Towards a Sustainable Electronic Health Record System in Cambodian National Tuberculosis Program

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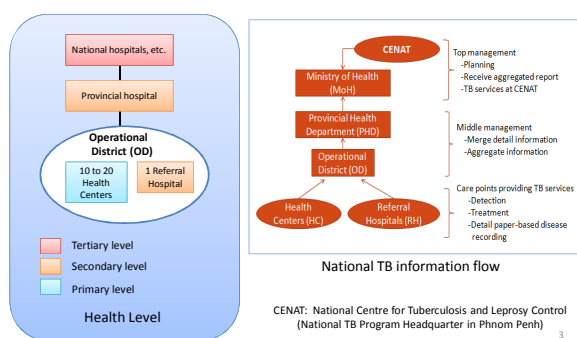
***Sent from the Cambodian Ministry of Health**

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Objectives

- To look for a **better way** to manage Cambodian TB records based on openEHR standard
- To introduce openEHR-based **"Virtual EHR Editor"** (http://kenai.com/projects/openehr-app/sources/subversion/) focusing on its development process
- To **draw a plan** for TB EHR introduction to Cambodian health system (see. Appendix)

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Cambodian Health Level and TB Information Flow

National TB information flow

CENAT: National Centre for Tuberculosis and Leprosy Control
(National TB Program Headquarter in Phnom Penh)

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Some insights

- TB Services are **free of charge**
- The **information flow is uniform** across the country
- **Data sharing** has no policy constraints
- Therefore, **templates can be standardized and shared** across the country
- ICT infrastructure
  - Only **0.485% (≈ 74,000)** of the total population using the internet (in 2007)
  - The government **encourages the use of ICT**
  - Mobile and internet providers and subscribers are surging
  - Problems with **high service cost in expense of slow connection speed and small service coverage area**
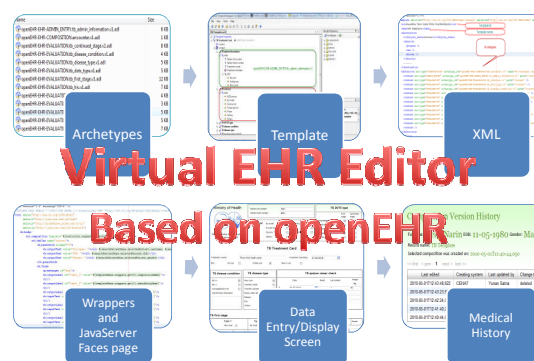 - **Lack of human resources**

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Lessons Learnt from Other Countries

- In Cambodia
  - the **national EHR standard** should be introduced
  - the **government** must use its influence to coordinate and enforce EHR standard-compliance
  - **fragmented system development** and unnecessarily prohibiting medical regulations must be avoided
  - **bottom up system design** approach with user close involvement in the system development process
  - **a good design of EHRS**, unique patient identifiers, design of a quality data dictionary and practical privacy policy

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## From Archetypes to Medical History

Archetypes → Template → XML

Virtual EHR Editor Based on openEHR

Wrappers and JavaServer Faces page → Data Entry/Display Screen → Medical History

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Archetypes used to form a TB Template

1. **List of 13 openEHR Archetypes, excluding Demographic Archetypes**
   - 12 newly created openEHR EVALUATION archetypes
   - 1 COMPOSITION archetype from openEHR Clinical Knowledge Manager, serving as the root archetype for TB Template

Name	Status
1. openEHR-EHR-ADMIN_ENTRY.tb_admin_information.v1.adl	
2. openEHR-EHR-EVALUATION.tb_continued_stage.v1.adl	
3. openEHR-EHR-EVALUATION.tb_disease_condition.v1.adl	
4. openEHR-EHR-EVALUATION.tb_disease_type.v1.adl	
5. openEHR-EHR-EVALUATION.tb_dots_type.v1.adl	
6. openEHR-EHR-EVALUATION.tb_first_stage.v1.adl	Newly created
7. openEHR-EHR-EVALUATION.tb_hiv.v1.adl	
8. openEHR-EHR-EVALUATION.tb_lung_image.v1.adl	
9. openEHR-EHR-EVALUATION.tb_note.v1.adl	
10. openEHR-EHR-EVALUATION.tb_referral.v1.adl	
11. openEHR-EHR-EVALUATION.tb_sputum_smear_check.v1.adl	
12. openEHR-EHR-EVALUATION.tb_treatment_outcome.v1.adl	
13. openEHR-EHR-COMPOSITION.encounter.v1.adl	Already existing in openEHR repository

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Newly Created Archetype Example
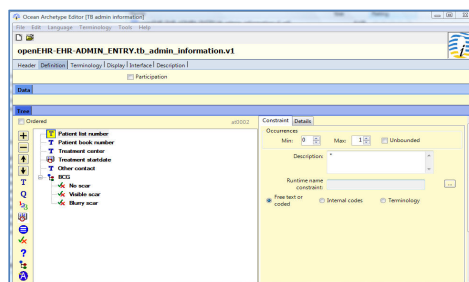
openEHR-EHR-ADMIN_ENTRY.tb_admin_information.v1
designed using Archetype Editor

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Review of Existing Archetypes Concerning "Tuberculosis"

- List of current archetypes specifically concerning "TB"
  - openEHR-EHR-COMPOSITION.encounter.v1
  - openEHR-EHR-OBSERVATION.body_weight.v1
- Reasons why the current list is not sufficient
  - Cambodia recording format needs openEHR "ItemTable" structure, but the **weight archetype** cannot fit in the structure
  - There are many other TB-specific recording variables that cannot be found with current archetypes (e.g. BK+, Hospitalized DOTS, etc.)
- Although the current list does not fulfill our recording needs, more and more archetypes (possibly TB-related) are being proposed to openEHR Archetype Review Board for standardization. We may join and contribute to the reviewing process.

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Demographic Archetypes

List of 5 Demographic Archetypes
- Downloaded from the openEHR Clinical Knowledge Manager (CKM)
- The current Template Designer does not support yet
- Template XML has to be manually created (field occurrence and slots)
- PERSON Archetype is the root archetype to create Demographic Template

| Name	Status
1. openEHR-DEMOGRAPHIC-ADDRESS.address_iso.v1.adl	
2. openEHR-DEMOGRAPHIC-CLUSTER.person_additional_data_iso.v1.adl	Exist in the openEHR repository, but not yet under review, nor approved
3. openEHR-DEMOGRAPHIC-CLUSTER.person_birth_data_iso.v1.adl	
4. openEHR-DEMOGRAPHIC-PERSON.person.v1.adl	
5. openEHR-DEMOGRAPHIC-PARTY_IDENTITY.person_name_iso.v1.adl	Exists in openEHR repository and classified as under review

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TB Template Created by Template Designer, using Archetypes
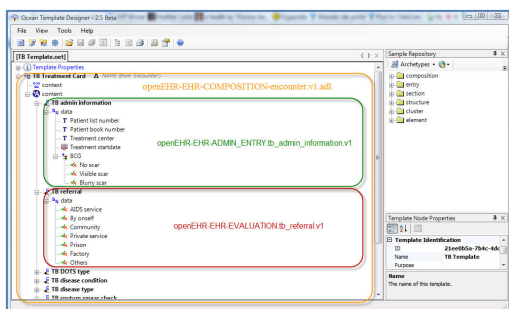
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TB Template Converted into XML format
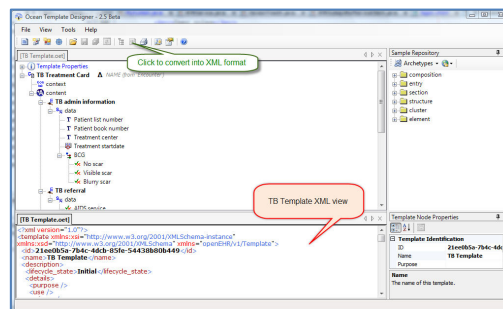
TB Template can be converted automatically into XML format

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## TB Template Converted into XML format (Cont'd)

Detailed TB Template xml

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TB Template in xhtml Format to Create JavaServer Faces(JSF) Page

Binding TB template to JSF page using Wrapper technique
- A tool has been developed by us using Wrapper technique to **auto generate the JSF page**
- Each wrapper field is **bound to a UI component and an archetype field**
- The auto generated **JSF page can be customized** for preferred User Interface
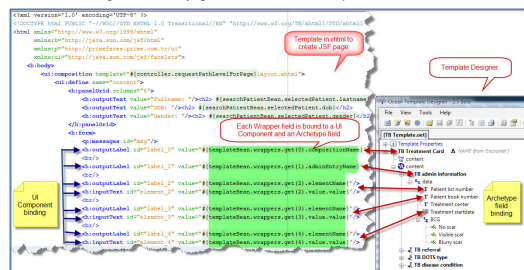
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What is a wrapper?

- Derived by us from the **concept found in "Opereffa"** project

Opereffa Project

Description

Opereffa stands for openEHR REFerence Framework and Application. It is a project for creating an open source clinical application which will be driven by the Clinical Review Board of openEHR. The clinical application will be built on top of a Java based open source framework, which is using the existing open source Java reference implementation of openEHR.

Vital Statistics

Project Team	Seref Arikan, Dr. Tony Shannon (chair openEHR CRB), Professor David Ingram (Chair openEHR Foundation, HoD, CHIME, UCL)
Project Mailing list	Technical discussions - openehr-implementers@openehr.org Clinical discussions - openehr-clinical@openehr.org
Language(s) & Technologies	Java 1.6, Apache Tomcat, Postgresql RDMS, Eclipse development environment & Platform, Eclipse BIRT
Downloads	http://sourceforge.net/projects/opereffa
Issue reporting	Problem Reporting (public)
Source repository	http://www.openehr.org/svn/opereffa
Documentation	http://opereffa.chime.ucl.ac.uk
Status	Release 0.1

http://www.openehr.org/projects/opereffa.html

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What is a Wrapper? (Cont'd)

- Archetypes (within a template)
  - using ADL Parser (Archetype Parser), translate them into run-time **Archetype Object Model** (AOM)
  - maintain **data validation rules** contained in AOM
  - their fields are further **constrained according to template xml** (occurrence and slots)
  - Obtain **computer memory representations for their fields**
  - their fields are to **be bound to screen input components** that will accept user input (see. Template JSF page)
- For example:
  - Composition → CompositionWrapper
  - Observation → ObservationWrapper
  - ....
  - DvCount, DvQuantity, etc. → CountWrapper, QuantityWrapper, etc.

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Customized TB Data Entry and Display Screen Derived from TB Template

TB Template screen that imitates the paper record form, as a result of customizing auto generated JSF page

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Standard TB Paper-base Record Form in Cambodian Language

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Screen Shot Examples

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Conclusion and Recommendations

- The **National TB Program sets a good example** for other health programs regarding TB services uniformity
- Introduction of openEHR should be **stepwise** due to the lack of resources
  - Starting from **OD headquarters** before reaching **Health Centers and Referral Hospitals**
  - System deployment will start from **standalone environment long before LAN and the internet connection**
  - There will be some **future challenges** regarding joining all Demographic records from each OD together

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Conclusion and Recommendations (Cont'd)

- **Fragmentation** of EHR system development should be avoided
- EHR Editor uses **minimum archetypes**, but openEHR encourage maximum, globally shared archetypes
- A Cambodian medical committee should be formed officially to:
  - **maintain medical terms** in a national data dictionary
  - **decide which archetypes** from openEHR repository for creating official templates
  - **review** any proposed template
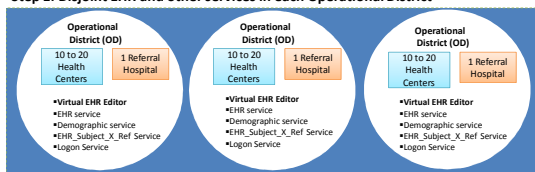 - **propose newly created archetypes** to the openEHR community

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Appendix

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Possible EHR Development Plan for National TB Data Collection

Step 1: Disjoint EHR and other services in each Operational District

- ❑ OD headquarter is the center of data collection within its boundary (Health centers and Referral hospital)
- ❑ Currently, in one OD there is only one or two computers without LAN connection
- ❑ According to the plan, one computer at OD will offer all the services (see. Fig)

Note:
- Virtual EHR Editor: Web server, providing User Interface and links to other servers
- EHR Service: Web service server, linking to EHR database that stores all medical records
- Demographic Service: Web service server, linking to Demographic database that stores all patient personal data
- EHR_Subject_X_Ref_Service: Web service server, linking to EHR_Subject_X_Ref database that stores the cross-references of patients and their medical information

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Step 2:
- LAN connection in each OD head quarter
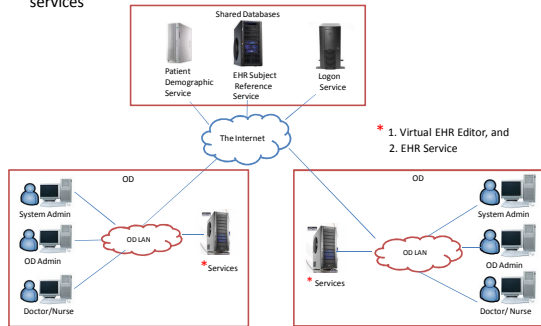- Client access to EHRs within the same LAN through Virtual EHR Editor
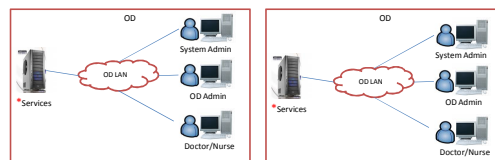
* 1. Virtual EHR Editor,
  2. EHR Service,
  3. Demographic Service, and
  4. EHR_Subject_X_Ref_Service

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Step 3:
- LAN in each OD is connected to the internet
- Join Demographic and other relevant services from all ODs
- Separate EHR service linked to the central Demographic and other services

Shared Databases

Patient Demographic Service

EHR Subject Reference Service

Logon Service

The Internet

* 1. Virtual EHR Editor, and
  2. EHR Service

OD

System Admin

OD LAN

OD Admin

* Services

Doctor/Nurse

OD

* Services

OD LAN

System Admin

OD Admin

Doctor/ Nurse

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Thank You!

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