Handheld computing devices in a surgical ward

Advantages on clinical information sharing

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Contents

- Design of an application for the surgical ward
- Monitoring of communication during users’ testing of the application
- Monitoring of users’ feedback
- Study of the proposals for further implementation
Background (1): Campus Bio-Medico

Campus Bio-Medico University was founded in Rome in 1991. Currently it includes the Faculty of Medicine and the Faculty of Engineering.

The University Hospital (15 departments - 124 beds) is close to the didactic seat and includes an outpatients clinic, a day-hospital unit, operating theatres, units of intensive care.
Background (2):

- **Hardware infrastructure**
  - Ethernet LANs, IEEE 802.11 WLANs, and 2.5/3G cellular data networks WLAN

- **Software environment**
  - database SQL
  - ASP.NET application

- **Applications using mobile devices:**
  - Nurses’ drugs administration
  - HISS (Hospital information system for students)
    - involved students of Medicine, Nursing and Dietetics courses
  - Dieticians’ menu administration
Bringing mobile devices in the Surgical Ward

Composed by seven surgeons and six residents, the surgical ward staff at Campus Bio-Medico takes care of:

- general surgical ward patients (15 to 20);
- out patients clinic (30 hours per week); surgical interventions (30 hours per week);
- diagnostic day hospital.
Challenges

- reducing errors
- enhancing rapid and constant information sharing among the surgical staff
- context-aware interaction
- personalization of content management and interface design
Analysis (1):
Data management in surgery ward

- morning briefing of the entire staff, including the nurses of the ward
- daily round, when handwritten notes are taken on a paper sheet over a wooden tablet
- manual up-dating of the clinical documents
Analysis (2)

- transcription of clinical data

- writing of a cumulative report for the patient’s discharge from the hospital
Content management (a):
From unstructured data…
Content management (b):
...to structured data

<table>
<thead>
<tr>
<th>Patient</th>
<th>Hospital</th>
<th>Surgical Intervention</th>
<th>Post-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Admission date</td>
<td>Procedure</td>
<td>Physiologic parameters:</td>
</tr>
<tr>
<td>Surname</td>
<td>Date of discharge</td>
<td>Date of surgical intervention</td>
<td>- blood pressure;</td>
</tr>
<tr>
<td>Date of birth</td>
<td>(if the surgical intervention has already been performed, number of post-operative day)</td>
<td></td>
<td>- body temperature etc;</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>- diet;</td>
</tr>
<tr>
<td>Diagnosis</td>
<td></td>
<td></td>
<td>- ileus or gas canalization;</td>
</tr>
</tbody>
</table>

- in/outgoing fluids;
- parenteral fluids or nutrition;
- urinary output etc
Interface design (1): information display

Screen divided in two parts

Items displayed according to users’ preferences

Only last records are visible; archive can be easily accessed
Interface design (2): data entry

- Multiple choice
- Dynamically created forms
  - layout can change depending on the quantity and quality of information inserted
- Predefined options/free notes
- Information automatically entered:
  - Date, time and author of data entry
Personalization

Each user:

- can choose if he wants to work on-line or off-line
- can save his view-state
- can visualize first his/her patients and then the others’
- can visualize different kind of information depending on his role (physician or nurse)
Context awareness

- The information displayed is functional to the context (nurses/physicians; in the office/at bedside)
- The interface dynamically adapts to the screen size
- The system automatically switches from on-line to off-line functioning
Project development

- January-February 2004: analysis
- March-April 2004: software development
- May-September 2004: first experimental phase
- October 2004-June 2005: implementation
- July-August 2005: second experimental phase
First experimental phase: *quantitative* results

<table>
<thead>
<tr>
<th>Table</th>
<th>Records</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>tb35NoteInterventi</td>
<td>176</td>
<td>13/05 – 14/09</td>
</tr>
<tr>
<td>tb37NotePazienti</td>
<td>297</td>
<td>13/05 – 14/09</td>
</tr>
<tr>
<td>tb39EmoderivatiInterventi</td>
<td>7</td>
<td>28/06 – 08/09</td>
</tr>
<tr>
<td>tb40EmoderivatiNonAssociati</td>
<td>2</td>
<td>12/07 – 02/08</td>
</tr>
</tbody>
</table>
# First experimental phase: quantitative results

<table>
<thead>
<tr>
<th>Records per month</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>30</td>
</tr>
<tr>
<td>in June</td>
<td>43</td>
</tr>
<tr>
<td>July</td>
<td>50</td>
</tr>
<tr>
<td>August</td>
<td>26</td>
</tr>
<tr>
<td>September</td>
<td>12</td>
</tr>
</tbody>
</table>

**Average**: 2-3 records per day

**Max**: 16/07/04-21/07/04 six records per day

**Pause**: 10/08 – 25/08

**Most performed surgical interventions**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colecistectomia laparoscopica</td>
<td>27</td>
</tr>
<tr>
<td>Emicolectomia dx/sin</td>
<td>10</td>
</tr>
<tr>
<td>Tiroidectomia totale</td>
<td>7</td>
</tr>
<tr>
<td>Gastrectomia totale</td>
<td>6</td>
</tr>
<tr>
<td>Emorroidectomia</td>
<td>8</td>
</tr>
</tbody>
</table>
First experimental phase: *quantitative results*

**Records per month:**
- 30 in May;
- 43 in June;
- 50 in July;
- 26 in August;
- 12 in September

Average: 2-3 records per day

**Max:** 16/07/04-21/07/04 six records per day

**Pause:** 10/08 – 25/08

**Most performed surgical interventions**
- Colecistectomia laparoscopica 27 records
- Emicolectomia dx/sin 10 records
- Tiroidectomia totale 7 records
- Emorroidectomia 8 records
- Gastrectomia totale 6 records
First experimental phase: qualitative results

- relative advantage: information is always updated;

- technical problems: wireless connection performance and power supply;

- users’ interface: more space for free notes;

- users’ interaction: more rapidity in information exchange, more time to discuss about details
Conclusions

- Interaction is strengthened

- Despite implementation, the surgeons claim more ‘freedom’ in recording data

- Paper will be completely substituted only when the right balance between structured data and ‘freedom’ is achieved

- On-line and off-line usage must be transparently performed (users don’t have to care about it, although they must be conscious of it)
Future developments

- Can electronic record improve the quality of care into the hospital?

- Can PDAs be used as decision support devices?

- Can students use these technologies to be best prepared to their future professional activity?