Technology-Assisted Protocolised Healthcare Delivery in Rural India

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ABSTRACT

We are interested to study the effectiveness of information and communication technologies to assist the implementation of protocolised healthcare delivery in rural Tamil Nadu, India.

1. INTRODUCTION

Medical protocols, which are statistically driven and rule based "workflows to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances" [3], are the norm in developed countries. In India, however, adherence to a clearly formulated set of protocols is rare and results in significant variations in healthcare delivery by different providers. This is especially relevant in rural areas where the clinical expertise available at local health centers is poor and it therefore becomes important to enforce guidelines in diagnosis and medication. Our goal is to ensure greater consistency in primary healthcare management through the application of appropriate computer technologies.

This poster describes a research project to this end in collaboration with the IKP Center for Technologies in Public Health (ICTPH) and its sister concern Sughavazhvu. "ICTPH is piloting a physician-managed, health extension worker (HEW) aided, technology-enabled comprehensive primary healthcare delivery model" [1] in Thanjavur district, Tamil Nadu. Medical professionals with a background in Ayurveda, Yoga, Unani or Siddha are trained in modern medicine and deployed to rural clinics that are equipped with laptops with Internet connectivity. The clinicians use these to enter patient visit details into the Health Management Information System (HMIS) [2], a web-based electronic medical record (EMR) and inventory management system developed in-house by ICTPH. A manual audit mechanism is also in place, whereby EMRs are randomly sampled and examined periodically by qualified personnel to ensure that the appropriate protocol(s) from the manual [1] were followed in each case.

Our goal is to automate the auditing process to ensure that standard protocols are being followed in rural clinics. Note that this is a different method than that taken by clinical decision support systems [4,5] which focus on assisting clinicians with diagnosis. Our partner organization ICTPH strongly felt that given the lack of robust data to build automated decision support systems at the rural clinic level, protocol verification was a more practical route where clinicians could be relied upon to make

accurate diagnosis but with retroactive checking of the steps taken by them. Our work is only in the initial stages, but based on our experience so far we strongly feel that widespread adoption of ICT assisted protocolized healthcare could help scale healthcare delivery in rural areas of large countries such as India. In the following sections, we describe our experience and the protocol verification tool we are building.

2. OVERVIEW

2.1 An Example

The following example will be helpful to understand the current system in place. A 62-year old male patient visits a clinic with symptoms of headache and fever. While doing a routine blood pressure check-up, it was found that his BP was 150/100. He was advised certain lifestyle modifications like regular exercise and diet control, and asked to come after a week for another check-up. The next week, no change was found in the readings and the doctor prescribed a standard medication for BP – Hydrocholorothiazide tablets (12.5mg) – be taken once daily for 15 days. An auditor examining the EMRs later that day observed that the patient actually had a co-morbidity of diabetes which had been recorded a year back in previous visits. However, Enalapril, which is the recommended drug for BP patients who are also diabetic, was not the one that was prescribed. Moreover, the patient was not issued a voucher that entitled him to two free visits to the clinic, as stated by the protocol. The auditor flags this as an error in the audit system by adding a note with the details.

2.2 Consultation Workflow and Audit

The broad consultation workflow, outlined below, describes the procedure followed during a patient's visit to a Sughavazhvu clinic and specifies what data is stored in the EMR. In this workflow, the clinician actively uses the HMIS.

1. Medical examination: the patient is examined by the clinician. Symptoms, vital signs, history and diagnostic values (if any) are keyed into the HMIS. [In the example given above, symptoms included headache and fever, and blood pressure was a vital sign.]

2. If enough information is not available to reach a diagnosis, additional test(s) are recommended by the clinician. Otherwise the clinician arrives at a diagnosis that is keyed into the system. [In the example given above, the sole diagnosis was hypertension.]

3. Prescription/follow-up: Medicines are prescribed, and/or lifestyle modifications are recommended, and/or follow-up visits are scheduled. [In the example above, the prescription (Hydrochlorothiazide) and the dosage (once daily for 15 days) were keyed into the HMIS. A follow-up was also

scheduled 15 days from the current date.]

Finally, an audit of randomly sampled records is done by a trained practitioner in the central office of Sughavazhvu. [In the example above, it was in this step that the auditor noticed in the patient's history that he was diabetic, and required a different drug.] An error note with relevant details is attached to each medical record that did not adhere to the protocols in force. This process is done manually as of now, and we aim to automate this workflow using the protocol verifier tool.

3. IMPLEMENTATION

The inputs to the verifier engine we are building are the EMR, the patient profile and the protocols themselves. The various components of the engine are shown in Figure 1.
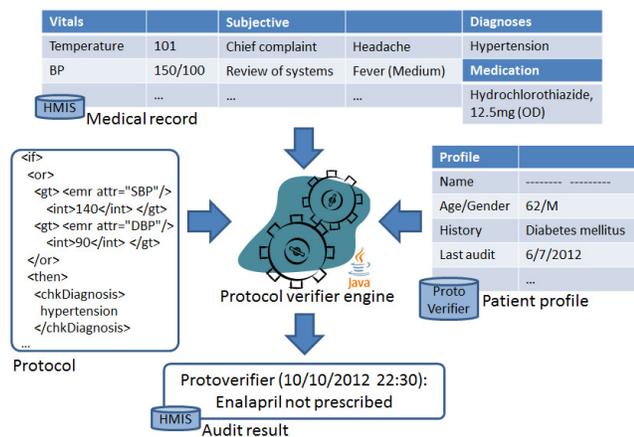

Figure 1. Components of the protocol verifier

- The protocols can be codified as if..then.. conditions and associated actions, and represented in XML format. Conditions can be combined using logical operators. We are currently codifying several protocols related to the cardiovascular system since ICTPH already has extensive documentation in this domain.

- The medical record contains information about the vital signs, lab tests/results, diagnoses, medications and follow-ups. These can be directly picked up from the HMIS database.

- The HMIS currently does not have a consolidated patient profile data structure. We are therefore building a separate schema that is periodically updated to consist of information such as the patient's history of hypertension, diabetes and hyperlipidemia, along with information about the current treatment line being followed.

Below is a snippet from the hypertension protocol in XML format. It uses a conditional to check whether the both the following conditions are satisfied – systolic BP > 140 and diastolic BP > 90 – before reaching the diagnosis. Expressions used in a conditional can have values from the EMR, patient profile and literals which are combined using relational or logical operators. The profile is also checked to see if the patient has a co-morbidity of diabetes mellitus. If so, Enalapril is prescribed; otherwise, Hydrochlorothiazide is prescribed.

```
<if>
  <or>
    <gt> <emr attr="SBP"/> <int>140</int> </gt>
    <gt> <emr attr="DBP"/> <int>90</int> </gt>
  </or>
  <then>
    <chkDiagnosis>hypertension</chkDiagnosis>
    <if> <isDiabetic>
      <then> <chkMed>Enalapril</chkMed> </then>
      <else> <chkMed>Hydrochlorothiazide</chkMed>
      </else>
    </if>
  </then>
</if>
```

If any protocol compliance issues are found, audit notes will be appended to the EMR to highlight the issues. After ensuring that this implementation is functioning as required, a protocol-builder UI will be developed to allow doctors to easily build more protocols.

4. CURRENT STATUS

A couple of visits to ICTPH and its clinics have helped us understand the requirements on the ground and the usage patterns of clinicians on the field. After a survey of the available medical expert systems and rules engines we decided to go ahead with in-house development for the pilot implementation. This approach has the advantages of being simple and highly customizable.

We have also carried out some analysis on the clinical data to arrive at certain interesting visit patterns. In certain cases, it was noticed that even though a patient visited the clinic with BP values less than the normal, the diagnosis was recorded as 'hypertension' and not 'hypotension'. This indicates the relevance of protocol checking on EMRs. In certain other genuine cases of hypertension, the clinician did not prescribe the recommended number of tablets, or sometimes, prescribed no medication at all. Through our discussions with ICTPH we understood that this is usually because the patient does not have enough money to pay for the medicines, or because he has been supplied with medicines free of cost from the nearby government-run Primary Health Center. To ensure that this additional information is recorded in the system, we suggested that a 'Not dispensed' checkbox be added beside each medication or lab test recommended. On being clicked, the above mentioned reasons are shown to the clinician, who then selects the appropriate one(s).

5. REFERENCES

[1] J. Jun, V. Rajendran and A. S. Swetha, "Protocolised patient management within the ICTPH health systems model," 2011.

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