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 implemention

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

- it includes an out patients Clinic, a day-hospital unit, operating theatres, unities 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

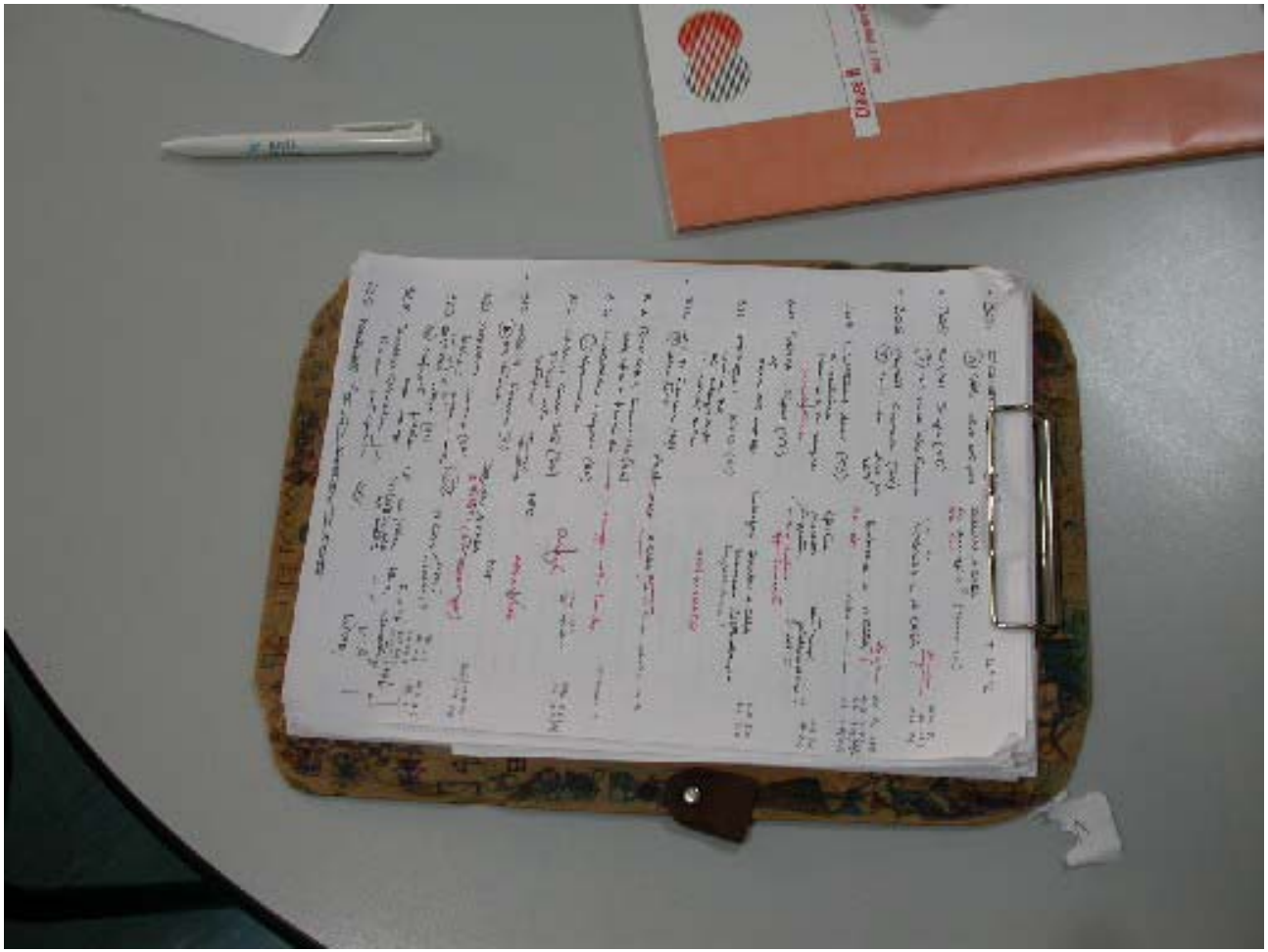
Analysis (2)

- 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

Patient	**Hospital**	**Surgical Intervention**	**Post-operative**
Name Surname Date of birth Age Diagnosis	Admission date Date of discharge	Procedure Date of surgical intervention (if the surgical intervention has already been perfomed, number of post-operative day)	Physiologic parameters: ■blood pressure; ■body temperature etc; ■diet; ■ileus or gas canalization; ■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
- Dinamically 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 desplayed is functional to the context (nurses/physicians; in the office/at bedside)
- The interface dinamically 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	Records	Period
tb35NoteInterventi	**176**	**13/05 – 14/09**
tb37NotePazienti	**297**	**13/05 – 14/09**
tb39EmoderivatiInterventi	**7**	**28/06 – 08/09**
tb40EmoderivatiNonAssociati	**2**	**12/07 – 02/08**

First experimental phase: *quantitative* results

Records per month	
May	30
in June	43
July	50
August	26
September	12

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**

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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 strenghtened
- 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?