Health-oriented Electronic Oral Health Record for Health Surveillance

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1. Introduction

Provision of adequate oral health services

- The scope and coverage of services
- The proportion of the national health services budget
- The prevalence and severity of oral diseases
Background

The World health report 2000, World Health Organization
Public Health Surveillance system requires an appropriate information that can identify the population who are high risk and those who have need for treatment.

Electronic Health Records (EHRs) are used to improve healthcare systems. A recent report on oral health surveillance indicated that the coordinated use of EHR, administrative, and claims data could help in tracking progress oral health care.

Steele, 2012
Currently, the information for health surveillance are based on oral health indices for monitoring disease (disease-oriented).

# K07.63  Pain in temporomandibular joint, not elsewhere classified

*Excludes:* temporomandibular joint-pain-dysfunction syndrome (Costen) (K07.60)

# K07.64  Stiffness of temporomandibular joint, not elsewhere classified

# K07.65  Osteophyte of temporomandibular joint

# K07.68  Other specified temporomandibular joint disorders
The significant problems of the oral health services and surveillance include; the absence of useful model for **health-oriented oral care** that links the concept of health and the goal of healthcare (0=Absence of need for care)
Objectives

1. To **develop and evaluate** a new Health-oriented Electronic Oral Health Record (Health-EOHR) that integrated new oral health status graphical user interface and the health-oriented status and intervention model to **facilitate oral health surveillance**.

2. To compare the existing EOHRs and the Health-EOHR by a comparative intervention study, focus on **dentist satisfaction with the function and the impact on their work, oral health services and surveillance**.
1.1 Electronic Health Record

EHR is a repository of electronically maintained information about an individual’s lifetime health status and health care, stored such that it can serve the multiple legitimate users of the record.

Include: Demographics, Medical history, Medication and allergies, Immunization status, Laboratory test, Radiology images, Vital sign, Billing information

Shortliffe and Cimino, 2006
In the early 1990’s the ADA began collaboration with others to describe a specific EOHR that complements the EHR used for general healthcare.

The EOHR has many uses, including:
- Quality indicators
- Clinical patient population medical and dental history profiles
- Information support for clinical decision-making
- Decision support information for management of administrative functions
- Electronic data interchange

Atkinson et al., 2002
Health Surveillance is the ongoing systematic collection, analysis, and interpretation of data, closely integrated with the timely dissemination of these data to those responsible for preventing and controlling disease and injury.

Thacker and Berkelman, 1988
1.3 Health Surveillance

Information needed for Public planning

**Sociodemographic Population profile**
- Age, Ethnicity
- Social class, Population mobility

**Disease levels**
- Epidemiological data
- Range of condition
- Severity of disease
- Disease distribution
- Trends in disease

**Existing service provision**
- Availability of services
- Range of treatments available
- Costs of care
- Location of services
- Access to services
- Effectiveness of interventions

**Public concerns**
- Population priorities
- Views of health service
- Demands on health service
2. Research Methodology

1. User Requirement Survey
2. Development of the Health-oriented Status and Intervention Model
3. Graphic User Interface Design
4. System Implementation
5. System Evaluation
Semi-structured interviews and focus groups were performed to identify general and specific expected needs of the existing EOHR users.
Almost all participants (85%, n=17) expected a need for systematic collection, analysis, interpretation of data for early identification of the size and character of oral diseases, and the need for oral healthcare in individual and community level.

The user requirements that were mentioned by 20 existing EOHR users from 8 hospitals in Chiang Mai were inductively categorized.
2.2 Development of the Health-Oriented Status and Intervention Model

Development of the Health-Oriented Status and Intervention Index

- Development of Intervention Index
- Oral Health Status Graphic User Interface Design
- Development of Status and Intervention Model and Decision Support
- Delphi Assessment

System Implementation

System Evaluation

- Dentist Satisfaction
- Health Surveillance
### 2.2.1 Intervention Index

The intervention index is used to identify care needs and classify the tasks, instruments, and personnel needed to provide the care required for an individual and community.

<table>
<thead>
<tr>
<th>Oral health status</th>
<th>Intervention index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collection of information</td>
<td>Oral health care needed</td>
</tr>
<tr>
<td>Self-care</td>
<td>0</td>
</tr>
<tr>
<td>Maintenance of surface, support, or structure</td>
<td>1</td>
</tr>
<tr>
<td>Position anomaly dimension</td>
<td>2</td>
</tr>
<tr>
<td>Loss of support, structure, function</td>
<td>3</td>
</tr>
<tr>
<td>Partial</td>
<td>4</td>
</tr>
<tr>
<td>Full</td>
<td>5</td>
</tr>
<tr>
<td>Replacement fixed</td>
<td>6</td>
</tr>
<tr>
<td>Replacement removable</td>
<td>7</td>
</tr>
<tr>
<td>Dependence Handicap</td>
<td>8</td>
</tr>
<tr>
<td>Concept</td>
<td>-1</td>
</tr>
<tr>
<td>Concept 0</td>
<td>-0</td>
</tr>
<tr>
<td>Concept -1</td>
<td>-1</td>
</tr>
</tbody>
</table>

- Oral health status
- Intervention index
2.2.1 Intervention Index

**Health-oriented:** The numeric system that indicates health status and direction towards the goal of healthcare

0 = Absence of need for care / A reference condition a beginning or end/goal.
9 = Dependence Handicap / Least wanted need

0 ← 9 (Concept Zero)
### 2.2.2 Oral Health Status Graphic User Interface Design

<table>
<thead>
<tr>
<th>Status description</th>
<th>Graphic</th>
<th>Index</th>
<th>Intervention</th>
<th>ICD-9-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculus (-Z-) = &lt; 2 mm</td>
<td>![Image]</td>
<td>1</td>
<td>Self-care</td>
<td>96.54</td>
</tr>
<tr>
<td>Calculus (-Z-) 2-3 mm</td>
<td>![Image]</td>
<td>1</td>
<td>Self-care</td>
<td>96.54</td>
</tr>
<tr>
<td>Calculus (-Z-) = &gt; 3 mm</td>
<td>![Image]</td>
<td>2</td>
<td>Scaling</td>
<td>96.54</td>
</tr>
<tr>
<td>Horizontal Pocket</td>
<td>![Image]</td>
<td>4</td>
<td>Root planning</td>
<td>24.31</td>
</tr>
</tbody>
</table>

The graphic user interface has been designed to follow steps in status recording, from chief complaint to hygiene and periodontal condition, defect and restoration.
2.2.2 Oral Health Status Graphic User Interface Design

<table>
<thead>
<tr>
<th>Status</th>
<th>Status description</th>
<th>Intervention Description</th>
<th>ICD-9-CM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentin Defect</td>
<td>Graphic</td>
<td>Filling</td>
<td>23.2</td>
</tr>
<tr>
<td>Pulp Threat</td>
<td>Graphic</td>
<td>Filling</td>
<td>23.2</td>
</tr>
<tr>
<td>Roots/Enamel</td>
<td>Graphic</td>
<td>Replacement (Laboratory processed)</td>
<td>23.41</td>
</tr>
<tr>
<td>Pulpitis/ Necrosis</td>
<td>Graphic</td>
<td>Root Canal Treatment</td>
<td>23.71</td>
</tr>
<tr>
<td>Supernumerary Tooth</td>
<td>Graphic</td>
<td>Tooth Removal</td>
<td>23.09</td>
</tr>
<tr>
<td>Missing</td>
<td>Graphic</td>
<td>Replacement (Tooth)</td>
<td>23.42</td>
</tr>
</tbody>
</table>

The graphical user interface design for the status as well as the translation of the intervention into International Classification of Diseases (ICD) codes.
The experts were asked to grade their agreement with 80 items in the SI model on a 5-point Likert scale. All experts took part in focus groups. The experts were invited to discuss positive and negative aspects of the SI index and to give suggestions for its development.
### 2.2.3 Status and Intervention Model and Decision Support

<table>
<thead>
<tr>
<th>No.</th>
<th>Tooth</th>
<th>Status Description</th>
<th>Intervention code</th>
<th>Operator</th>
<th>Time (min.)</th>
<th>Instrument Set</th>
<th>Cost (Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>Vertical Pocket</td>
<td>4</td>
<td>Dentist</td>
<td>15</td>
<td>Periodontal</td>
<td>340</td>
</tr>
<tr>
<td>2</td>
<td>11,21,22,31,32,41,42</td>
<td>Horizontal Pocket</td>
<td>4</td>
<td>Dentist</td>
<td>45</td>
<td>Periodontal</td>
<td>1,360</td>
</tr>
<tr>
<td>3</td>
<td>16,25</td>
<td>Dentin defect</td>
<td>5</td>
<td>Dental nurse</td>
<td>20</td>
<td>Restoration</td>
<td>600</td>
</tr>
<tr>
<td>4</td>
<td>11,12,15,16,18,21,22,23,31,32,41,42,43</td>
<td>Recession</td>
<td>2</td>
<td>Dental nurse</td>
<td>30</td>
<td>Scaler</td>
<td>280</td>
</tr>
<tr>
<td>5</td>
<td>14,17,24,26,27,32,35,36,38,4,45,46,47,48</td>
<td>Missing</td>
<td>8</td>
<td>Dentist</td>
<td>10</td>
<td>Impression</td>
<td>5,400</td>
</tr>
<tr>
<td>6</td>
<td>11,13,21,22,23,25,31,32,33,34,35,41,42</td>
<td>Gingivitis -z- 2-3 mm.</td>
<td>1</td>
<td>Self-care</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>34</td>
<td>Root filling + Post + Crown</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

SI index and decision support has been covered on the oral status treatment needs, records of planned, clinic organization and scheduling of patients. As for the decision support, the appropriate intervention, care provider, time, setting and cost have been provided for a given oral status.
SI score is an indicator of individual or community health status and types of intervention in holistic views.
2.2.3 Status and Intervention Model and Decision Support

**Holistic Oral Health Index**

\[
\text{Holistic Oral Health Index} = \sum_{i=1}^{N} \frac{X_i}{N}
\]

- \( X_i \) = Intervention codes [1st digit of code], \( N \) = Number of teeth

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**Image**

A screenshot of a user interface showing a calculation of the Holistic Oral Health Index. The formula is displayed alongside the calculation results. The interface includes an image of teeth and various codes. The code used is the 1st digit of the intervention code, and the number of teeth is the denominator in the calculation.
The graphic user interface of each oral health status item has been designed to consider the concept of cognitive ergonomics.
2.3 Graphic User Interface Design
Our idea is to develop Health-EOHR that can plug into the existing Hospital Information System. The Health-EOHR operates in client-server architecture that connects infrastructures and networks of community and healthcare centers.

The diagram shows how the Health-EOHR program works from users entering data to when they get the decision support message.
Based on the questionnaires, interviews, and oral health status recording reports;
- **Dentist satisfaction**
- **Usefulness and facilitate to health surveillance**
2.5 System Evaluation

- Dentist Interviews, questionnaires
- At least 1 year of experience using EOHRs
- Level of satisfaction or dissatisfaction;
  - Holistic oral health index
  - Decision support and treatment planning
  - Interpret oral health information to support oral health surveillance system
2.5 System Evaluation

- Level of agreement or disagreement;
- Monitor patient progress
- Improve the quality of dental care
- Useful tools for disease management

The Wilcoxon test was used to detect any differences in user satisfaction between the existing EOHRs and the Health-EOHR.
3. Results

- Interviews and questionnaires were conducted from June to August 2012 to assess dentist satisfaction.
- Twenty-six dentists from 11 ICOH-collaborating hospitals were recruited.
- Most participants considered their skill in using EOHR systems average and novice users (65.4% and 11.5%, respectively).
3. Results

3.1 Level of Satisfaction

- a. Holistic oral health index
- b. Decision support and Treatment planning
- c. Interpret oral health information to support health surveillance system

![Bar Chart](image)

- Existing EOHR
- Health EOHR

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very dissatisfied
- Function installed but not used

- 3.8
- 80
- 88
- 91.7
3. Results

3.2 Level of Agreement

- a. Monitor patient progress
- b. Improve the quality of dental care
- c. Useful tools for disease management
3. Results

### Dentist Satisfaction: The Wilcoxon test

<table>
<thead>
<tr>
<th>User-Satisfaction</th>
<th>Existing EOHRs (Mean Rank)</th>
<th>Health-EOHR (Mean Rank)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Holistic oral health index</td>
<td>0</td>
<td>12.00</td>
</tr>
<tr>
<td>2. Decision support and treatment planning</td>
<td>0</td>
<td>12.50</td>
</tr>
<tr>
<td>3. Interpret oral health information to support oral health surveillance system</td>
<td>1.50</td>
<td>12.98</td>
</tr>
<tr>
<td>4. Monitor patient progress</td>
<td>3.50</td>
<td>10.87</td>
</tr>
<tr>
<td>5. Improve the quality of dental care</td>
<td>2.50</td>
<td>12.93</td>
</tr>
<tr>
<td>6. Useful tools for disease management</td>
<td>3.00</td>
<td>13.87</td>
</tr>
</tbody>
</table>

The results of user satisfaction in health surveillance system indicated a significant difference ($p<0.001$).
4. Discussion

SI index can be used for early identification of the size and character of oral diseases and the need for oral healthcare in individual and community.

The assessment of user satisfaction and general observations by the researchers revealed that the dentists mainly appreciated the ability of program.
Conclusions

The new Health-EOHR improves dentist satisfaction, provides benefits to holistic oral healthcare, the useful tool for systematic collection, analysis, interpretation of data for helps plan, manage and evaluate the healthcare delivery system, and facilitate health surveillance.
Surveillance system (To provide information for guiding interventions and directly measure the effect of interventions):

Input:

1. Disease is arrested at an early stage.
2. Loss of function is prevented.

Interpretation by means of AI (Artificial Intelligence algorithms):

Table:

<table>
<thead>
<tr>
<th>Information from input</th>
<th>Intervention code</th>
<th>operator</th>
<th>Operation place</th>
<th>supporter</th>
<th>Operation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plaque&gt;3 mm</td>
<td>1</td>
<td>Self-care</td>
<td>home</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Calculus&gt;3 mm</td>
<td>2</td>
<td>Dental nurse</td>
<td>Primary care unit</td>
<td>Care giver</td>
<td>20 mins</td>
</tr>
<tr>
<td>Pulpits</td>
<td>6</td>
<td>Dentist</td>
<td>1st referral unit</td>
<td>Transportation provided by community</td>
<td>40</td>
</tr>
<tr>
<td>Impacted+pain</td>
<td>7</td>
<td>Oral surgeon</td>
<td>2nd referral unit</td>
<td>Transportation provided by community</td>
<td>40</td>
</tr>
</tbody>
</table>

Output:

- Treatment plan
- Prescription for care

Simulation training

Information

Numeric language

Health-oriented index
Thank you for your attention.