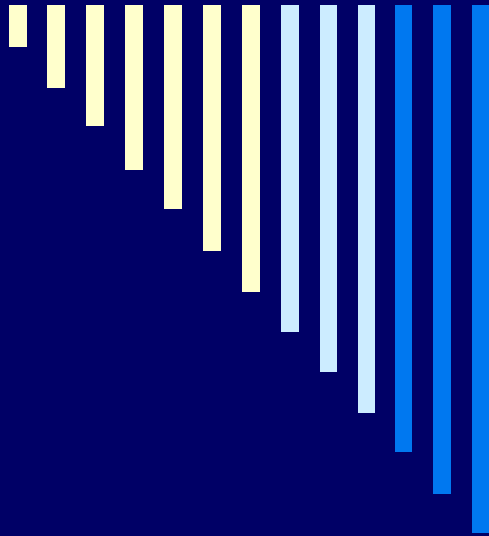
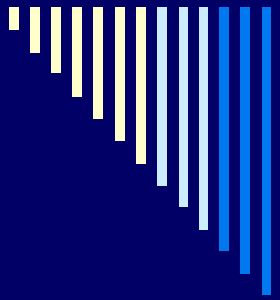


HISS



The impact of
innovation in
medical and
nursing training

A Hospital Information System for
Students accessible through mobile
devices



Students oriented

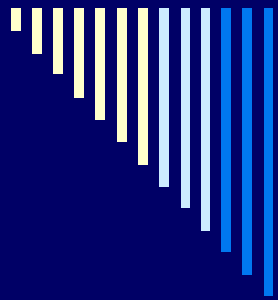
Students of Medicine, Nursing and Dietetics practicing in the wards were trained to use handheld devices connected through a WLAN to record patients' data

Università Campus Bio-Medico di Roma

September 2003 – July 2004

Funded by HP Grant

“Applied Mobile Technology Solutions in Learning Environments – 2003”

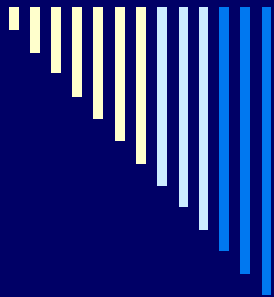


Learning and working

- to teach our students the use of new technologies they will encounter in the future while working in hospitals
- to give our students a better tool to learn the medical topics they were dealing in the wards
- to define the user interface for medical applications on handheld computers



We used the students' feedback to develop new approaches for a real operational Hospital Information System for handheld computers



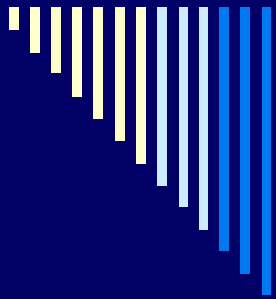
Too difficult to achieve

- We were interested in examining whether the students using handheld computers were achieving better results in their examinations
- We soon realized that this last goal was too complex to accomplish because too many factors are involved in the learning phase



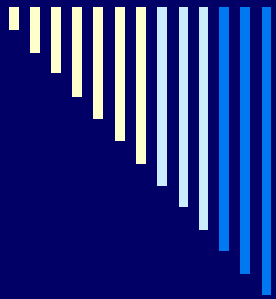
One year, four steps

1. Sep-Dec 2003: development of a simulated Hospital Information System restricted to clinical information, leaving aside all the administrative modules and some specialized areas (radiology, laboratory etc.)
2. Jan-Mar 2004: first users' trial; analysis of the first results and of students' feedback
3. Apr-May 2004: development of a new version of HISS
4. Jun-Jul 2004: second testing phase and gathering of proposals for the implementation of a Mobile Hospital Information System



Challenges overcome

- Conversion of written notes into an Electronic Patient Record (EPR) suitable for handheld computers
- Designing of new interfaces for small devices to collect and examine data at the bedside
- Frequent changes in contents due to users' feedback



Keep the good ones

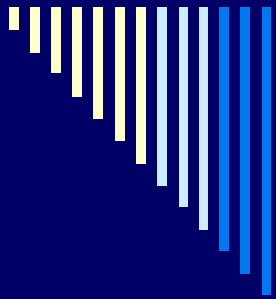
- We developed the structure and contents of EPR studying some existing models and addressing the specific needs of our Hospital
- To achieve a higher acceptance degree of both teachers and students we used the existing paper models and added predefined answers to make data entry easier
- Using a few XML tags we were able to build more than 30 different data entry masks and change rapidly their contents, without rewriting the code

From XML to the device

```
- <Sezione>
  <Titolo>Diagnosi</Titolo>
- <Voce>
  <NomeVoce>Tipo di diagnosi</NomeVoce>
  - <Valore>
    - <Drop>
      <Opzione>Morbo di Crohn</Opzione>
      <Opzione>Rettocolite ulcerosa</Opzione>
    </Drop>
  </Valore>
</Voce>
- <Voce>
  <NomeVoce>Zone interessate</NomeVoce>
  - <Valore>
    - <Check>
      <Opzione>Colon</Opzione>
      <Opzione>Retto</Opzione>
      <Opzione>Ileo</Opzione>
    </Check>
    <Testo />
  </Valore>
</Voce>
- <Voce>
  <NomeVoce>Complicanze</NomeVoce>
  - <Valore>
    - <Check>
      <Opzione>Fistole</Opzione>
    </Check>
  </Valore>
</Voce>
```



Figure 1. XML data entry visualized on the palm computer



Technicalities & freedom

Since we were not bound to real production and we had no strict deadlines, we were free to try different solutions:

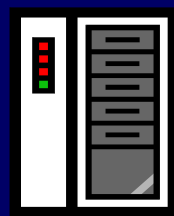
- on-line and off-line
- XML and relational database
- access through WLAN, GPRS, UMTS
- interface adaptation for pocket and desktop PC's

Actually we based our system on

ASP.NET, C#, XML and SQL Server.

HISS Architecture

From data to device



ACCESS POINT

SERVER

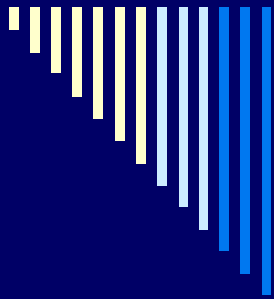
- Windows Mobile 2003
- Pocket IE
- integrated WLAN

- 3 for each ward
- WEP 64 bit
- MAC filtering

- Windows 2000 Server
- .NET Framework
- IIS 5.0

- SQL Server 2000

The HISS DB collects basic in-patients data from the actual HIS through a limited read-only access



Bedside data collection

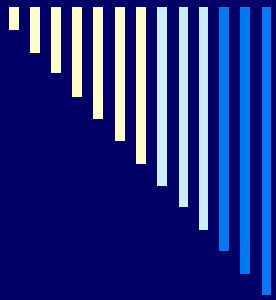
- anamnesis (family, personal, physiological, pathological)
- general health conditions examination
- request for radiological, chemical and endoscopic examinations
- drugs prescription and administration
- request for surgical intervention



Nursing students collecting records

- entrance evaluation
- medical diagnosis
- collaboration problems
- nursing diagnosis
- calculation of fluid balance

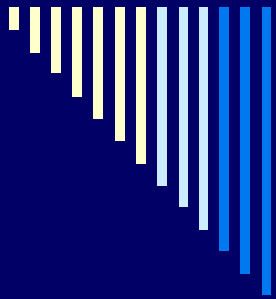




Dietetics students collecting records

- anamnesis
- patient appreciation of hospital food
- daily change of diet for each patient
- monitoring of some gastrointestinal pathologies (Crohn's disease and chronic ulcerative colitis)



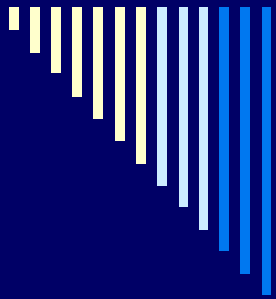


Bioengineering students technical work



- follow courses held in the Information Technology Department of Campus Bio-Medico on software and hardware installation
- set up the hardware devices in the wards
- set up the software prepared by ELIS, main partner in the HISS project
- teach medicine, nursing, dietetics students on the use of HP iPaq and applications
- monitor usage and collect comments, bug notices, proposals and other information from the users

HISS Interface



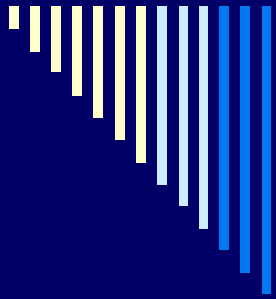
User oriented

- Drop down or check lists
- Multiple sections masks
 - Avoiding long pages
- Frequently used options
 - Easily accessible
- Additional text boxes
 - Three sizes

Anamnesi alimentare
Scegli la sezione:

Ha mai seguito una dieta?:

...deva farmaci?:
si
no

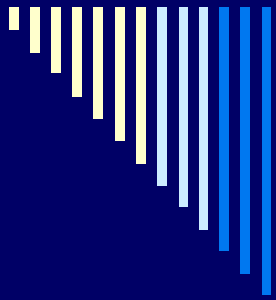


Many wireless networks

WLAN, GPRS, UMTS, Mobile IPv6

management of mobility at the network layer, allowing network applications to be unaware of changes in the network

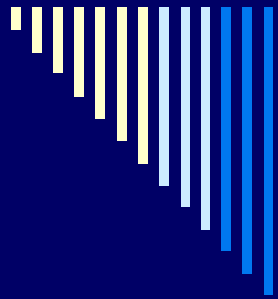
easiness of use and configuration and seamless roaming: the user does not need to change anything moving from local to geographic wireless networks



Participants & records



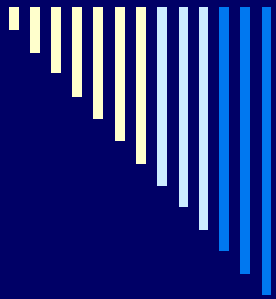
- 110 students
 - 495 medical records
 - 243 nursing records
 - 193 dietetic record (plus 919 by tutors)
- 1500 patients
- 30 different tasks



Dietetics students positive comments

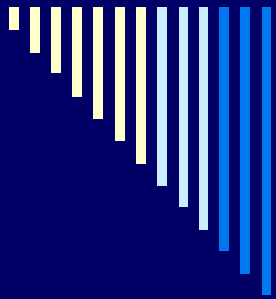
- speed in finding the answers
- time spared in the transcription of data from paper to PC
- usability

the palm computer does not need a stand and it is not "uncomfortable"



Nursing students accuracy

- The students using handheld devices for data entry in structured masks were more accurate than those writing on a blank piece of paper
- They noticed more things (having different questions to answer) and were more precise



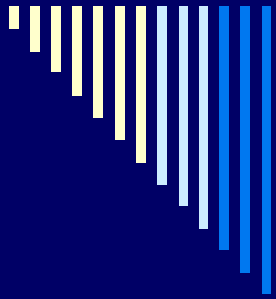
Medicine students rejection

- First extensive phase

Rejection by many students because of rejection by their tutors in data entry

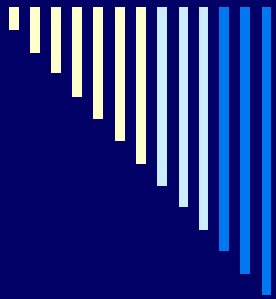
- Second intensive phase

Limited to those departments that showed a positive attitude: cardiology and general surgery



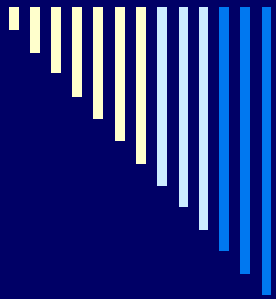
Open issues and future

- Enhancing the hospital level of technology by improving the accessibility to the information system at different levels (students, nurses, physicians) through mobile technologies
- Improve teaching and learning in the wards through a faster access to clinical data
- Designing new interfaces for small devices to collect and examine data at the bedside
- A deeper comprehension of security issues
- Analysis of geographical mobility needs and performance evaluation



We are the champions

- The Dietetics department adopted the interface produced by the students
- Some physicians started using the palm devices in their daily work
- The Nursing department started a project for the adoption of a nursing record using mobile devices



Further information &
contacts

<http://research.unicampus.it/hiss>

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