The use of Mobile Information Communication Technology (MICT) in clinical settings”

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Claims: Use of Mobile ICTs → → Increases in the efficiency of work [1-3].

Growing variety of *mobile computing devices:* Laptop Personal Computers (PCs), Tablet PCs, handheld PCs/Personal Digital Assistants (PDAs), and PDA-phones/smartphones,

The terms mobile, ubiquitous, pervasive and anytime/anywhere computing are often used interchangeably in the literature [2, 4].

Lyytinen and Yoo [5], however, suggest that mobile computing should be restricted to situations that increase our "*capacity to physically move computing services with us. As a result, the computer becomes a taken-for-granted, ever-present device that expands our capabilities to inscribe, remember, communicate, and reason independently of the device's location*" [5].

MICT → Professionals “can” be connected (perhaps intermittently, if not wirelessly connected) to others and to organizational IS (e.g. EMR)/info sources (e.g. medical reference data or the Internet) while moving

→ MICTs as “time flexible” and “space-adjusting technologies” that reduce the impact of physical distance on work patterns and relationships and may alter activity [6].

Potential and Visions --- VS --- “Realities” and “Challenges”

It has been suggested [10, 11] that MICTs may improve ward rounds by:

(i) making available up-to-date patient data "at the point of care", or allowing faster updating of treatment plans, leading to better treatment;

(ii) allowing access to reference information, leading to improved clinical decision-making, and increased opportunities for learning

Some assumptions/Themes in MICT in Health commentary articles:

a) Doctors are highly mobile, always "on the run" but making important decision as they do so.

b) Doctors cannot memorize and thus need a computer with them at all times.

c) Effective healthcare IS, for example EMRs, are in place to be accessed by MICT

d) Online access to as much information as possible (eg. full medical articles in a PDA) is relevant everywhere for medical decision-making and enhances medical education.

e) Remote access to patient data could mean fewer visits to real patient, saving time in patient "care". VS → MICTs will save time for clinicians, releasing resources for patient care or enabling reduced staffing levels.

Scarce! ---- YET ---- Two main sources: Survey studies (Handheld, US); pilot/implementation cases (often with RCT design)

Surveys [11, 13-15] :

a) The number of users seems to influence the utility of functions like sending information ("beaming") and may be related with higher uptake.

b) The numbers of users varies between sites and from 1998 to 2003 does not seem to present a clear trend

c) Different work-roles and settings may explain the differences found, especially between resident and attending physicians.

Pilots [26]:

a) MICTs create new challenges that are different from Desktop IS

- no case described implementation processes in hospitals

b) Modalities of Mobility (eg. traveling, wandering, visiting) are not taken into account when choosing device or analyzing data on usage

c) Little evidence to support claims about possible effects on work practices except more convenient info access, preference for link EMR.


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Research question (Qs)

How, and with what implications for clinical work practices, are doctors and hospital organizations using mobile ICT?

This was addressed in three ways:

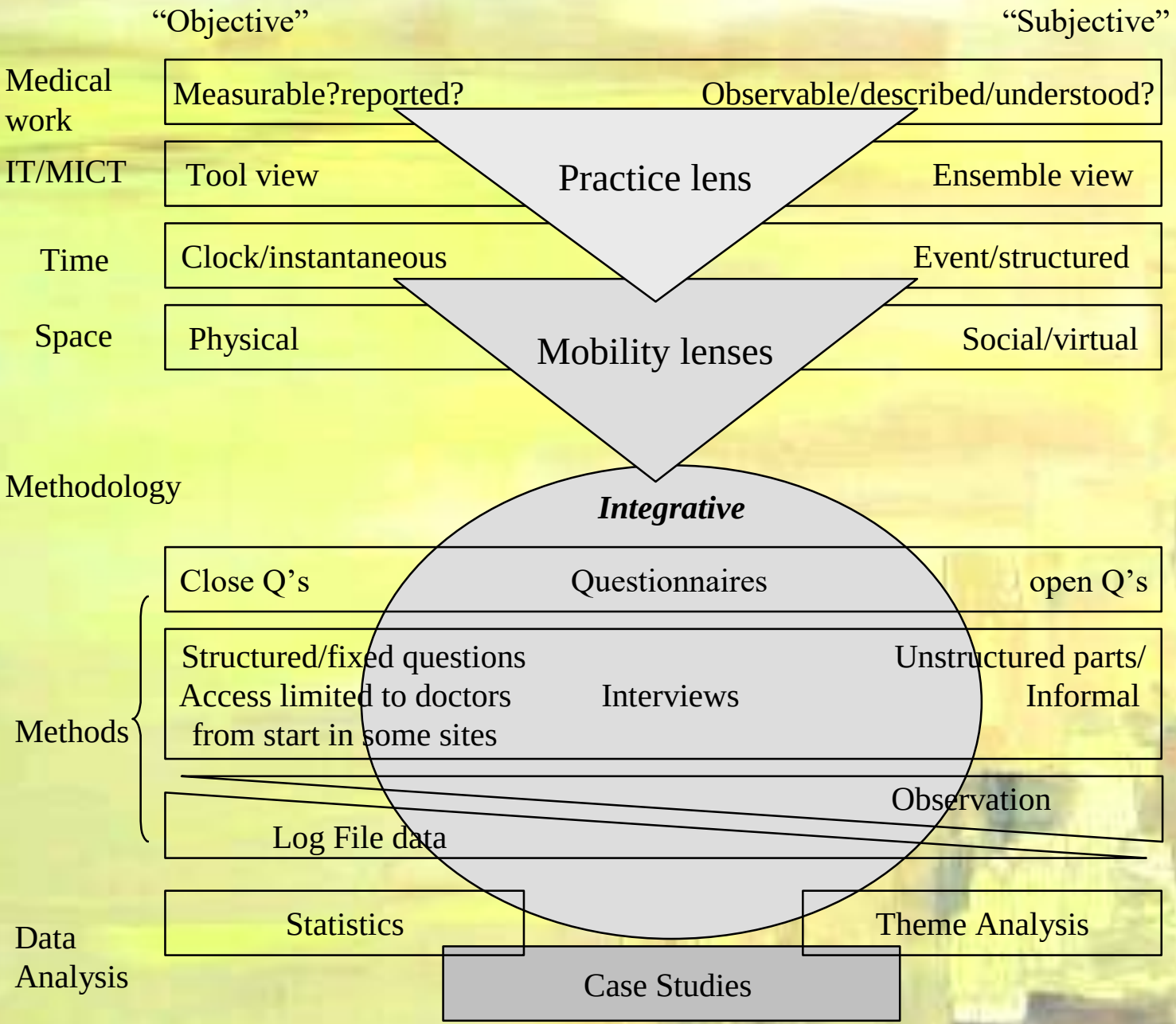
1) assessing usage of mobile ICTs in different clinical settings, with respect to issues such as the types of hardware, software and applications in use, the extent and domains of use, user characteristics;

2) identifying factors influencing the adoption of mobile ICTs both at the individual and organizational level;

3) evaluating the effects of the use of mobile ICTs on clinical work practices, on an individual, group and organizational level.

Strategy : breadth (across several groups of doctors in several countries)
+ depth (detailed study of departments using MICT)

Research Approach



Research Carried out – 1. Dept. Without deployed MICT - AD HOC USAGE

	Coun-try	Collection sites	IT Level	Clinical settings	Methods (n=…)	Additional data collected (not from doctors)
Sub-sample A	Port.	Hospital Fernando Fonseca (Lisbon)	No/ low	All	Q1 (82) + I1 (11) + I1a (7)	Interview with CIO and clinical directorate Observation
Sub-sample B	Port.	Hospital Geral de Santo António (Porto)	No/ low	All	Q1 (111) + I1 (5) + I1a (3)	Interview with CIO
Sub-sample C	US (DC)	Medicine Department in Washington Hospital Center (Washington)	Low/ medium	Wards/ out patient department	Q1 (44) + I1 (8) + I1a (2)	Interview with department manager,
Sub-sample D	Sing.	Singapore General Hospital (Singapore)	Low/ medium	All	Q1 (146) + I1 (7) + I1a (6)	Interview with CIO and 2 IT staff
Sub-sample E	UK(1)	Breast unit, Addenbrooke's Hospital (Cambridge), Renal Unit and Liver units at University Hospital Birmingham (Birmingham)	Low/ medium	Wards; Outpatient	I1 (23)	

AMIA Paper

1) A significant proportion of doctors did not have or use MICT devices.

2) Ownership was not clearly related to either usage pattern or frequency of use ("voluntary" ownership seems to relate higher use).

3) Providing handheld computers ("involuntary" ownership) did not lead to higher number of users, higher frequency of use or significant differences in tasks carried out

4) Doctors owning handheld computers alone, or in combination with laptops, used them more frequently than those using laptops alone.

5) Differences in usage pattern proportions (i.e. having both a Handheld and a Laptop PC against having either of these in isolation), ***rather than demographics***, were a better indication of differences in usage frequencies and the tasks for which MICT

2. Dept. where MICT was made available to Docs – Uptake, Effects on Practice

Coun-try	Collection sites	Clinical settings/IT Level	Type of MICT	Methods (n=…)	Additional data collected (not from doctors)	Case
UK	Paediatric Intensive Care Unit, (London)	Intensive care/Low	Handheld	I2 (11) + I2a (1) OBS (2w)		A - Recent introduction of MICT
US (NY)	Emergency Department, (Albany)	ED/Low-medium	Handheld	Q1 (30) + I1 (2) + I1a (1)		B - Recent introduction of MICT
UK	Beast Unit (Cambridge)	Outpatient/ Medium	Tablet PC	I2 (6) + I2a (1) OBS (2w)	Interviews with IT manager	C - Recent introduction of MICT
Sing	Orthopaedics and Hand surgery (Singapore)	Wards/medium	Tablet PC Mounted PC	Q2 (36) + I1 (6) + I1a (2)	Interview with CIO and 2 IT staff	D - Recent introduction of MICT
US (DC)	Medicine Department, (Washington)	Wards/High	Wireless Laptops/ Handheld[2]	Q2 (33) + I2 (15) +I2a (1)		E - Established use of MICT
UK	Renal Unit (Birmingham)	Wards/ Medium	Tablet PC &Mounted PCs	I2 (7) + I2a (2) OBS (3w)	Interviews with 6 IT staff/developers LOGS; PUB	F - Established use of MICT
US (NY)	Medical Genetics (Albany)	All/Medium	Handheld	I2a (1)		G – Establish use of MICT

CASE E IFIP Paper

CASE F HC2005

CASE G

Preliminary results I - individual and group level

CASE E

Wireless tablet PCs (and recently Mounted PC) available 7 years

All clinicians clamed to use tablet PCs,
Log File analysis showed prominent use of Tablet PCs in morning ePrescription and Labviewing main tasks, little use of webBNF

CASE F

Adoption/non-adoption of Wireless laptops – In detail later

CASE G

Enthusiastic use of Smarthphone – “living with clinical information anywhere anyplace

Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Results I – Case Description - The Department and its "Wireless Laptops"

Multi-speciality tertiary care facility.
60 doctors ; 12-bed intensive care unit; 87 beds wards ; outpatient clinics.

-MICT: standard laptop PCs with WiFi wireless connection. Attached to a food trolley and could not be removed,

- ***AC adapter and cable***
- ***No mouse or extra battery***
- ***Movable as a whole – tray adjusted/ free space***

Full access to Windows software,
2 hospital systems (full EMR – including all imaging studies, and a drug administration system mostly used by the nurses)
Intranet resources (links to departments guidelines and protocols, library holdings and online resources),
Broadband access to the Internet.

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Results II – Case Description - The Department and its "Wireless Laptops"

33 staff studied - 24 Attendings - 9 Residents or Interns,
= % of men and women.
< half owned a handheld/PDA.
All used a desktop every day (60% more than 10 times a day. Attendings more often than Residents).
The Internet was used for clinical work – by all at least once a week

Wireless laptop usage in the department:

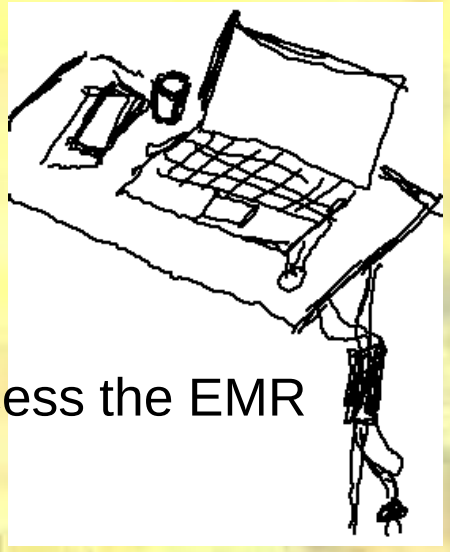
20% - high frequency users (>5x day),
35% - medium frequency users,
20% - less than once a week
25% - non-users.

All - to check patient data,
2 - for medical calculations
1 - send clinical-related emails.
Zero - checking hospital guidelines

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Results III – Case Description - The Department and its "Wireless Laptops"

Individuals can be divided into three groups:



"multi-task" users (enthusiastic-use) who browsed the internet for medical information, checked medical and drug reference information as well as consulting the EMR,

"standard" users, who used the laptops only to access the EMR

"Non"-users.

Age, gender, seniority and usage of technologies other than MICTs showed no significant difference between the user group and the non-user group.

The "multi-task" user group reflected the seniority and gender make-up of the department, but included predominantly high and medium frequency users, most of whom owned a handheld/PDA (compared to almost none of the other groups).

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Results IV – Case Description - The Department and its "Wireless Laptops"

High turnover of staff. (4 weeks rotations)

knowledge of EMR use had to be continuously replaced.

Wardrounds – using laptops opportunity for Attendings to teach others about the operation and capabilities of the hospital's systems.

Patients located in wards on two consecutive floors.

Ward: central area (with several desktop computers) from which six corridors of patient rooms lead off. Each floor had two or three doctors' rooms (with five desktop PCs). The lift (elevator) was located away from the centre of the wards.

"Each of the teams has a laptop, chained, nailed, spiked or something to a portable table, which makes it quite cumbersome by the way because we tend to go up and down between the third and fourth floor and you have to carry the table with you or go use the elevators which are painfully slow." ***Resident, Team Alpha***

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Results V – Case Description - Views of non-users

During observation only 2 out 5 teams regularly used Laptops

Team Alpha (recently arrived Attending, Resident, 2 Interns, med stud)

Last year (…) Rounds tended to be more administratively frenetic when we had the laptop with us. There was more a temptation to do orders immediately, there was more waiting for lab results to come back and interrupting a chain of thought regarding the patient ***Resident, Team Alpha***

I didn't want [the laptop] with us because I wanted folks on rounds to focus on the pieces of information that struck them as they were collecting it … The likelihood was [also] that there would be nothing more than one or two data points on a couple patients that we miss and that would be required for a decision at that point. ***Resident, Team Alpha***

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Results VI – Case Description - Views of non-users

During observation only 2 out 5 teams regularly used Laptops

– Team Alpha – Resident was charismatic and decided not to use them

- based on his previous experience as part of team that used them
- plan is discussed based on available information before round
- laptops seen as bad for education – diluting attention
- laptops seen as useful when rounding on large number of patients

- Laptops were also not used at other times

If I'm pushing the laptop around I can't use the stairs, I can't carry it with me, it's hooked up to that desk, (…) I find that when I'm walking around the wards I'm running all over the place so I don't want to have to be responsible … for the laptop; if it gets damaged or stolen or anything. So it's not really a benefit. And there's so many computers available anywhere I am, I'm no more than 5 or 10 seconds away from sitting down at a desktop and getting the information I need. Intern, Team Alpha

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Results VIII – Case Description - Views of users

Efficiency and control over plan execution

"Because all of the orders are on the computer it just makes things run smoother if during rounds you come up and say, I need this order done, rather than waiting 'til the end of rounds to do it, you know you can do it right there. (…) The round's a lot more complete I think, also, much more efficient."

Medical Student. Team Beta

"I want up to date information, I want to see the information myself rather than relying on somebody else's recitation of it. (..)And then of course I do want to be able to review all the medications and not only rely on what somebody tells me the patient's on. Because they sometimes are mistaken. (...) [and] I want to be able to implement whatever plan we're concerned about immediately. I do not want to delay, I want to enter it into the system as we talk"

Attending, Team Gamma

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Results VIII – Case Description - Views of users

Attending Physician Style

[With] the first Attending … we'd have more sit down rounds in our team room discussing things. So at that point we would be putting … the orders directly onto our desktops and then when we would round we wouldn't really take the computer with us. The second Attending … would prefer us to have the computer with us but at that time we were having a lot of glitches with the computers. The last Attending we've had, again she seems to be more sit down, get things kind of under our grasp and then go from there. Although we still take the laptop with us. But again taking the laptop with us helps just getting orders done quicker and as something comes up you can order it at that time, or looking again at radiology is useful". ***Medical Student. Team Beta***

I am a data person. So I like the availability of data" ***Attending 2, Team Beta***

I mean usually we go a couple of days and then something goes wrong. But that's been a constant. And everyday I'm going to a computer person going, they're not working again." ***Attending 1, Team Beta***

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Case Analysis I
- Accounting for the adoption of MICTs in wardrounds

No association with usage or non-usage	• *Age* • *Gender* • *Seniority* • *Use of desktop technology/internet* • *Previous experience* • *Team size* • *Availability of desktop computing* • *Availability of full EMR on the laptops*
Association with both usage and non-usage	•*Walking wardround*

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Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Case Analysis II
- Accounting for the adoption of MICTs in wardrounds

Some association with non-usage	• *Unreliability of technology* • *Building layout* • *Device characteristics* • *Senior doctors' satisfaction with existing wardround practices* • *Senior doctors' preference for decision-making with data available before the round* • *Senior doctors' belief that junior doctors need to be able to present and defend their decisions* • *Senior doctors' concern about distraction of junior doctors during wardround* • *Sitting wardround*

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Case Analysis III
- Accounting for the adoption of MICTs in wardrounds

Some association with usage	• *Senior doctors' willingness to instigate new practices* • *High case load* • *Senior doctors belief in the benefits of laptop use* • *Senior doctors' perception of benefits of rich data availability for education and decision-making* • *Senior doctors' perception of need for timely data and action* • *Senior doctors' belief in collective, real-time decision-making*

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Discussion

In contrast to findings of other studies it appeared that characteristics such as age, gender and seniority did not seem to influence MICT device use.

Benefits of MICT use in wardrounds were not self-evident

- significant proportion of doctors did not use the laptops at all.

- immaturity (and hence unreliability) of the technology is only a partial explanation

What helps us understand use and non-use behaviours displayed ??

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Mobility in the Round:
Use of Wireless Laptop PCs in Clinical Wardrounds

Discussion I

1) Not all wardrounds are equal:

- they are not the uniform, highly mobile practice suggested by some advocates of MICT use. (eg. Sitting wardrounds)

- different perceptions of the function of ward rounds (for example decision-making with available data and testing of junior doctors' presentations or collective decision-making moments with all possible data)

- attitudes regarding rich and timely data in clinical decision-making, the effectiveness of existing practices and their willingness to change practices.

- the costs and benefits of MICT use based on individual perceptions as measurable evidence was lacking.

- strong social influences. such as the power relationships, existing work routines, team dynamics and department practices, such as on device sharing, shaped laptop usage and were also influenced by it.

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Discussion II

2) Local circumstances

- High staff turnover, for example, meant that training needs were high and continuous but also that using laptops on wardrounds provided an important opportunity for sharing of experience on EMR use.

- Hospital architecture, combined with specific device characteristics caused problems for even the most enthusiastic users.

3) Mobility of the device itself is therefore not necessarily the same as its mobility in practice.

4) Active role of users in the adoption of MICT devices. ***This operates in a variety of ways:***

- their perceptions of the costs and benefits of wider availability of information

- their willingness to change routines to accommodate device usage.

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Discussion III

4) Active role of users in the adoption of MICT devices.

➔ ***Important because individual users' access to mobile, computer-based resources is often dependent on whether they bring the devices to the work setting themselves.***

➔ ***if the purpose of MICT use is seen to be the provision of ubiquitous information resources, rather than devices per se, then users may feel that their needs are adequately met by static devices, providing these are sufficiently numerous and available, without needing to have the device at the exact point of use.***

Ubiquity may therefore be seen not as an objective characteristic of a technological resource, but as dependent also on users perceptions and effortful action.

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Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds

Conclusions

Evidence from this and other sites in our study suggest that common issues may extend beyond the particular medical setting:

- variability of apparently standard work practices,

- importance of individual perceptions (and the social processes influencing them),

- the role of established organisational routines

Evidence presented suggests that possibilities for "ubiquitous information(-rich) environments") do not arise automatically or instantly.

- especially in the context of current attempts to provide such environments through mobile devices, the realisation of these possibilities appears to be subject to significant social influences.

- Without clear evidence of unequivocal benefits, adoption will rely on users' beliefs about the value of ubiquitous information. – these cannot assumed to be universally positive.

Source: Martins, HMG, Jones, MR (2005) "Mobility in the Round: Use of Wireless Laptop PCs in Clinical Wardrounds, Proceedings of the IFIP 8.2 Conference, August 2005, Cleveland, OH, USA

Preliminary results II - Organization use of MICT to support clinical work

MICT Device

Size, screen size, screen brightness, battery longevity, weight, robustness
Computing power
Operating system

MICT Implementation Context

Wireless coverage
Battery chargers
Privacy and Security
Policy about usage
Application provided
Training provided

Workspace

Open - Close
Architecture
Layout
Lighting

MICT device at hand

Mobility in practice

Screen visibility

Usable Charge

Wireless access to HIS.

Available applications

Transport burden

Risk of theft/lost

Enthusiastic Use
- use of the device's full potential for the work situation enacted as desired

Problematic use
a) disrupting effects on work practice as desired
b) non-use of device's mobile potential

Non-use

Clinical work context

Mobility "modalities" involved

Time required

Aims

Data needs
Data processing needs

Isolated vs Collaborative

Individuals involved

Individual (s)

General IT/MICT proficiency
Training received

Perception of usefulness
Feeling of Empowerment/ vulnerability

Work

Travelling, Visiting
Wandering

Nature data
Certain tasks required

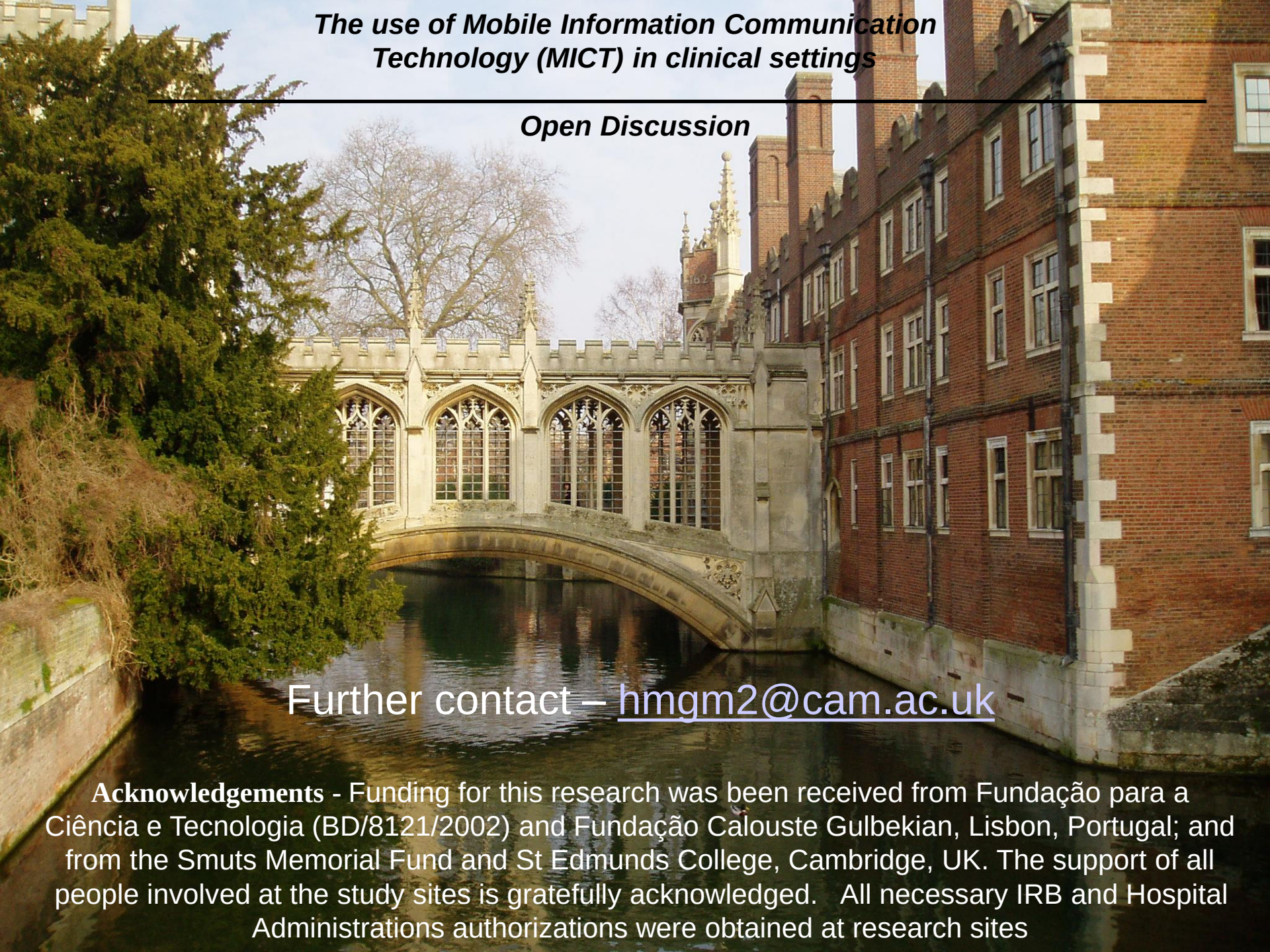
Individual vs collective

info/decision sharing

Established perceived aims

Data usage patterns
Thinking processes

Reproduced from: Martins HMG, Jones MR. "Relevance of mobile computing in the field of Medicine" in *"Handbook of Research on Mobile Business: Technical, methodological and social perspectives"* edited by Unhelkar, B., IDEA group publishing (IGP), Hershey, PA, USA (in press)



The use of Mobile Information Communication Technology (MICT) in clinical settings

Open Discussion

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