Extending Usability of Personal Health Records

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Figure 1: Concept of separating personal information from sensitive health data

Table 1: Example of anonymizing records

<table>
<thead>
<tr>
<th>Name</th>
<th>T. Date</th>
<th>Disease</th>
<th>Attr</th>
<th>Pseud</th>
<th>P. Pseud</th>
<th>T. Date</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>15-04-1951</td>
<td>Heart D.</td>
<td>Pseud</td>
<td>P.Pseud</td>
<td>010..0100</td>
<td>02-09-3459</td>
<td>DH</td>
</tr>
<tr>
<td>Bob</td>
<td>23-07-1959</td>
<td>AIDS</td>
<td></td>
<td></td>
<td>010..0100</td>
<td>25-01-2951</td>
<td>PQR</td>
</tr>
<tr>
<td>John</td>
<td>09-11-1954</td>
<td>Heart D.</td>
<td></td>
<td>Heart D.</td>
<td>PQR</td>
<td>12-12-2459</td>
<td>GTFD</td>
</tr>
</tbody>
</table>

Identification info  Anamnesis data

Health data  Patient pseudo.  Anam. pseud. table  Anonymous DB

Encryption  Encrypted Profile

IC card  Decryption (Kp)  Calculate original data

Figure 2: Database anonymization process in P3HR

Figure 3: Data availability with change in data sensitivity

Figure 4: Scope for secondary use (SSU) in P3HR with change in data availability

Figure 5: Comparative scope for secondary use (SSU) in P3HR and Traditional system

$h = \text{height of a domain hierarchy}$

Weighted hierarchical distance (WHD) of domain generalization (from height $p$ to $q$)

$$WHD(p,q) = \sum_{i=1}^{p} \omega_{p,j-1}$$

$n = \text{the number of attributes in the attribute set of anamnesis data}$

$Av_i = \text{availability} \ \{0,1\} \ \text{of } i^{th} \ \text{attribute}$

Let $t = \{v_1, v_2, ..., v_m\}$ be a tuple, $t' = \{v'_1, v'_2, ..., v'_m\}$ be a generalized tuple of $t$.

Scope of secondary use (SSU) :

$$SSU(t') = \sum_{i=1}^{m} Av_i \left(1 - \sum_{j=1}^{m} WHD(L(v_j), L(v'_j)) \right)$$

$$SSU(T) = \frac{\sum_{i=1}^{N} SSU(t_i)}{N}$$

$N$ = \text{the number of tuples in the table $T$}