

Activity-Based Computing

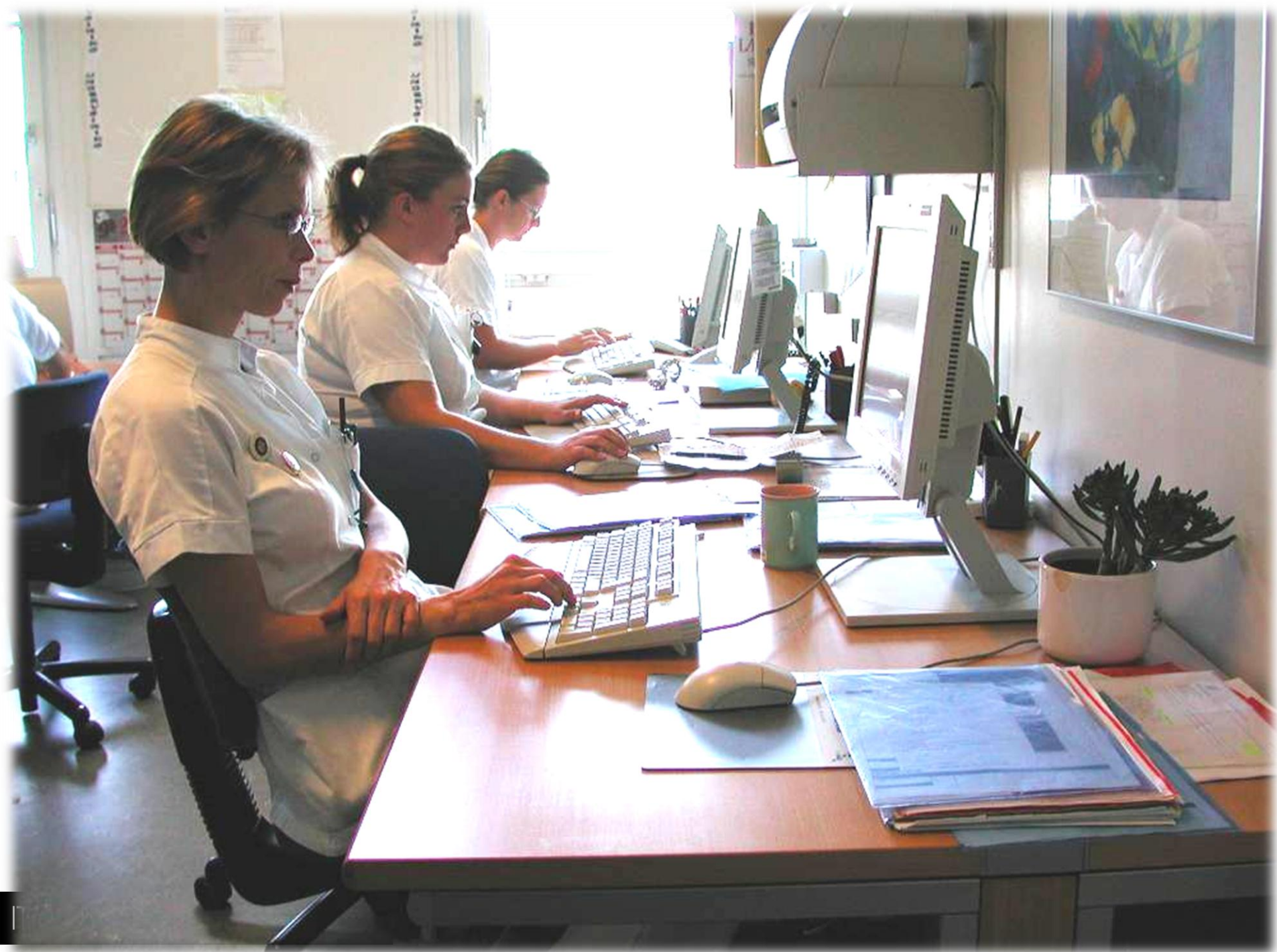
Jakob E. Bardram

Some observations



Clinicians...

- handle huge **data** sets
- organize work in **tasks**
- is constantly **multi-tasking**
- is highly **mobile**
- extremely **collaborative**
- are often **interrupted**
- works with **physical** “stuff”
- does not have a **desk**
- do not have a **personal computer**



Background & Goals

Medical Insight



SYSTEMATIC
software engineering



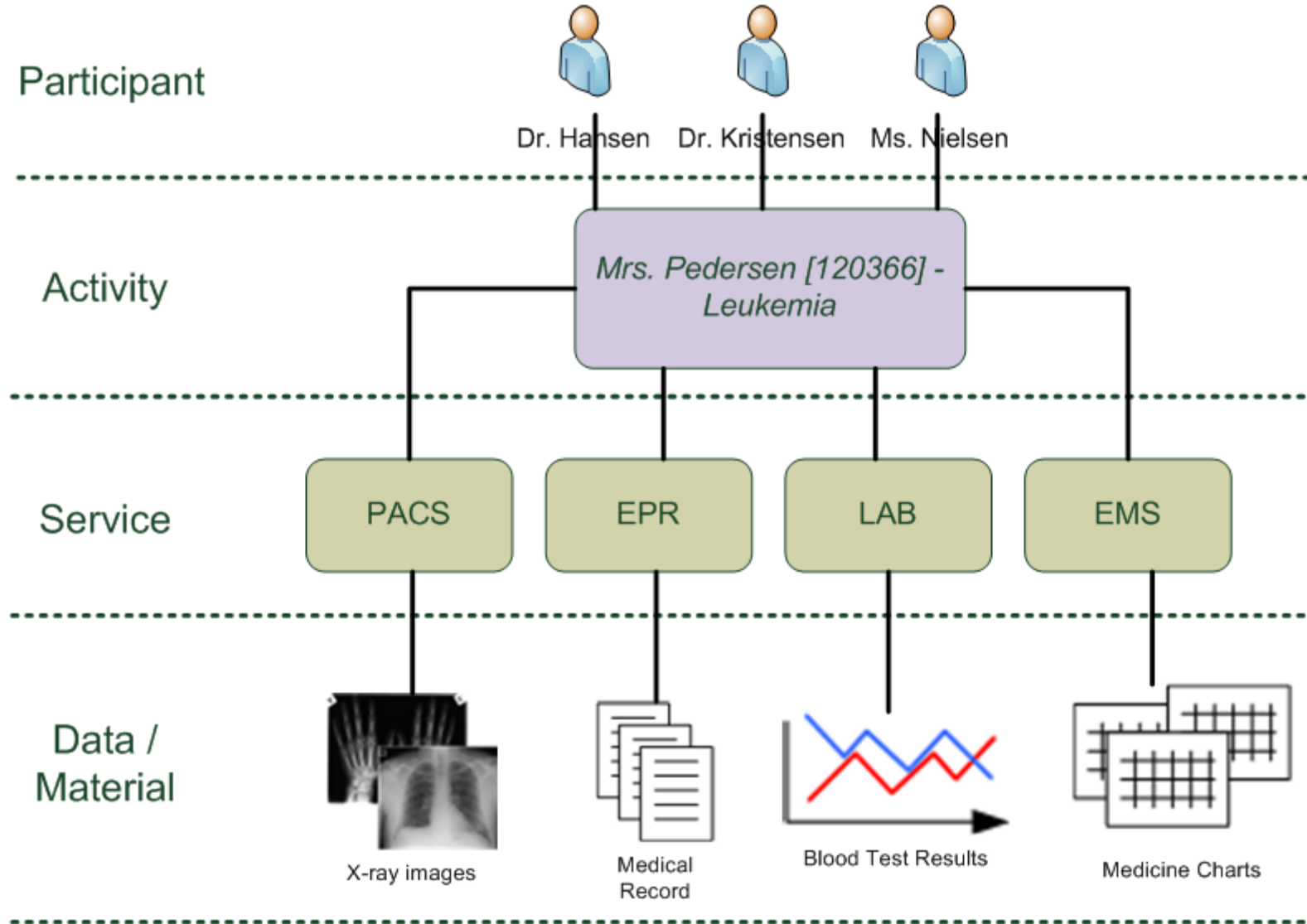
Background

- Extensive ethnographic field studies of clinical work in hospitals
- Design of clinical applications
- Cooperation with EPR and PACS vendors
- Research within Pervasive Computing

Goals

- Pervasive Computing infrastructure for hospitals (HW+SW)
- Development framework for clinical applications

Activity-Based Computing



Activity-Based Computing in one slide



- **Activity Centered** – Integration of related services & data
- **Activity Suspend & Resume** – Many concurrent activities
- **Activity Roaming** – The user's session is distributed across different devices
- **Activity Sharing** – An activity has several participants, shared in real-time
- **Activity & Context Awareness** – An activity is aware of the users' real world activity context

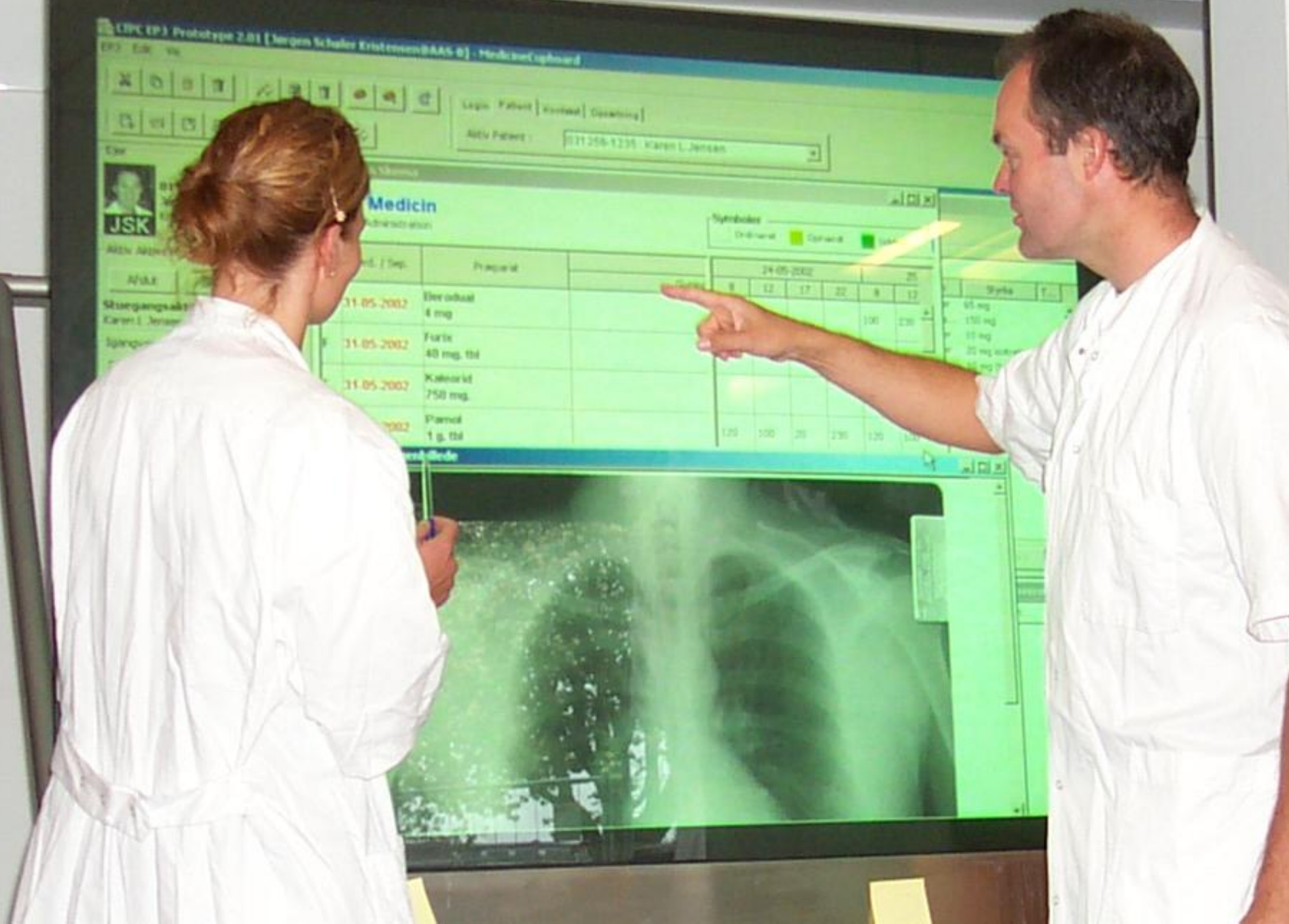
ABC HARDWARE

Activity-Based Computing Hardware

From Personal Computers to Public Computers

- Public Displays
 - Wall-based
 - Tabletops
 - Mobile and Handheld
 - Embedded (into e.g. hospital bed)
- Location Tracking
 - Staff
 - Patients
 - Equipment (incl. public displays)
- “Device” integration
 - Monitoring equipment
 - Anesthesia equipment





Wall-based Public Displays

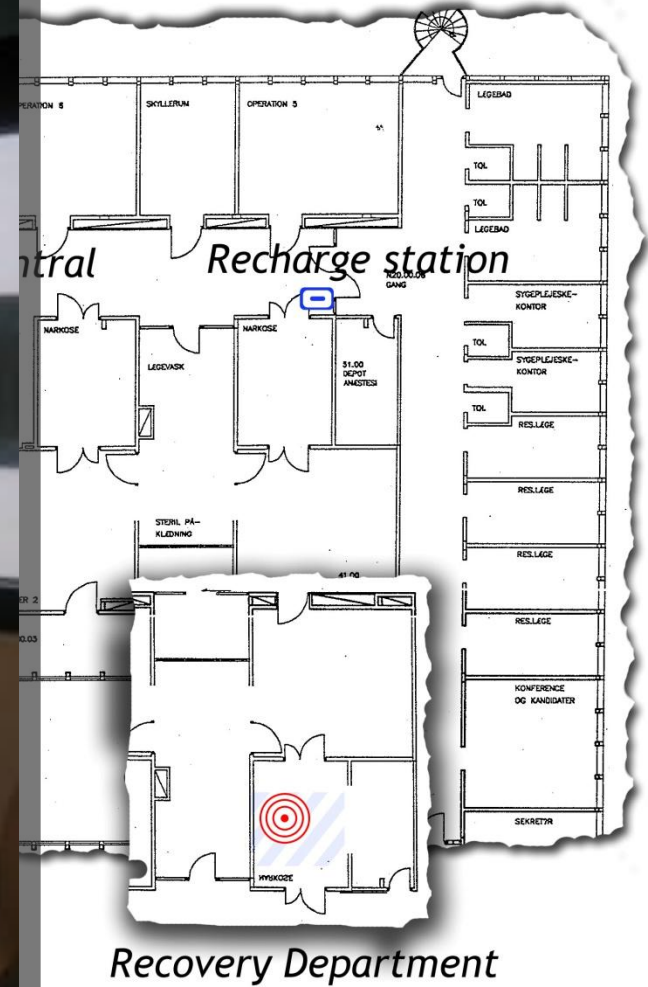
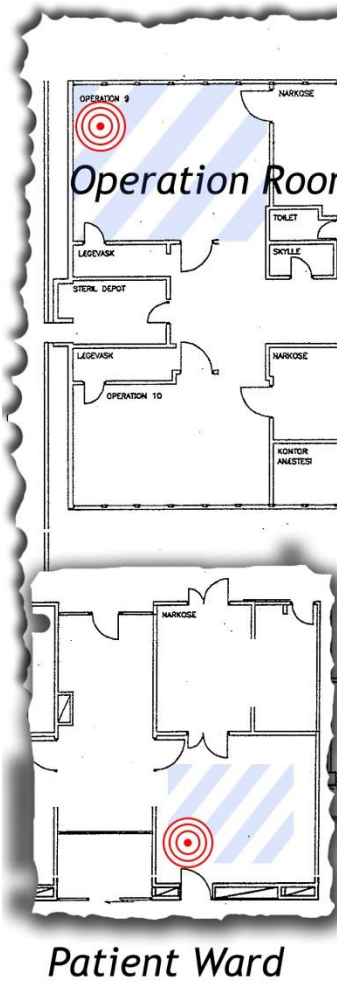








Indoor Location Tracking



ABC INFRASTRUCTURE

- Distributed Pervasive Computing infrastructure
- Development framework for ABC-aware applications
- Supports
 - easy integration of applications
 - mobility, collaboration, interruptions, ...
 - “next-generation” hardware (large interactive displays, tablet PCs, mobile phones, sensor networks)
 - robust applications in a physical environment
- Approach
 - Middleware – close integration with OS
 - Easy development of “next-generation” applications




Nuværende lokation:

OR4



Sygeplejerske

Birgitte Nielsen



Anaestesi

Joergen Felthaus



Patient

Liselotte S. Germer



Kirurg

Peder Suder



110972-1234 Liselotte Stilling

Location: OR4

Appendicitis - Akut blindtarm; GA; Obs
BT



120977-3411 Ole Hansen

Carpaltunnel Hø. haand, 35 min. COT



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Appendicitis - Akut blindtarm; GA; Obs BT

081138-9637 Uffe E. Jensen

Oesophagusperforation, venstre side

120977-3411 Ole Hansen

Carpaltunnel. Højre hånd, 35 min. COT

110644-8755 Benny Lautrup

Tenolyse højre albue, 55 min - COT skrevet ...

121233-7766 Ingolf Andersen

Intumescens på abdomen i GA 60 min.

210988-9733 Ole Jensen

Hypokalemi, akut 40 min, CGY 1

211188-9733 Muhammed

Location: P5
Ab pro akut 40 min, CGY 1 + spiraloplagning

030666-6633 Iona Olsen

Location: P5
Manisker 50 min, COG 17 skrevet

011178-5733 Elsebeth G. Nielsen

Location: P5
Trigeminusneuralgi, CGY 1

270977-3376 Karen Schmidt

Location: Konferencerum
Hernie inguinalis højre + mesh + fj. lipom



OR4

Sygeplejerske
Birgitte Nielsen

Anaesthesiologie
Joergen Felthaus

Patient
Liselotte S. Germer

Kirung
Peder Suder

Ösophagusperforation, vgl. Seite

Intumesceeris på abdomen i GA 60 min.

Tenolyse h. albue, 55 min - OOT skrivet

Hypokaliæmi, pro skut 40 min, GFR
1

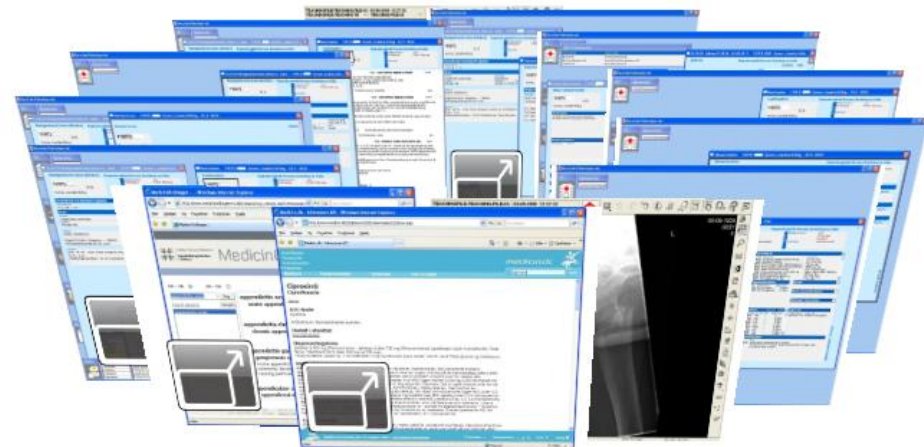
Leads: 75
 Transfer: 30 min, CDG 1.5 skript

Location: 95
Tropenhausstraße, 05712

Location: Coniferium
runic inguinalis hiege + math + 9
loom

Location: FS
 All pro obs 40 min, QTY 1 +
 spinoblasting

110972-1234 Liselotte Stilling Germer



120977-3411 Ole Hansen



TEACHINGFILE-TEACHING FILE-65-252

TEACHINGFILE-TEACHING FILE-65

03-09-2008 12:57:52

TEACHING FILE-65

1/1

ACCESS>TEACHING FILE-65

TEACHINGFILE-TEACHING FILE-65-CR-4878

Horsens Regionshospita

W 3.600 : L 1.800

Decal Patient Journal

Hjemmesider

16.02.04 Røntgenbeskrivelse (Ekstern)

Samh 110972

Germer, Liselotte Stilling

Røntgenbeskrivelse (Ekstern)

Røntgenbeskrivelse af Horsens, Et-andstrup og Odder

110972- ---- 35 år

Germer, Liselotte Stilling

Overførsel fra ekstern system

17.02.04 11:19

Svar

Indtjekningsdato Skadetiden 16.02.04 17:26

Indtjekningsdato 2004/02/11 12:09 22.04.04 12:11

Samh

Andre diagnoser:

Hypocistisk diagnose, - 1090330

Røntgenundersøgelse af crup

Noter:

Rox. af hv. crup viser normale osse og artikulære forhold.

P.d.: I.e.

Underundersøget: 16-02-04, Radiolog Jens Hovsen

Kontinuation, 110972 Germer

11.03.02 08:17 RR med a. 03.7

11.03.02 08:05 hals 03.7

15.03.02 12:45 Indtjekning 03.0

16.03.02 12:54 Operationel indledning 03.0

16.03.02 12:50 Operationel beskrivelse 03.0 PE01

16.03.02 14:00 hals 03.0 PE01

11.04.02 14:47 MR svær 03.0

21.12.02 00:30 Skadetiden 05.8

21.12.02 00:32 Skadetiden 05.8

29.12.02 16:16 Skadetiden 05.8

17.01.03 11:00 1. røntgenundersøgelse 03.7

02.02.03 12:16 Skadetiden 05.8

13.02.03 12:08 Telefonkontakt 03.7

23.02.03 16:45 Utryk 03.0 FØDEGANG

09.03.03 09:47 Utryk 03.7

09.03.03 11:15 Utryk 03.7

20.03.03 15:36 Telefonkontakt 03.0 FØDEGANG

14.09.03 10:13 obs. vandsyg 03.0

110972

Status (aktuel fortalt)

Obstetrik

Patienthistorie

Administrativt

Kontinuation

Medicin

Ordinationer

Resultater

Syggepleje

Epilektik

Advarsler

Makuleret

Kontinuation 110972 Germer, Liselotte Stilling 05.9 ORTO

Kontinuation

Røntgenbeskrivelse af Horsens, Et-andstrup og Odder

110972- ---- 35 år

Germer, Liselotte Stilling

Er pt. overvægtig

Regelmæssig hjerteafslid = perifer puls.

Vesikulær respiration overalt.

ser der menstruationsblod i vagina. Porto lobet

End. vaginas, uterus stort normal af størrelse, men lidt sm.

Der er lidt slemme

Vag. uterushøjnæring

ser i uterus af størrelse omkring 15 mm og midt i denne en lille

oplysning på et par mm.

Der er ingen frivæske i Fossa Douglasi, og intet abnormt til

slemme

Lone Assmusen, overlæge, Læge

15.03.02 Operationsindledning 03.0 GYNÆKOLOGISK-OBSTETRISK AFD. PE01

12:51

Planlagt operation

KMBADO Evacuatio uden (vacuumaspiration)

Standard

Lone Assmusen, overlæge, Læge

16.03.02 Operationsbeskrivelse 03.0 GYNÆKOLOGISK-OBSTETRISK AFD. PE01

12:00 Stufstap: 16.03.02 12:15

Stuf 3 Fronte. Plantagt Stuf Udloft

Relevant PE01

PG gm.

Indledning og anæstesi

SKS NAAC Generel anæstesi

Indledning og anæstesi

SKS V KMBADO Evacuatio uden (vacuumaspiration)

I D0034 Inkomplet spontan abort uden komplikation

Cervikalkanalen passabel for Hegar 10/8. Med sug nr. 10

trækkes en 11 cm dybt kylet for lod var. Der skabes efter med stump curette.

kavitetten tom. Der gives Methergin. Uterus velkontraheret. Tilsluttet slyngning

Pl er 50. pot.

Kan gå hjem senere på eftermiddagen.

Epilektik skrevet.

vacuumaspiration

sk skrevet

12:00

sk skrevet

12:15

sk skrevet

Patientet kontamineret

Ingen antibiotika

Side 2



Activity-Based Computing

- ABC is a new computing paradigm designed to support hospital work
 - Large information sets, mobility, collaboration, interruptions, ...
 - New “public” hardware systems & location tracking
- Proof-of-Concept has been designed, implemented, and evaluated
- A result of a long participatory design process with a wide range of clinicians.
- Continued work on ABC is going on at ITU
- Internationally a well-known approach to computing
 - Microsoft, IBM, ...

Acknowledgments

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Danish Council for Strategic
Research



Selected ABC Publications

- Activity-based computing for medical work in hospitals. JE. Bardram. *ACM Transaction on Computer-Human Interaction*, 16(2):1-36, 2009.
- A Novel Approach for Creating Activity-Aware Applications in a Hospital Environment. JE. Bardram. In *Proceedings of INTERACT 2009*, pages 731-744, 2009.
- CLINICAL SURFACES -- Activity-Based Computing for Distributed Multi-Display Environments in Hospitals. JE. Bardram, J. Bunde-Pedersen, A. Doryab & S. Sørensen. In *Proceedings of INTERACT 2009*, pages 704-717, 2009.
- Pervasive Computing Support for Hospitals: An Overview of the Activity-Based Computing Project. JE. Bardram and HB. Christensen. *IEEE Pervasive Computing*, 6(1):44-51, 2007.
- Support for activity-based computing in a personal computing operating system. JE. Bardram, J. Bunde-Pedersen and M. Soegaard. In *CHI '06: Proceedings of the SIGCHI conference on Human Factors in computing systems*, pages 211-220, 2006.
- Activity-Based Computing: Support for Mobility and Collaboration in Ubiquitous Computing. JE. Bardram. *Personal and Ubiquitous Computing*, 9(5):312-322, 2005.
- More on
 - <http://www.itu.dk/people/bardram/pmwiki/pmwiki.php?n=Publications.Projects#abc>