE</td>
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<tr>
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<td>02</td>
<td>Rx</td>
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<tr>
<td>2</td>
<td>Attended</td>
<td>Venkata Rajeswari Talasila</td>
<td>379131900144660</td>
<td>F/45 Yr/General</td>
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<td>02</td>
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<td></td>
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<td>5</td>
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<td>Reprint</td>
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<td>Reprint</td>
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<td>C F M/C F M Unit 1</td>
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<tr>
<td>10</td>
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<td>02</td>
<td>Rx</td>
<td>Reprint</td>
</tr>
</tbody>
</table>
C-DAC's toolkit for SNOMED CT (CSNOtk)
SNOMED / ICD-10 Diagnosis Entry
Diagnosis Entry with EHR Standards Compliance
Drug & Procedure Rx Based on EHR Standards

Drugs from hospital drug list (To comply with SNOMED CT Drug Terminology for India in future)

**Drugs/Advices:**

- **Drug Name:**
  - para
  - PARACETAMOL (150MG/ML) 2ML INJ
  - PARACETAMOL 1GM
  - PARACETAMOL 60 ML
  - PARACETAMOL 500MG
  - PARACETAMOL 650MG

**Dosage:**
- 2 Drops
**Frequency:**
- OD
**Start Date:**
- 03/29/2019

**Procedures:**
- Clinical Procedure

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Lab Reports Trends Analyzer (LOINIC)
Lab Results History & Trend Analyzer on Mobile/Tabs

Doctor's Desk Demo

Patient Details
CR No: 331011700087206
Name: B Sudhakar (38 Yr/Male)

Glucose Fasting

Plasma Glucose (Fasting)

Name: 15-Feb-2019
Range: 70 mg/dL - 100 mg/dL
Value: 94

Activated Partial Thromboplastin Time (APTT)

AEROBIC CULTURE
ANCA IMMUNOFLUORESCENCE
BU/SC/SE
Calcium
CBC (HB, PCV, TLC, PLT, PS)
COMPLETE URINE EXAMINATION (CHEMISTRY & MICROSCOPY)
CREATININE

Lab Reports:

Test Name: HBS Ag ELFA
CR No: 331011700087206
Name: B Sudhakar (38 Yr/Male)

Test Name: HCV ELISA
CR No: 331011700087206
Name: B Sudhakar (38 Yr/Male)

Test Name: HIV ELFA
CR No: 331011700087206
Name: B Sudhakar (38 Yr/Male)

Health Informatics Group, CDAC Noida

10/31/2019

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SNOMED CT Expo 2019, 31 Oct-01 Nov 2019, Kuala Lumpur, Malaysia
## History

### PATIENT CLINICAL DATA

<table>
<thead>
<tr>
<th>Name</th>
<th>CR No.</th>
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<tbody>
<tr>
<td>[Name]</td>
<td>[CR No.]</td>
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<table>
<thead>
<tr>
<th>Department (Unit)</th>
<th>Reprinted On</th>
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<tbody>
<tr>
<td>C F M/C F M Unit 1</td>
<td>31-Oct-2019 / 10:13:44</td>
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<table>
<thead>
<tr>
<th>Mobile No</th>
<th>Occupation</th>
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<tbody>
<tr>
<td>[Number]</td>
<td>-</td>
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</tbody>
</table>

### 31 Oct, 2019 (C F M/C F M Unit 1)

HOPi: K/C/O of T2 DM since 1 year using Glucoryl M2 once in two days, FBS-274, PPBS-460, Urine glucose 2+, traces of albumin + and plenty of pus cells in urine. Lipid profile- deranged, CBC- Normal and thyroid profile- normal, , Albumin-5, BUN-10.65, Urea-22.8, creatinine-0.4

### 26 Oct, 2019 (C F M/C F M Unit 1)

HOPi: Urge and stress incontinence - Associated with increased frequency in micturition, no h/o burning micturition, No h/o fever

**Surgical History**: Abdominal hysterectomy - 18 years back

**Personal History**: bowel movements regular, sleep disturbed

**Treatment History**: irregualr? medication for diabetes- alternate day

**Past History**: has h/o stress incontinence once in a while, has hip pain radiating to thigh since childhood, right side limb short than left side
**OPD PRESCRIPTION**

**Name**: Chakradhar S Shukla  
**CR No.**: 34813434643  
**Age/Gender**: 75 Yr/F  
**Patient Category**: General  
**Father/Spouse Name**: Nanaiah  
**Department (Unit)**: C F M/C F M Unit 1  
**Visit Date**: 31/10/2019  
**Consultant Name**: Dr. Navya Krishna Naidu  
**Occupation**:  

**CHIEF COMPLAINT**: Giddiness(2 Months), SOBOE - Shortness of breath on exertion(2 Months), Burning sensation(2 Months)  

**HISTORY OF PRESENT ILLNESS**: K/C/O T2DM and HTN, No medications or records brought by patient.  

**VITALS/GE**: Weight: 47.00kG., Height: 149.00CM, BMI: 21.17CM, BP :145.0/80.0mmHg, Temperature : 0.00F, B.S. Fast: 0.00mg/dl, B.S. PP: 0.00mg/dl, HBA1C: 0.00mg/dl,  

**DIAGNOSIS**: Diabetes mellitus(Provisional, ), HTN - Hypertension(Provisional, ),  

**INVESTIGATIONS ADVISED**:  
1) HbA1c (T27), 2) UREA (URE), 3) Serum Creatinine (SC), 4) CBC*, 5) ECG (ECG), 6) Urine Routine (UR),  
To review with reports  

**TREATMENT ADVICE**: Diabetic diet advised  

**Rx**:  
1. METHYLCOBALAMINE-750MG+PREGABALINE-75MG, One Tablet, HS, 30 Days, (After Food at bed time)  

**CLINICAL NOTE**: To bring old medical records/medications using by pt. To come on fasting for lipid profile/FBS/PPBS test on next visit  

No Known Drug Allergy  

**FOLLOW UP**:  

Signature of Consultant  
Dr. [Signature]

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SNOMED CT Expo 2019, 31 Oct-01 Nov 2019, Kuala Lumpur, Malaysia
Patient Uploaded Prescription Image Viewing
Prescription Scanning & Upload—Case Study at NIMS, Nephrology Department

- Prescription Scanning was implemented in NIMS, Hyderabad

- During a 4 month period, 2,200+ prescription images (up to 3 per visit) were uploaded by doctors/assistants.

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Prescription Scanning with AI Assisted Digitization using OCR

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Voice-Based Prescription Generation System

User can input:
1. Vitals
2. Reason of Visit/Chief Complaint
3. Diagnosis
4. Patient Examination
5. Patient History
6. Medication
7. Lab Tests
Mobile/Tablet based interfaces With Voice Support
SNOMED-CT Terminology Compliance

- The voice-to-text Doctor Desk app allows for entering SNOMED CT Terminology for diagnosis and other prescription fields.
- Clinician uses voice to input initial field data.
- Dropdown lists populates with matching SNOMED terms.
- Clinician can select the appropriate term from the list.
- This solution provides an alternative approach to clinical data entry via voice which is standard compliant as opposed to conventional methods of keyboard-based input.
- Voice-based interfaces allow for convenience of clinicians for providing input on tablets/mobile devices.
Findings from an Implementation Case Study

The Doctor Desk LITE was implemented at the following hospitals:

1. All India Institute of Medical Sciences, Manglagiri
2. All India Institute of Medical Sciences, Raibareily
3. All India Institute of Medical Sciences, Nagpur
4. All India Institute of Medical Sciences, Patna
5. All India Institute of Medical Sciences, Raipur
6. Nizam’s Institute of Medical Sciences
7. Telangana State – Gandhi Hospital
8. Odisha state-wide implementation (Capital Hospital, Bhubaneshwar)
AIIMS Mangalagiri

Case Study Report
Patient e-Rx Recorded

Month-wise Rx Count

Run Date: 23/10/2019 14:22:04

<table>
<thead>
<tr>
<th>Month</th>
<th>Rx Count</th>
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<tbody>
<tr>
<td>Mar-2019</td>
<td>1155</td>
</tr>
<tr>
<td>Apr-2019</td>
<td>2472</td>
</tr>
<tr>
<td>May-2019</td>
<td>2053</td>
</tr>
<tr>
<td>Jun-2019</td>
<td>2081</td>
</tr>
<tr>
<td>Jul-2019</td>
<td>3005</td>
</tr>
<tr>
<td>Aug-2019</td>
<td>2591</td>
</tr>
<tr>
<td>Sep-2019</td>
<td>1928</td>
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</tbody>
</table>
Compliance with SNOMED-CT Entry in Prescriptions
Compliance to use of SNOMED Concepts in Recording Diagnoses
Distribution of Patient Diagnoses

Total Patients Diagnosis Count

- **DIABETES M**... 453
- **CORONARY A**... 364
- **MALARIA** 288
- **CHRONIC HE**... 209
- **OA(EXT)** 147
- **ACUTE FEBR**... 97
- **VENOUS ULC**... 51
- **DDIABETES ...** 18
- **BLUNT INJU**... 12
- **T2 DM(EXT)** 9
- **FRACTURED ...** 7
- **ALLERGY** 5
- **G3P2002 AT...** 4
- **NEUROFIBRO...** 4
- **VERTIGO FO...** 0

Run Date: 23/10/2019 11:01:59

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Top SNOMED Terminology used in Complaints
Lab Test Requisitions Raised

Lab Wise Total Requisition Raised

Run Date: 23/10/2019 11:20:44

- Biochemistry: 83.2%
- Radiology Ct: 0.4%
- Cardiology: 0.3%
- Haematology: 0.4%
- Radiology Usg: 0.6%
- Microbiology: 3.9%
- Radiology MRI: 0.3%
- Cytology: 0.1%
- Pathology: 10.9%
Lab Patient Count and Requisitions Raised

<table>
<thead>
<tr>
<th>depthName</th>
<th>Lab Patient Count</th>
<th>Test Req Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>C F M</td>
<td>175 40</td>
<td>461 40</td>
</tr>
<tr>
<td>Dental</td>
<td>9 0 0</td>
<td>14 0</td>
</tr>
<tr>
<td>Dermatology</td>
<td>10 0 3</td>
<td>21 0 1</td>
</tr>
<tr>
<td>E N T</td>
<td>31 4 24</td>
<td>35 4 39</td>
</tr>
<tr>
<td>General Medicine</td>
<td>113 53</td>
<td>316 56 1</td>
</tr>
<tr>
<td>General Surgery</td>
<td>6 0 11</td>
<td>11 0 11</td>
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<tr>
<td>Obstetric Gynaecology</td>
<td>56 0 78 122 25 4</td>
<td>65 0 78 159 50 4</td>
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<tr>
<td>Ophthalmology</td>
<td>3 0 0</td>
<td>9 0 0</td>
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<tr>
<td>Orthopaedics</td>
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<td>10 0 9</td>
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<td>Paediatrics</td>
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<td>0 1 1</td>
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<tr>
<td>Psychiatry</td>
<td>3 14 0</td>
<td>4 14 2</td>
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Conclusions and Future Work

1. Doctor Desk\textsuperscript{LITE} has been proposed as a comprehensive solution for facilitating clinical data entry, including data compliant with SNOMED CT.

2. Multiple live implementations have shown that clinical data entry has significantly improved as a result of using the Doctor Desk\textsuperscript{LITE}.

3. Interfaces for prescription entry using voice on mobile devices has also helped in ease of clinical data entry for physicians.

4. Future work involves increasing scope of standard compliance in developed solutions and facilitating widespread adoption.


6. Integration with interoperability frameworks such as Continuity of Care Document (CCD) and HL7 messaging would also enhance adoption of EHR standards.
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